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See published book for notes and references

Chapter 1 - Ecology and Industrialism

One of the obvious areas of sociology in which environmental concerns ought to be considered is the sociology of industrialism, the rationality and practices of industrialism being a repeated object of attention in discussions about the environment. The sociology of industrialism is a longstanding and well-researched field (see Kumar 1978 and Badham 1984) in which environmental issues are highly relevant yet largely excluded. This chapter discusses how such issues are relevant to this area of sociology. It looks at the limits of the sociology of industrialism and at an environmentalist analysis of industrialism. This sets us up for the rest of the book, which is concerned with the interaction between the study of society and politics and the ideas of environmentalism.

Environmental issues need to be more considered in the sociology of industrial societies - both in research and courses. However they are at present generally excluded by the focus of these on the internal requirements, contradictions and reproduction of industrialism. In the first section of this chapter I will outline the main preoccupations of the sociology of industrial societies and the way in which they focus on internal social processes at the expense of external natural-environmental factors. In the second section I will discuss why such factors are relevant to a complete understanding of social processes.

The section following that outlines the main claims of a famous and influential ecological study of industrialism, the *Limits to Growth* report, in order to demonstrate the relevance of ecology and environmental factors to the sociology of industrialism. The subsequent section deals with criticisms of the report. The report's arguments are typical of those in the green literature more generally, and criticisms of it are typical of those often made of green thinking.

Finally I will shift the emphasis from developed industrial nations to less developed countries to show how, in this case also, economic, social and political development is interrelated with external natural-environmental factors and how the latter are integral to a complete sociological understanding of the predicament and future fate of the developing world.

The ecological limits and internalist focus of the sociology of industrialism

Sociologists have tended to focus on the interaction of industrial and social development in the formation and reproduction of industrial societies at the expense of attention to external natural-environmental factors affected by and affecting such processes. The sociology of industrialism is limited in ignoring, first, the environmental consequences of social processes - pollution, for example. Second, in a reverse direction, it ignores the range of factors which

affect societal development which are natural as well as social - resource availability for instance.

Industrial and social processes have an effect on the environment and natural environmental factors affect industrial and social development. Yet sociologists focus on the internal social processes of industrial societies at the expense of their interrelationships with the natural environment. As such they are unable to gain a full and realistic understanding of the causes and effects of the industrial and social processes they are interested in. The neglect of the environment in the sociology of industrialism is problematic as such, not only for environmental but also for sociological reasons.

Sociology was founded amidst the establishment and gathering speed of industrialism, and its foundation was oriented to laying down a set of concepts and theories intended to make sense of the developing modern industrial order. Alienation and exploitation, the division of labour and anomie, rationalization and legitimacy were all major defining themes in the work of founding figures like Marx, Durkheim and Weber respectively (see Giddens 1971) and are of enduring concern in contemporary sociology.

The concepts and preoccupations that were developed by the founders of the discipline in the nineteenth century reflected this milieu and have imposed their imprint on sociology since. Sociologists of industrialism like Kumar (1978) and Badham (1984) describe this fact. Sociology textbooks like Lee and Newby (1983) reflect it, examining the interpretations of industrialism made by classical sociological theorists and the contemporary application of those early established preoccupations.

What, then, have been the typical concerns of sociological studies of industrial societies? To what extent have they failed to account for environmental factors? And how are such factors relevant to the explanation of the formation and development of industrial societies?

Industry and society

Maria Hirszowicz (198 1: 1) defines industrialism as 'the new stage of social organisation in which human life is dominated by industrial production'. Sociologists tend to look at aspects of industrial society (the state, education, ideology and class divisions, for example) in terms of the extent to which they reproduce industrialism, cause it conflict or strife or gain their character from the stage of development of industrial production.

One way of understanding the preoccupations of the sociology of industrialism is to think of them as being concerned with the interrelationship of industry and society - both the effects of the development of industry on society and of society on industry. Let me take these two different directions of causality in turn.

First, sociologists have been concerned with the effects of industrial production and economic and technological change on social structures and processes. They look, for instance, at the effects of the development of mechanization, economic growth and the factory system on work organization, patterns of residence and migration, the degree of community in social relations, changing forms of political structure and shifts in forms of social structure and social mobility.

Secondly and conversely, they have been interested in the way social structures and processes have an effect on industry and industrial and economic development. For instance, the extent to which social structures and processes, as well as gaining their character from the effects of industrial production, contribute to the reproduction of industrialism (e.g. through education, the family, the state or ideology) or cause it conflict or strife (e.g. as a result of class divisions, loss of state legitimation or ideological dissensus) - these are further issues of prime concern to sociologists.

Richard Badham has argued, along these lines, that the central concerns of the sociology of industrialism are the 'social requirements of industrial development, social structures that either facilitate or hinder the efficient pursuit of industry and the impact of industrial development on society' (Badham 1984:2).

Different areas of study of the industry-society relationship

Let me illustrate my argument about the focus of the sociology of on the effects of industry on social processes and vice versa by looking in more detail at major concerns in the area.

1 The effects of industrialism on social relations. Sociologists working in this area are often interested in the social implications of technical and economic changes such as mechanization, economic growth and the factory system at the time of the industrial revolution and, more recently, developments such as automation and computerisation. These are seen to have an effect on: the growth and decline of patterns of residence and migration, first urbanization with industrialization and later deurbanisation with developments such as improved transport, communications and information technology; changes in the depth of social relations from pre-industrial community to alienation, anomie and looser forms of association after industrialization, associated with urbanization and the division of labour; changes in the experience of work and social structure and mobility with the decline of old forms of work and the growth of new occupations; the development of bureaucratic and democratic forms of political system and ideologies and forms of family and education suited to meeting the needs of industrialism.

2 The dynamic of industrialism. Sociologists of industrialism are also concerned with explaining changes with the development of industrial societies arising out of technological change and concomitant social changes. Some explanations focus on the shift of industrial

capitalism in its 'late' or 'advanced' phases from 'liberal' and 'laissez-faire' to more 'corporate' or 'monopoly' forms and then, in some, back to 'disorganized' forms. 'Convergence' theories propose an endogenously driven logic of convergence towards common sets of social and cultural institutions among industrial societies as a result of their common industrial character. 'Post-industrialists see industrial societies as moving into a new era – the 'information society', 'knowledge society' or 'service society' - based on the manufacture of information rather than goods, service industry rather than manufacturing, white collar rather than blue collar work and post-scarcity, technical knowledge and expertise. 'Post-fordists' see industrial societies as moving not beyond industrialism but from a Fordist mode of industrialism based on mass production, standardization and uniformity in economic and social life towards greater diversification, flux and flexibility in production, consumption and social lifestyles. All these explanations are concerned to trace the dialectic between technology and social process, between technical change and new forms of economic organization and social structure.

3 The bases of order and cohesion in industrialism. Another area of concern in the sociology of industrial societies has been with the ideological and political bases on which social order, cohesion and compliance are secured and maintained. Sociologists look, for instance, at the role of dominant ideologies in securing normative agreement among dominant and subordinate groups in society. And they examine the way in which states secure and maintain their legitimacy among citizens through appeals to their democratic and representative credentials and by attempting to meet the contradictory demands of different groups in society. Once again the focus is on the relationship between industry and society. It examines the requirements of industrial production and capital accumulation and their relationship to social and ideological institutions and norms which meet those requirements.

4 The reproduction of industrialism. Relatedly, sociologists also examine the role of institutions like the family and education system in the biological and social production and reproduction of industrialism. They examine the sexual division of labour behind the production and reproduction of the workforce and their socialization in the family and education system into structures and imperatives of hierarchy, division of labour, competition and achievement appropriate to the smooth running of modern industrial capitalist economies. In other words they examine the relationship between the requirements of industrialism, and its productive base in particular, and appropriate social institutions.

5 The impact of industrialism on work and social structure. Sociologists have also been interested in the effects of economic and technical change in industrialism on the nature and experience of work and on the shape of the occupational or social structure. They look, for instance, at the impact of the shift from agricultural and skilled craft production to less skilled assembly-line factory work with machines. They have had an interest in the

development of techniques such as Taylorism and scientific management and, subsequently, the effect on types and locations of industry and the work experience of automation, computerization and the information revolution. Job satisfaction or enrichment, degradation and deskilling have been important concerns. Sociologists have been interested in shifts between different sectors of industry - agricultural, manufacturing and service, for instance - and the implications these have for the occupational and class structure in society - the decline of the male, manual, manufacturing worker, for instance, and the growth of white collar and part-time temporary work and the feminization of the labour force.

The main point about these different areas of preoccupation in the sociology of industrialism is that they focus on the relationship between industry and society, whether they perceive causality in one direction or the other. They fall to break out of that relationship to a conceptualization of the relations between industry and society on one hand and the external natural world on the other: how they impact on the external natural world with resultant effects back again and how that external natural world imposes constraints and limits in its own right. I have focused so far on the ecological limits of sociological explanations of industrialism. The same sort of limits exist In relation to criticisms of industrialism.

Critiques of industrialism

Sociologists have not been uncritical of industrialism. From Marx, Weber and Durkheim on they have questioned the capitalist or socialist, individualist or bureaucratic forms that industrialism has taken. They have looked sorrowfully at its centralizing, bureaucratic and alienating tendencies, at division and conflict and at what has been lost as well as gained relative to the past (see Giddens 1971).

But the critique of industrialism has been 'internalist' and has rarely looked at industrialism in its external context. The first sense in which it has been internalist relates to the range of empirical factors of which its conceptual framework extends to taking account. The second relates to the range of theoretical alternatives it incorporates.

The empirical point first: critiques of industrialism have been mostly within a concern with the industrial or social forms industrialism has taken. Exploitation, bureaucratization, anomie and so on all describe phenomena internal to industrial and social relations. The critiques do not generally break out of the industry-society relationship to a framework which assesses the relationship between industry, society and the wider natural environment. This is the first empirical sense in which critiques of industrialism are internalist. They are empirically uninclusive of the range of relationships involved in industry-society-nature processes when they try to build critical appraisals of the merits and limitations of industrial societies.

The second way in which critiques of industrialism are internalist concerns more the range of theoretical alternatives accounted for in criticisms of industrial societies. In addition to not taking the external natural world into account, they have, after some initial hankering for a pre-industrial past, become increasingly focused on alternative paradigms within an acceptance of industrial production and growth to the exclusion of alternatives outside the industrial paradigm. Critiques have been around socialist or capitalist, liberal or collectivist alternative forms of industrialism. They exclude attention to evaluations which come from outside industrialist assumptions and can question industrialism itself as well as the different forms of it. So in a theoretical as well as empirical sense their focus is internal to industry society factors and the paradigm of industrialism and does not extend to a conceptualization of relations external to the industry-society relationship and to alien non-industrial paradigms of reference and evaluation.

Ecology and the sociology of industrialism

Let me summarise the usefulness of ecology for a fuller and more realistic sociology of industrialism, capable of conceptualizing the range of factors involved in the formation and development of industrial and social processes. There are three points: the first concerns the meaning of 'ecology; the second the traditional focus of sociology; the third the relevance of natural factors identified by ecologists to societal processes of interest to sociologists.

First, 'ecology'. This is usually taken to mean the study of the relationships between humans, plants and animals and between them and their wider environment. In other words it looks not only at the internal societies of species but also at how their character and development forms in interaction with other species and in relation to broader environmental conditions.

Secondly, sociology, on the other hand, is not a particularly ecological discipline in the full sense of this word, because it analyses the internal structures and processes of human societies in isolation from the external natural environment and without paying attention to the relationship between society and external natural factors in the way that ecologists do. Sociologists do look at individuals in their social environment. There has even been a branch of the discipline - human ecology - dedicated to a fuller ecological conceptualization of social life in the wider context of its physical surroundings. But few sociologists have stretched out to a conceptualization of social life in the natural environmental context.

These two points so far suggest that sociology does not take full account of the range of social and non-social factors which impinge on the formation and development of human societies and that ecology can bring back into sociology a fuller account of such excluded external natural factors.

This brings us to the third point. What sort of relationship with society have I suggested that external natural factors have? There are three ways in which such a relationship can be seen to occur: the first involves the impact of nature on society; the second the impact of society on nature; the third the effect of society's impact on nature back on society again.

First, external natural factors limit the way in which societies develop. Sociologists have been well aware of the significance of technological developments, cultural conditions, the existence of specific social groupings and political choices in society as facilitating and driving social change. Marx, for instance, put great emphasis on the development of productive forces, the role of emergent class groups like the industrial bourgeoisie and on dialectical contradiction as driving through change. Weber complemented this with an emphasis on the role of ideas, religious ideas in particular, in historical development. Nowadays historians impress on us that directions of change are not socially predetermined but that within the range of economically and socially permitted alternatives there are political choices which are another factor in change.

Yet ecologists would want to add the role of natural limits such as resource availability and finitude as factors affecting societal development. The initial availability of resources will affect a society's industrial and social development. Certain industries are only possible if the resources on which they rely are available and accessible. This applies to the early days of British industrialisation as much as to the route that the oil-producing nations and developing third world countries take now.

In the third world, one factor affecting divergent experiences of different nations is varying access to resources. In addition, third world ownership of resources, bio-diversity for instance, is an important source of power in the relationship of less developed countries with the developed world, which in this example requires access to bio-diversity for its drugs industries. The availability of specific resources can, in short, be one determinant of a society's industrial and economic future, its political power and the social circumstances of its citizens.

Furthermore, the long-term finitude of resources, as well as their initial availability, can cause societies either to choose certain courses of action or be forced to adopt them. This is the issue environmentalists are keen to press on politicians and industrialists in the developed world. As they see it, the finite availability of currently used resources must compel us to find alternative energy sources and perhaps, as a result, different paths of economic development and social lifestyle, an issue to which I shall return in the next chapter. In short, there are natural as well as economic, technological, cultural, social and political limits and influences on societal development.

So natural limits on societal development are one element constitutive of the society-nature relationship from which an 'internalist' sociology distracts us, but which a sociology

corrected in its rubric by a more ecological input could bring back in. A second issue is one in which the direction of effect goes not from nature to society but society to nature. Society is not only affected by natural limits but also has an effect on nature in the form of, for example, pollution and the depletion of resources. The pursuit of particular paths of industrial development can lead to the pollution of the air, sea and land. High profile examples of this might include: CFC and C02 emissions involved. respectively, in ozone depletion and global warming; the dumping of sewage and toxic wastes in the sea and in landfill sites and the use of pesticides, fertilizers and such like, all of which affect the land, water and plant and animal life; not to mention car fumes and acid rain and many other examples of the environmental effects of social processes.

Pollution and resource depletion obviously affect 'nature'. They pollute and deplete it! Yet they also have a reciprocal effect on human societies and this is the third area in which the relationship between society and nature can be seen to be operative. Not only does nature place limits on societal development, not only does societal development affect nature, but the effects of societal development on nature rebound on human societies again.

Resource depletion, for example, leads to limits on certain sources of fuel for industrial production. Others may have to be sought out, and production and growth may have to be run down or redirected into areas which can be supported by new forms of energy or resources. This can have an effect on social lifestyles which are shaped in part by patterns of production and growth in the economy. On pollution, ozone depletion is thought to remove ozone protection from the sun's ultraviolet rays which can cause skin cancer. Global warming caused by CO2 emissions, is likely to lead to rising sea levels, loss of land and other climatic effects on the quality of life for humans, such as the accentuated pollution from car fumes in cities. All the other forms of pollution mentioned affect food production or create health risks for humans in a variety of other ways.

In short, the society-nature relationship is constituted by natural limits on society, society's effects on nature and the effects of society's impact on nature as they rebound on society. A sociology which excludes attention to such factors is unable to explain in a complete and realistic way the full effects and causes of societal development, whether in the past, present or future. A sociologically as well as environmentally adequate sociology would have to be more ecological and look not only at the internal structures and processes of human societies; it would also have to look at them externally and in their full ecological context.

The *Limits to Growth* thesis

Let me look now at a classic ecological analysis of industrialism - the Club of Rome's *Limits to Growth* report (Meadows et al. 1983) - the debate around which is covered only briefly in some of the secondary introductory literature. I hope to illustrate two things: first, the sort of thing a more ecological sociology of industrialism could be getting up to; second, ideas

central to environmentalism and typical criticisms of it, both of which are well represented in debates around the report. In other words, a discussion of the report will allow us to see along what lines a more ecological sociology of industrialism could develop and introduce us to some of the main tenets and areas of criticism of environmentalist thinking. My book is centrally about environmentalist ideas and their relation to the study of society and politics. Spending some time on a piece of work which illustrates issues surrounding both is of interest in itself and also useful for introducing wider issues which are the concerns of this book.

The *Limits to Growth* report was first published in the early 1970s, when capitalist liberal democracy was plagued by internal crises and criticisms and concerns for civil liberties, peace and the environment were on the rise. At the time other works significant in the evolution and establishment of environmentalism were published. *Limits to Growth* focused on the predicted results of continuing levels of resource depletion, pollution and population growth. An issue of the green journal *The Ecologist* focused on proposals for alternative, more environmentally friendly forms of society (Goldsmith et al 1972). E.F. Schumacher's *Small is Beautiful* (1974) combined practical proposals and analysis of third world development with alternative philosophy. It gave to green thinking Buddhism, where Limits to growth brought it computer modeling.

An Italian management consultant, Aurelio Peccei, concerned about the global and interdependent nature of contemporary problems and the inadequate, short-term and national focus of policy-makers, founded the 'Club of Rome', a group of industrialists, business advisers and civil servants with similar concerns. The Club turned to the Massachusetts Institute of Technology (MIT) in the USA, where Jay Forrester and other technologists and systems analysts were developing computer modelling techniques capable of analysing complex interdependencies between variables and projecting different scenarios of change, assuming changes in different variables within the whole (Forrester 1970).

The authors of *The Limits to Growth*, Meadows et al., commissioned by the Club of Rome, adopted such techniques to make predictions about the consequences of continued growth in industrialization, resource depletion, pollution, food production and population growth. They extrapolated from growth in each factor as it had occurred between 1900 and 1970, showing how it would grow if it continued at this rate until the year 2100. They then altered in turn assumptions about how each of the variables would grow, feeding the projections into their computers and seeing what the outcome of each scenario would be.

They found that that the factors they analysed were highly interdependent and that changes to single factors often merely pushed problems on to others. Technical innovations to modify or deal with the consequences of growth in each of the factors, they concluded. could slow but not halt crises which could only be prevented by actual halts in growth.

I will outline the different scenarios they projected before moving on to lessons they drew from such projections and then to criticisms that have been made of the research.

The Computer Runs

There are seven different permutations that Meadows et al. considered, each of which assume alterations to growth in different combinations of the factors considered: population growth, industrial output, food production, pollution and resource depletion. In each run they assume a solution to the problem that precipitated overshoot and collapse in the first run.

The first permutation is their 'standard run', in which they assume continued growth on 1900-70 trends in all of the factors. The prediction on this simulation is for dramatic exponential growth in all the variables, leading to 'overshoot and collapse'. High levels of industrialisation lead to resource depletion. Depletion and the diversion of capital from investment to the search for resources leads to the collapse of industry and of service and agricultural sectors dependent on it. Lack of food and health services leads to population decline. Halts in growth happen in all these areas well before 2100.

In the second run Meadows et al. assume technological developments which will double resource availability, depletion having been the key factor in collapse on the first run. This time high industrial output leads to unabsorbable pollution levels. Pollution and lack of food lead to an increased death rate. Industrial growth, elongated by the extra resources. still leads eventually to resource depletion.

In the third run they add the assumption of technological developments which can double resource availability (e.g. nuclear power, new techniques for sea-bed mining and the use of low-grade ore) and cut resource use to a quarter of present levels (e.g. through new techniques of recycling and reclamation). However unlimited resources does not prevent the same key problem of the previous run - unsustainable pollution levels. The lives of industrial output, food production and service industry are elongated but still eventually collapse, and population is hit again by this.

In the first run depletion was the key problem. The second and third runs assumed solutions to this, but these led to collapse caused by pollution. The fourth run assumes technical solutions to pollution: nuclear power and recycling (which cut down on some polluting emissions) and pollution control, for example. It is assumed these will add a fourfold reduction in pollution to the extra resource availability of the previous run. Resource depiction and pollution crises are averted and population and industrial output rise. However, the latter two factors lead to the exhaustion of arable land through over-exploitation and appropriation by industry. This leads to a food shortage crisis. Capital is diverted to agriculture to solve the problem but this leads to the collapse of industrial output. Population falls as a result of food shortages.

The next two runs assume technical solutions to food production and population levels to tackle food shortage crisis of the last run. The fifth run assumes land yields are doubled by developments such as high-yield grain. Once again this added to the assumptions about resource availability and pollution control made on the previous runs. Increased food and industrial outputs, however, increase to levels so high that pollution levels rise despite the controls and are again the source of collapse for the same reasons they were in the second and third runs. In the sixth run voluntary birth control which prevents the birth of all unwanted children is assumed. But even this only slows and does not halt population growth, so leading only to the postponement of the food crisis.

The seventh and final run assumes a combination of all the solutions so far outlined: resource availability, pollution control, food production and population control. The result is still overshoot and collapse as a result of land overuse and food shortages, resource depletion and excessive pollution leading to a food production crisis and rising death rate. As with previous runs, solutions on one factor often only push the problem on to another (runs 1-4) and technological solutions slow but cannot halt growth (runs 5 and 6), which still, on Meadows et al.'s calculations, leads to collapse before the year 2100.

Lessons from the Limits to Growth *report*

I will come to criticisms of the *Limits to Growth*, but let me look first at some general implications which come out of it. In the projected trends identified and the results of the computer runs four main conclusions arise which define the argument of the report and have become of central significance in environmentalist thinking: the first on interdependency; second, the natural limits thesis; third, the notion of exponential growth; fourth, the significance of social as well as technical solutions.

First, interdependency. Meadows et al. argue that the character of a system and each of its parts is constituted by the interdependent relationship between the parts. Different elements are affected by others and each element affects others, often with a reciprocal effect back on itself again. The structure of a system is as much constituted by relationships and the dynamic interactions and 'feedback loops' between different parts of the system as by the parts themselves in isolation:

> Of course, none of the five factors we are examining here is independent. Each interacts with all the others ... Population cannot grow without food, food production is increased by growth of capital, more capital requires more resources, discarded resources become pollution, pollution interferes with the growth of both population and food. (Meadows et al. 1983:89)

Figure 1.1 The *Limits to Growth* computer runs

Standard Run (I): assumes growth in all factors

Industrialization -> resource depletion -> capital diverted from investment to search for resources -> collapse of industry -> collapse of dependent service and agricultural sectors -> lack of food and health services population decline

Run (2): assumes problem of depletion solved by high resource availability

High resource availability -> high industrial output -> high pollution increased death rate -> eventual resource depletion

Run (3): assumes problem of depletion solved by technical developments

High resource availability -> high pollution -> eventual halts in industrial output, food production and service industry -> high death rate

Run (4): assumes pollution solved by technical developments

Rising population and industrial output -> overexploitation and exhaustion of arable land -> food shortages -> capital diverted to agriculture collapse of industrial output -> population fails

Run (5): assumes technical development increases land yields

Increased food and industrial outputs -> higher pollution -> higher death rate -> eventual resource depletion

Run (6): assumes voluntary birth controls reduce population

Voluntary population controls -> insufficient reduction in population food production crisis -> population fails

Run (7): all solutions combined

Land overuse -> food shortages -> resource depletion -> excessive pollution -> food production crisis -> rising death rate

The MIT team found that each time they altered one variable there was still eventually a crisis even if after a longer delay than there would have otherwise been. Sometimes this was because technical solutions only slowed rather than halted growth, so postponing but not preventing crises. But at other times it was because solutions on one factor only offloaded problems onto another where crisis led to overshoot and collapse. In other words, the different variables were interdependent and a resolution of problems in one often led to problems in another. Resolving resource availability problems, for example, as in the second and third runs, leads to pollution crises cause by resource-driven industrial growth. Resource availability combined with pollution control, as in the fourth run, also only loads the problem

onto another area when over-intensive agriculture and use of arable land for industrial expansion leads to food production problems.

The significance of interdependency is also illustrated in the natural limits thesis, where development in society is seen to be constrained by limits in the natural world and in the social versus technical solutions thesis where problems in the natural environment are seen to have causes in processes in the social world. Not only are different socioeconomic processes interlinked, implying the need for interdisciplinary social science, so too are natural and social processes, suggesting that interdisciplinarity should spread also to relations between the natural and social sciences.

So one thing that comes out of *The Limits to Growth* is that problems are not isolated but are part of a bigger context and related to other issues and problems. Changes in one part of a system are linked to changes in another. The emphasis on interdependency runs through explanations and prescriptions in green thinking in general and is by definition what 'ecology' is all about. In some cases interdependency between parts leads to a stronger, holistic position which sees the whole as more than the sum of the parts. The ontology of interdependency is reflected in Meadows et al.'s choice of method. They use a systems analysis approach and computer modelling capable of comprehending and charting complex and multiple changing links and relationships. It is also reflected in their prescriptions, which are geared to interdependence and are distinctively global and co-operative in character especially when compared to decentralist self-sufficiency proposals such as those of Goldsmith et al. (1972).

Meadows et al. put particular purchase on the necessity for a long-term and systems understanding of problems when so many of us in everyday life and policy-making take a short-term immediate perspective, both over space and time. We look for short-term solutions to the most proximately obvious problems rather than longer-term solutions with an eye to the relation of proximate problems to others less immediately pressing on our attentions yet no less objectively important.

The second important issue to come out of the Club of Rome report is the natural limits to growth thesis. Perhaps the main conclusion of the report is that growth in industrial societies is not compatible with the finite nature of the planet's resources and ability to carry population and absorb pollution. The report points to the unsustainability of present levels of growth in 'population, industrialisation, pollution, food production and resource depletion' (p. 23). The food and resource needs of people cannot be met indefinitely over certain population levels because land runs out or is made infertile by overuse and non-renewable resources are exhausted. Waste produced and pollution caused by production to meet human needs cannot be absorbed and transformed into safe forms by the world's ecosystem beyond certain limits. The resource and food supplying and pollution and waste-absorbing capacities of the earth are naturally finite. Population and industrial output

pursued indefinitely will exhaust natural limits in all these respects because of human food and resource needs and pollution that comes with growth in these factors. You cannot, in short, pursue infinite growth in a finite world.

Some of the computer simulations described by Meadows et al. fail to avoid crisis because resolutions to problems in one area create problems in another, as highlighted in the discussion of interdependency above. Sometimes, though, it is because technological solutions only take the edge off problems of resource depletion, pollution, food production, over-population or industrial output and stall crisis until later. Problems are about growth beyond certain limits, and technical solutions slow growth and delay the date at which limits are reached rather than bringing growth down to levels compatible with finitude. since this requires halting growth altogether.

All this is a major theme in wider environmentalist thinking. Greens emphasise the absoluteness and unavoidability of natural limits and the futility of continuing with growth on a planet where there are natural and unavoidable limits on how far it can go.

The third issue to come out of the Club of Rome report is the idea of 'exponential growth'. This is a notion that lies behind Meadows et al.'s analysis of existing trends and on which many of their extrapolations are based. The report gives a startling illustration to explain the meaning of the term.

> ‘Suppose you own a pond on which a water lily is growing. The lily plant doubles in size each day. If the lily were allowed to grow unchecked, it would completely cover the pond in thirty days, choking off the other forms of life in the water. For a long time the lily plant seems small, and so you decide not to worry about cutting it back until it covers half the pond. On what day will that be? On the twenty-ninth day of course. You have one day to save your pond’. (Meadows et al. 1983:29)

This can be read as a metaphor for the planet-wide situation, the pond symbolizing the planet and the lily, say, pollution. Linear growth involves growth by a constant amount over a constant time period, the lily growing by a meter square each day, for instance. It occurs incrementally and by the same amount in each same time period. But exponential growth occurs when a quantity increases by a constant percentage of the whole over a constant time period - the lily, say, doubling in size each day. This can produce immense numbers very quickly and in quantities which escalate more and more massively at each stage. Meadows et al. argue that population, food production, industrialization, pollution and resource depletion are increasing in an exponential manner.

At each stage growth jumps dramatically and at each stage the size of the jump itself grows fantastically bigger. Final collapse can come very suddenly with a huge exponential leap soon

after the rate of growth seemed to be way off causing crisis - the syndrome of the twenty-ninth day. Current growth levels can appear deceptively less problematic than they are, and when growth is curving up exponentially curbing it is something you cannot leave until you are quantitatively even halfway to crisis as over time this may be the eleventh hour. The concept of exponential growth explains the vision of sudden catastrophic crisis in much green rhetoric and the alarmism in the face of apparently easily containable problems that many greens are criticized for.

The fourth and final outcome of The Limits to Growth which is of note is the emphasis on social rather than technical solutions. Greens have continued to emphasize the report's stress on the inadequacy of technical fixes - technological solutions formulated within existing economic and social practices, values, lifestyles and levels of growth which are not compatible with natural limits. On the runs 3-7, summarized in figure 1.1, a number of technological solutions to problems such as resource depletion, pollution or food shortages are proposed. In each case crisis still occurs because the solutions only sustain growth for longer and so stall overshoot, rather than running down growth which is the real problem.

Technical solutions to resource depletion in runs 3 and 4 merely allow growth to continue in other sectors (industrial output, pollution, population and food production) which leads to collapse due to pollution and its effects or food shortages. In run 5 technological developments which increase food production create pollution problems due to growth in the other areas as a result of food holding up. In fact pollution becomes so inflated as a result of the new boosts to resource availability and food production that even technical innovations of the sort proposed in run 4 cannot contain it. In this case not only is crisis pushed into a second area by technological innovations which sustain growth in the first, but in the second area technology is inadequate to containing the problem. The same goes for run 6, on which the birth control fixes proposed are simply not sufficient to bring down population and avert a food crisis.

In short, technical solutions fall either because they sustain growth to overshoot in other areas (e.g. fixes on resource availability, pollution and food in runs 3-5) or because they are ineffective in holding back growth where they are supposed to (e.g. pollution and birth controls in runs 5 and 6). In both cases the problem proves to be continuing growth in a finite system. Technical solutions which attempt to sustain growth or vainly try to curb it are inadequate to the resolution of problems of resource availability, pollution, food production, population and industrial output because they do not deal with the root problem, which is growth itself in a system in which there are natural limits.

There are optimists who have faith in human abilities to produce technologies which have not yet been developed but which could sustain growth without the resource depleting and polluting effects of older technologies. These are regarded by Meadows et al. and others like Trainer (1985) with caution. Relying on the faith that environmentally friendly technologies

can be developed on a scale that would allow us to continue existing lifestyles without the existing problems of growth is seen to be a risky business. A surer solution is seen to be attacking root causes: social systems and values based on growth. The restraining of growth to levels compatible with the planet's supplying, carrying and absorbent capacities is required. This requires the rolling back of economic objectives and social lifestyles on which growth is based - social rather than technical solutions.

These, then, are four main principles of central significance in *The Limits to Growth* and in environmentalist thinking in general: that problems are interdependent and require across-the-board thinking and action; that growth is exponential and so in need of earlier rather than later remedies; that there are natural limits to growth which cannot be avoided by solutions which try to prolong growth; and that technical solutions are inadequate without social changes also.

The ideas of natural limits to growth and social rather than technical solutions to environmental problems are of particular significance for sociology. The first suggests that natural environmental factors are relevant to the study of society and the second that sociology has role to play in the resolution of environmental problems. The natural limits to thesis suggests that sociologists could provide a more realistic and complete analysis of the range of factors affecting the development of social systems if they paid more attention to natural as well as economic, social and political factors. Furthermore, if environmental problems have social as much as technical origins, then social scientists have as much to offer in their resolution as natural scientists and technologists. The analysis of the patterns of social life which prop up industrial growth or which would be appropriate for greater sustainability calls out for sociological expertise. At present, however, sociologists are reluctant to include nature within a wider ecological conceptualization of the range of factors relevant to the study of society or to treat environmental problems as an appropriate area for sociological study.

Criticisms of *The Limits to Growth*

Let me turn now to criticisms of *The Limits to Growth*. These are instructive for two reasons. First, they expose limitations in the report. Given the compelling nature of the report's findings and its influence, it is important to give critical appraisals of it serious and open-minded consideration. Second, criticisms of the report are typical of those made of wider environmentalist thinking. It is worth dwelling on them as criticisms of environmentalist thinking as a whole because they bear on the concern of this book with this more general phenomenon.

There are many places in which criticisms of the Club of Rome report are covered or made. Some criticisms address a distortion of its arguments rather than what it really says. Some are as one-sided, lacking in open-mindedness and loaded with ideological bias as they accuse

the report of being. Others, though, are more balanced, open and objective, and I will focus on one such response, Cole et al.'s (1973) *Thinking About the Future*, although misrepresentation and ideological closed-mindedness creep in even here at moments.

There are six areas of criticism of the report that I will address. These concern: (1) the timescale within which it predicts disaster will strike; (2) its pessimism and fatalism; (3) the limits of systems dynamics and computer modelling; (4) flaws in the data used in these methods and their presentation as scientific by Meadows et al.; (5) the class interests and ideological bias behind its conclusions; (6) the aggregative way in which it analyses global averages and is insensitive to regional differences and the specific situation of less developed countries.

The first problem can be dealt with swiftly as it has been widely accepted as valid by greens and the Club of Rome. Meadows et al. predicted crisis by the year 2100 and probably within 100 years of the date of publication in the early 1970s. The Club and most greens now accept that while they think crisis could occur in one of the scenarios outlined by the report if avertive action is not taken promptly they do not think it will come anything like as soon as this.

Perhaps the most frequently and forcefully put criticism is of the pessimism of the report, the second criticism mentioned above. The extrapolative method used by Meadows et al. focuses on physical limits and assumes existing rates of growth and technological innovation. It excludes humans' technological and political capacity to adapt. This is seen by critics to lead to pessimistic and fatalistic conclusions which are factually implausible yet encourage self-fulfilling prophecy by spreading fatalism, gloom and inertia rather than spurring action.

Meadows et al. extrapolate from rates of growth between 1900 and 1970 and assume growth continuing at similar rates into the future. They then calculate what the consequences of such continuing growth would be. As we have seen, their conclusions are that there would be crises of overshoot and collapse whatever way the different variables are altered to create changes in the system. However, the growth areas and feedback loops affecting growth rates which they incorporate into their calculations do not include technological development or political action - human-led feedbacks which could alter rates of growth. Different technological changes are assumed in the runs but human creativity and adaptation and improvements on existing technological responses are not built in as feedback loops. This leads, according to critics, to a set of conclusions which are inevitably doom-laden and falls to take account of human ingenuity and determination to alter rates of growth as they are assumed in the different variables calculated.

It is argued that a similar lack of technological optimism was evident in the predictions of Malthus and other eighteenth- and nineteenth- century economists. Yes the crises these

figures predicted were averted by changes in birth control, colonization, trade and technical progress which it was beyond the capacity of someone living in their historical context to foresee (Cole et al. 1973: 140-1, 153-4).

In short, pessimism and fatalism and a lack of faith in human adaptive capacities are built into Meadows et al.'s extrapolation method and the factors chose to include to feedback loops. This is seen to have led to negative consequences. Such conclusions, it is argued, have potentially disabling consequences for policy solutions. Pessimism and doom-mongering may lead to a feeling among people that nothing can be done and subsequently to a self-fulfilling inertia and lack of action (Cole et al. 1973: ch 14).

There is truth and error in this in this criticism. It is certainly true that Meadows et al. exclude adaptability from their calculations and even that the authors are unconvinced that adaptation will occur. But the very purpose of their research is to show what will happen if it does not. This is not to say that adaptation will not occur but that the consequences, if it does not, will be of the sort outlined. Meadows et al.'s models are warnings rather than predictions. Critics (e.g. Cole et al. 1973:209-10) are mistaken to read into predictions about the outcomes of modelled variables based on what are deliberate assumptions, predictions about what will necessarily happen in reality. In reality political and technological feedbacks may avert crisis. The models give predictions about what will happen if adaptation does not occur. In this sense critics miss the point when they accuse Meadows et al. of not building into their models social and technical ameliorative feedback loops (Cole et al. 1973:213). Such an exclusion is the whole point of the exercise.

In a level-headed assessment which deals with what *The Limits to Growth* actually says, Page argues (Cole et al. 1973) that the MIT models

> are not attempting to predict The Future, but to show the possible consequences of present trends and relationships continuing without drastic change. Indeed the message of most of the doomsday authors is not that forecasts are necessarily expected to materialise - but that they could do so if appropriate action is not taken now. (Cole et al. 1973:172)

The same could be said of green espousals in general. They are not usually deterministic predictions of doom (although sometimes they are) but warnings of what will happen if we do not act. They are calls to action rather than resignation to the lack or ineffectivity of it.

A third area of criticism is of the systems dynamics and computer modelling methods used by the Limits to Growth team. While models can be misused or go askew when based on poor data, there are some inherent problems in using them in the first place. Models are simplified constructions which pick out particular features and ignore others in order to create a manageable picture to analyse and deal with. The problem is whether the selectivity

and exclusions involved create a simplicity which outweighs in the results it can deliver the imperfection and distortions it creates (Cole et al. 1973:23-4). Because of the interdependency in systems outlined by Meadows et al., a conglomeration of many tiny exclusions from a model could accumulate to lead to simulations which go far away from what would happen in reality when the effect of complex details that have been left out is amplified many times (Cole et al. 1973:30). Similarly inclusions ay become overweighted with an effect on the conclusions out of proportion to their actual significance in reality (Cole et al. 1973:31).

These are problems inherent in any attempt to use modelling techniques for analysing systems. A fourth set of criticisms focuses not so much on modelling itself as on putative problems in the way in which Meadows et al. built or present their modelling method. There are two criticisms here, the first referring to the adequacy of the data used and the second to the way in which Meadows et al. present the scientificity and accessibility of their method. On the first criticism it is argued that, regardless of the intrinsic virtues or lack of them of systems analysis and modelling, these techniques in the hands of Meadows et al. are flawed because they are based on inadequate data and empirical information (Cole et al. 1973:28, 31, 109, 177). Furthermore, systematic rounding and approximations in numerical values might accumulate to lead to significant miscalculations in the final results (Cole et al. 1973:30). These problems become particularly amplified when extrapolations are made on the basis of the data along exponential rather than just linear lines so that what might only be small imperfections in numerical values at first become much bigger when multiplied exponentially (Cole et al. 1973:32).

One test of the accuracy of forecasting is to look at previous attempts at forecasting and the extent to which they have been accurate. Cole et al. argue that population forecasting has always been inaccurate and that there is no reason to suggest that modern attempts are going to be any more successful (Cole et al. 1973:171-2). The problem with forecasting is that it can only be based on extrapolations from present trends with no attention to possible future interactions which cannot be foreseen. As such we can only predict what will happen if humankind continues to act as at present (Cole et al. 1973:189).

In defence of the MIT team it has to be repeated that this less ambitious project is all they were trying to do. It was not their intention to predict the future fate of humankind, but only to say what it is likely to be if existing trends continue without changes we could foresee or not. The critique of forecasting is fair as a critique of forecasting but not as a critique of the Club of Rome report.

So the first criticism of the way on which the MIT team used their models is based on the accuracy of data. A second criticism on this question concerns the public presentation of system dynamics and computer modelling by Meadows et al. there are two points here. One is that Meadows et al. give an overly scientific appearance to research which essentially

leaves out adaptive capacities, is oversimplified, empirically inadequate and involves a lot of subjective value judgment (Cole et al. 1973:12). Computers, numbers and graphs are used to give a scientific appearance to the work. Far too many complex interactions are included, most of which are unnecessary and obstruct accessibility but give the appearance of a systematic scientific thoroughness (Cole et al. 1973:28). The second point on Meadows et al.'s presentation of their research method is that they falsely present as accessible, transparent and publicly testable a mode of research which is actually not easily available to the non-numerate or those unused to computers (Cole et al. 1973:213-4).

The point about the false scientificity with which Meadows et al. present their research is linked to the related fifth criticism that their research is, firstly, value-laden rather than objective and detached and, secondly, that it reflects the particular interest of a certain stratum or class grouping in society.

Cole et al. argue that far from being the detached objective scientific thing they make it out to be, the computer modelling used by Meadows et al is run through with biased value judgments and assumptions. For instance, the variables which Meadows et al, choose to feed into their computer runs reflect their pessimistic bias. If the initial assumptions are altered and different ones fed in, the result of the computer runs can look quite different and more positive for the future (Cole et al. 1973:133-4, 176-7). The pessimistic bias in particular was influenced by the context in which they were working, one in which there was a widespread millennial mood of discontent with the extremes to which advanced industrial societies had gone (Cole et al. 1973:214). This is accentuated by instances where data on growth are insufficient to allow trend analysis and so have been substituted for by subjective estimates (Cole et al. 1973:190). Furthermore, it is argued that not only is their historical analysis informed by pessimistic bias but that their prescriptions for the future are influenced by prior ideological preferences for non-material values and pursuits which are out of line with scientific neutrality and objectivity (Cole et al. 1973:207). The allegation that environmentalism is an ideological project concerned with politics that has been disguised as science concerned with the natural world has become a typical criticism of environmentalism as a whole.

The bias of Meadows et al., however, is seen to consist of more than an expression of a generalized pessimism about the march of advanced industrialism fed into computers. More damning than this, it is seen to reflect also the class interests of a particular social stratum in society.

One criticism dealt with by Cole et al. (1973: 139, 142-3, 154-6) is that environmental concern and hostility to growth reflects the biased interests of the materially well-off. To be concerned with the environment and non-material concerns which break with growth, development and material well-being reflects the interests of those who already benefit from the latter. It is not sensitive to the needs of those who would benefit from growth more

than environmental protection - the poorer sections of industrial societies or people in less developed countries. Furthermore, proposals which emphasize the need for controls on population rather than consumption, and so place the onus of change on third world countries with high birth rates rather than on the high-consumption nations of the 'North', further bolster the idea that concern for the environment is a luxury of the rich of the developed world.

Two issues come out of this which are relevant to environmentalist thinking in general. The first is the idea that environmentalism is, as a matter of empirical fact, very much the concern of middle-class people and that, therefore, it is they who are likely to be the main agent of change in the future politics of environmentalism. I will discuss this contention further in chapters 4 and 7. The second issue concerns the implications that environmentalist ideas and proposals have for equality, both within industrial societies and between industrial and less developed countries. I will return to this in the last section of this chapter. But as with the previous points Cole et al. again raise in relation to the Club of Rome report criticisms and controversies which are central to debates around environmentalism as a whole.

The sixth and final set of criticisms link issues to do with method and equality. Meadows et al., it is argued, have an over-exaggerated model of world rends which makes them insensitive to regional differences and the specific situation of third world countries (an oversight acknowledged in later Club of Rome sponsored work by Mesarovic and Pestel 1975). Furthermore proposals for no-growth, it is argued, are also over-aggregated and do not differentiate on the basis of what the composition and distribution of growth should be.

The trends that Meadows et al. fed into their computer runs and from which they extrapolated about the future were based on aggregated world average rates of growth (Cole et al. 1973:27-8). In other words they calculated growth across the world but did not distinguish between differences in growth rates in different parts of the world.

This is empirically problematic because it does not allow for sensitivity to local conditions – gamine or drought, for instance – which may have a specific effect on growth in some areas and not others and so affect local and general growth rates. Cole et al. calculated quite different results from dividing up growth regionally in different ways (Cole et al. 1973:119-21).

Furthermore, on prescriptions for change, no-growth proposals are seen by critics to avoid real, more complex problems about the composition and distribution of growth. Some forms of growth, for instance, may not be environmentally problematic and in need of curbing. Growth in some services - health or education, for example - may be less environmentally problematic than growth in some sectors of manufacturing industry. In addition, growth in some regions - e.g. the affluent 'North' may require rolling back while in others - e.g. less

developed countries - social considerations may dictate that it should continue and expand. In addition to physical questions about natural limits there are social and political issues to do with social choices and equality, choice of areas of growth and the distribution of growth. The focus on physical limits and no-growth does not allow us to take these into account.

These criticisms raise three points which are central to environmentalism as a whole. First, environmentalism is often regarded as insensitive to the particular needs of third world countries where growth needs are acute. Third world politicians are frequently incensed by calls to curb growth which has adverse environmental effects when they come from environmentalists in countries which have already developed industrially using environmentally problematic practices and can now afford to find less environmentally problematic solutions. As such, physical issues to do with the environment raise social and political issues to do with equality.

Second, no-growth proposals are also seen to be insufficiently complex in other respects - ignoring the varying environmental implications of different forms of growth as well as the different growth patterns and needs of different social groups.

Third, and continuing from the implications of the first point about the third world, environmentalism often involves prescriptions about desirable forms of economic, social and political organization on the basis of stipulations about natural limits and without sufficient attention to non-environmental social and political choices. We may want to choose certain social and political preferences (growth to alleviate poverty, for example) which are environmentally damaging, and radical ecology often does not allow for this. I shall return to this in chapters 2 and 5. My view is that environmentalism is necessary but insufficient for defining what a sustainable society should look like. This is because this involves social and political choices about issues like distribution and liberty, which are not specifically environmental, as well as attention to physical factors which are. There can be a green input into political theory but because thinking about how society and politics should be organized involves more than environmental criteria there cannot be such a thing as a green political theory, a political theory built on ecological stipulations alone.

Implications for the sociology of development

Sociologists of industrialism tend to focus on the developed industrial nations at the expense of their place in the wider global context, in particular their relationship to the less developed world and the way this relationship shapes the fates of both. However, there is a sub-branch in sociology, the sociology of development, which does look at this question and, in particular, at industrialization in the third world (see Harrison 1988). The sociology of development is a well established and important area of sociological study and, I wish to argue, one in which attention to ecological issues is very illuminating.

One criticism made of environmentalism, as I have mentioned, is that it is something that only the developed world has the luxury to be concerned with. Less developed countries have enough on their plates trying to foster development and growth and eradicate poverty, starvation and inequality without worrying about environmental consequences. They have too many pressing material concerns on their hands for them to worry about non-material issues.

Take one example. Developed countries want to phase out chlorofluorocarbons (CFCS) which are used in, amongst other things, aerosols and fridges. When CFCs are released into the ozone layer and exposed to the sun's radiation they decompose and release chlorine compounds which break up this layer. This is worrying because the ozone layer screens the earth from the sun's radiation which, in sufficient doses, can cause skin cancer and affect food production (Yearly 1991: 12-16). However, critics of green fears argue that poorer nations like China and India need more fridges and cannot afford expensive alternatives to CFCs. They do not have the luxury that the richer developed nations have to worry about such environmental issues.

There is a vital point here about the importance of development and material improvement which no-growth or low-growth greens in the developed world have to take seriously. Yet some greens would defend their concern with environmental problems inI the face of criticisms about the greater importance of third world development needs. Many greens are in fact active in political struggles over North-South relations and in third world-concerned activities like 'The Other Economic Summit' (see Elkins 1986). Others would argue that environmental issues rather than being a distraction from development and the well-being of less developed countries (LDCs) actually have a very important bearing on these.

Three reasons why this is the case might be mentioned. First, ecological crises such as the greenhouse effect and the depletion of the ozone layer are so global and potentially so grave that they affect everyone, North and South, and could be more serious and less trivial than criticisms from LDCs imply.

Second, developing countries also need to pay particular attention to environmental questions because of the environmental effects of industrialization. Countries North and South are suffering the results of the developed world pursuing industrialization blind to its environmental consequences. Now that knowledge of some of these consequences and their causes is available, planning alternative paths of industrial development with a long-term view which takes account of them makes sense from the point of view of LDCs themselves.

Third, the environmental effects of industrial development are accentuated in the third world by the dependent position of many LDCs and have serious impacts not only on the environment and local populations but also on development itself.

I will say more about the third point below. All three points, though, suggest that ecological insights are important to the sociology of development, to explaining the position of LDCs and to planning development.

I will focus now on the link between the dependent position of LDCs and environmental problems they face and on the way in which these problems have implications for development. First, I will mention specific issues such as environmental protection regulations, waste disposal and pesticides. I will discuss how these and other issues tie in with economic relations of dependency. Aid and debt are also relevant to this question. I will then say something, with reference to examples of soil use and deforestation, about the way in which environmental problems can affect development in the third world. Finally, I will move on from explanations of environmental problems in LDCs to proposals on development which attempt to be sensitive to environmental degradation.

Explanations of development and environmental problems in LDCs

The dependent position of third world countries on the North makes them especially vulnerable to the adoption of environmentally damaging practices Dependency theorists emphasise that, despite the ending of direct colonial political rule, economic, political and cultural dependency on, and domination by, developed countries continues in the third world.

Less developed economies depend, for instance, on investment from the North. One way they can attract it is with relaxed environmental regulations. Companies find this congenial because it cuts down on pollution control costs and means they can avoid having to make awkward changes to meet tighter regulations in the North. Many businesses may choose to stay in the North and tighten up their practices or try to evade regulations there. Where they do relocate to less developed parts of the world it may be to do with factors such as low labour costs or the availability of raw materials rather than looser environmental regulations. But looser regulations may still be one incentive that LDCs use, and they mean that once companies are there, regardless of what determined their decisions about industrial location in the first place, they and indigenous companies are freer to neglect the environmental impact of their practices (Yearly 1991:157-61).

Many third world countries, because of their comparatively loose regulations and the tightening of standards in the North, have become dumping grounds for hazardous toxic waste from the North. In fact some LDCs may positively discourage the importation of waste and drastically undercut disposal prices charged in the North because it is a source of much-needed foreign exchange (Yearly 1991:36). A similar situation exists in the case of fertilizers and pesticides, where restrictions on the manufacture and use of agro-chemicals is loose in many third world countries. These chemicals get into the land, water, animals and local people and ultimately into the stomachs of people in the North through the food they

eat. Chemicals which people in the North have banned are still used in the South creating a 'circle of poison' where people in developed countries still end up eating them in imported third world cash crops (Yearly 1991:168-9; Weir and Shapiro 1981).

Yearly (1991: 174-7) also points out how the web of dependency spun by third world aid and debt creates environmental problems. The financial interests of first world creditors and the development needs of debtors combine to ensure that loans are usually dedicated to big projects geared to rapid industrial development, with little thought for environmental impact. Furthermore, debt has to be paid off in foreign exchange so third world countries are keen to develop industries like cash cropping and mining where production can be exported to bring this in. These, of course, are industries which have a large environmental impact because they involved the use of soil and resources extraction.

Industrialization is an environmentally messy business at the best of times. But LDCs are dependent on attracting investment and foreign exchange from the North. This dependence may lead to the relaxation of environmental regulations and the promotion of damaging forms of production, so making LDCs especially prone to ecological degradation. This rooting of environmental problems in dependency is one reason why some greens are keen to advocate economic self-sufficiency, a point to which I shall return below.

All this is not only an environmental problem. It is also a development problem because environmental degradation can hit development strategies. The dependence and poverty of many LDCs lead them into, for example, agricultural practices which degrade the soil and ultimately damage crop and food production. Agribusinesses move into third world countries because their climate is favourable for the production of certain crops for export. They tend to go for maximum production with little regard for its effect on soil fertility. When yields fall on degraded soils, the companies can move on to new soils, but the locals are left with infertile land (Yearly 1991: 166-8).

Conroy and Litvinoff (1988) argue that major environmental problems in the South are deforestation and soil erosion. Food production which depends on indigenous natural resources is a major activity for rural third world people, and industries are frequently based on timber, paper, rubber and cotton textiles. As such the degradation or hyper-exploitation of these resources to the extent that further production becomes undermined is not only an environmental problem but also undermines economic development. Poverty leads the rural poor to over-exploit and degrade their environments, as do the high consumption levels of the rich North which puts heavy pressure on the third world's natural resources for development.

Proposals on development and environmental problems in LDCs

I have focused so far on explanations which analyse the relationship between development problems and environmental degradation. Let me turn now to proposals put forward to overcome these and foster what is known as 'sustainable development'. I will mention four: nogrowth strategies, de-development of more developed countries, self-reliance and appropriate technology.

The first proposal is for the global slowing or halting of growth in lone with natural finitude. Green non-growth proposals are much criticized by advocates of the needs of LDCS. On the explanatory side aggregated world average data in the *Limits to Growth* report failed to distinguish between different rates of growth and development needs in different parts of the world. This is also the case with no-growth proposals on the normative side (see Barkenbus 1977). Critics argue that developed countries with the highest rates of growth should shoulder the burden for slowing growth, whereas LDCs with greater development needs have a case for pursuing higher rates of growth within a context of globally slowed growth.

This leads to the second proposal for rolling back growth in a way which is sensitive to the development needs of third world countries. The proposal here is for the restriction of no-growth strategies to the developed world, while allowing growth to continue in LDCs (see Daly 1973). This proposal rests on a belief that the problem of third world development lies with the overdevelopment of the rich North rather than the underdevelopment of the South and that environmental problems are primarily due to high consumption in the rich countries rather than, say, population growth or the drive to develop in the South. The solution is to involve an accent on the North's de-development to allow for development in the South (see Caldwell 1977; Trainer 1985).

Greens challenge the idea that LDCs should be striving to reach the same levels of material consumption as the developed North (see Trainer 1985). These levels create problems for both development and the environment. On development, poverty is a result of affluence. Natural bases for development are damaged by over-exploitation of resources to provide goods for consumption by the rich. On the environment, the natural limits thesis suggests that only certain levels of growth and consumption are compatible with the finite resources of the planet. Natural limits will mot permit all countries in the world to sustain consumption and growth at the levels at which they occur in the developed world.

Modernisers argue that the solution to global inequality is more growth and a bigger cake. Greens argue that the global ecosystem cannot sustain a bigger cake. There are natural as well as social limits to growth and the planet cannot carry all the world’s population consuming at the western ate. An answer which is compatible with globally moderated growth but also allows for development in the third world and a distribution of shares infinite goods is for the developed world to consume less or ‘de-develop’. The point is for all to

consume at a sustainable level and not fro some to consume at such a level that natural limits do not allow the others to have an adequate share.

However there is a problem with this which leads to the third proposal for reconciling development with protection of the environment. The problem is that restricting no-growth strategies to the developed world while allowing growth to continue in LDCs fails to account for the dependency of LDC development on growth in developed countries. LDCs rely, for instance, on markets for export earnings and on the attraction of capital, management and technology from the developed world.

The third alternative which deals with this and is increasingly popular is a combination of 'sustainable development' (development which in the words of the Brundtland report 'meets the needs of the present without constraining the ability of future generations to meet their own needs' 16) with self-reliance. Self-reliance is needed to break with the dependency problem of the second proposal (see Barkenbus 1977).

Self-reliance is also a central objective of the fourth proposal for overcoming development and environment problems in LDCs ‘appropriate technology' (Schumacher 1973). This involves the use in development strategies of technology which is appropriate to the needs, culture and abilities of local populations and sensitive to their environment, rather than built according to the abilities and interests of outside parties who import it and, because they can move on, are not hit by the local environmental effects of their practices. Advocates of appropriate technology argue that development in LDCs based on imported Western technology, culture and practices is inappropriate because it is not fitted to the specific abilities, strengths and skills of indigenous LDC populations. Their development continues', therefore, to be dependent on first world interests, paternalism and expertise. Yet first world paternalism tends to obstruct as much as foster development because it relies on factors such as low third world labour costs and, as we have seen, is overexploitative of third world environments, so in the long term undermining development.

Appropriate technology, on the other hand, is sensitive to the environment in two related ways. First, it fosters indigenous self-reliance. Local populations should be able to develop without dependence on outside help. Therefore they will bear the effects, environmental or social,, of their choice of technology and will have an interest, in a way that an external unaffected body does not, in pursuing socially and environmentally benign paths of development and technological choice. Second, it is argued that appropriate technology which fits local circumstances and abilities will usually be smaller in scale and less disruptive of localities.

These last few points have taken us from explanatory critiques of industrialism to normative proposals for sustainability. Let me now move on more fully to this concern in the next

chapter. Here I shall discuss environmentalist proposals for the sustainable society and how this may be a relevant area for study and discussion in sociology and the social sciences.

Guide to further reading

There are both advocacies and criticisms of *Limits to Growth* in which the authors have clearly not read the report. Why this is the case confounds me because (for all its flaws) the book is brief, readable and stimulating. The best way to read further is to read the report itself. Some critiques of the report suffer from overdoses of ideological rage. The best critical assessment is Cole et al.'s *Thinking about the Future* (1973) although even here there are moments of misrepresentation and prior ideological antipathy creeps in. The first part of the book deals with technical criticisms and the latter part with ideological assumptions. Especially useful are chapters 1, 2, 9 and Pt II, a readable and mostly level-headed set of discussions. Chapters 5 and 1 of Yearly's *The Green Case* (1991) provide very good introductions to the political and economic dimensions of environmental problems in LDCS. I have found Barkenbus' article (1977) on slowed growth in Pirages's *The Sustainable Society* collection a useful discussion of the implications of lower growth proposals for third world countries. Adams' *Green Development* (1991) provides a more recent survey of the literature. Michael Redclift has written widely on sustainable development from a left-wing point of view, for example in development and the Environmental Crisis (1984) and Sustainable Development (1987). Influential contributions which have inspired followers and critics include the Brundtland Report's globally oriented *Our Common Future* (WCED 1987) and Schumacher's more locally oriented advocacy of intermediate technology in *Small is Beautiful* (1973).