FORMULATING ENVIRONMENTAL AND SOCIAL INDICATORS
FOR SUSTAINABLE DEVELOPMENT

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GENERAL SUMMARY

The programme of the present government includes a commitment to "working towards a new set of indicators of sustainable economic development which will take account of environmental as well as social factors". The central concern is to go beyond existing measures of economic activity produced within the national accounting framework (such as GDP or national income) in order to develop a more complete picture of economic and social progress in Ireland. The present publication provides an overview of the issues and options which arise in connection with this commitment, and suggests steps which might be taken in pursuing it.

The publication is set out in two largely separate essays, one dealing with environmental indicators, the other with social indicators. While it would be desirable to deal with those two topics together, the differences in the intellectual and institutional traditions from which they have developed are such that an integrated approach has not yet emerged. In the final section of the present summary, the recommendations emerging from the two essays are brought together, though they are presented separately in the body of the report.

PART I. Environmental Indicators

There have recently been many calls for the production of environmental indicators and a flurry of activity on developing them. This stems from a concern about the sustainability of the world's stock of environmental assets at the hand of human activity. As with any asset, if environmental assets become depleted or degraded, the future flow of benefits will shrink and could disappear altogether, with serious consequences in some cases. To help them to ward off these sorts of situations people require to be kept informed. To take an example, overfishing is, by definition, unsustainable, but it is less likely to happen if people know that it is occurring. Another provision is that the fishstock be owned or effectively controlled. A feature of many environmental assets is that they are frequently widespread and not owned, so information on them is not automatically gathered and control is not exercised; the earth's atmosphere is perhaps the best example. Inland waters and species of wild animals are further examples of environmental

assets where control may not be easy and information may not be gathered. Nevertheless, these are true assets which bestow real benefits on an undefined number of people. These recurring features of benefits that are widely spread, non-ownership and difficulties of control are the reasons why we require regular information as to whether the assets are being used in a sustainable manner. They are also the reasons why information is difficult to obtain.

The environment has many aspects which are hard to evaluate in monetary terms. Consequently, data must be expressed in physical units, and a huge amount of information can result, difficult for even the expert to assimilate. The attractive idea that such information might be condensed in a few easily-understood indicators leads some people to feel that there should be similar headline measures for the environment as there are for the economy, like national income or consumer prices. In fact, of course, different levels of information are needed for different uses. A single serious incident of a fishkill should be highlighted as at present, but as this may not be representative one will also need to know the overall situation in relation to Ireland's rivers, how they compare with rivers abroad. For similar reasons, work on environmental indicators has progressed at many levels elsewhere.

Three main types of indicator are described on which Ireland might embark. These are:

(a) environmental indicators for individual themes,
(b) environmentally adjusted (or green) national income,
(c) national sustainability indicators,

the ordering being roughly in ascending order of aggregation or monetary measurement. The basic data are usually expressed in physical units and indicators in physical units are receiving most official attention at present. Each of the three sorts is described with many illustrated examples. A summary of each is as follows.

(a) The construction of indicators for individual themes is quite flexible. Their orientation reflects the aims. To divide up the field in a logical way, practitioners have tended to use the pressure-state-response breakdown, where information can usually be categorised as answering the questions "what is the state and trend of the environment", "why", and "what are we doing about it". Of course categorisation is not always unambiguous: area of forestry may indicate "state", but where increase has been rapid or consisted of a single species of tree, the activity could be described as "pressure". Having good indicators, like management information, is not an end in itself; if there are problems, it is important to go behind the data to understand the relationships and to perceive the uncertainties stemming from different degrees of vulnerability of receiving media, and between areas and times. The indicators

are, however, an essential first step. Indicators described include the OECD's core set, Eurostat's Pressure Indices which are still under construction as part of a large programme, Adriaanse's sectoral indicator for agriculture and his theme indicator for acidification in the Netherlands, and finally Pearce's indicator of the sustainability of regional water resources in the UK.

(b) Green national income has been the subject of preliminary estimates in many countries – the word "preliminary" applies because there are still several issues of measurement to be settled. In fact even the system of traditional national accounts, being only fifty years old, is subject to unsettled issues. National income (NNP)[1] is a poor measure of welfare, being merely a measure of economic activity. However, it is one of the few comprehensive measures available, it is comparable between countries thanks to the system overseen by the United Nations and, being net of depreciation or the measure you arrive at "not reducing your productive capacity" to quote Hicks (1946), it is a valid measure of income. Unfortunately national income as currently measured only incorporates depreciation of produced assets, and does not depreciate non-produced natural assets which are non-marketed, and even those which are marketed, like forest and mineral depletion, are not depreciated in the national accounts.

Marketed assets are the first to receive attention in environmentally adjusted national income. Some questions still hang over how depletion is to be valued: one method is to convert the net income from a depleting resource into an equivalent perpetual stream of true (i.e., sustainable) income. Another important adjustment is to incorporate the degradation of environmental assets, such as the eutrophication of rivers or the damage to the ozone layer. It is here that various difficulties arise in obtaining monetary valuations (though a recent example for air pollution is given), such that the United Nations are recommending that countries start by constructing "satellite accounts" which may be expressed in physical units (like quantities of polluting gases released, or area of land damaged). In the Netherlands, a practical extension of the exercise has produced tables showing the changes in output from the main production sectors in the economy, alongside their annual changes in environmental damage. Another adjustment issue relating to measured national income is the treatment of expenditure on remedying and preventing environmental damage caused in the production process. While the manner of this adjustment is not settled, countries are encouraged to record such expenditure according to a standard format.

[1] Net National Product at factor cost, that is GNP less depreciation of produced assets or capital.

(c) National sustainability indicators are related to green national income in that the data requirements are similar. A sustainability indicator is a measure of the change in assets. If the change in assets, measured indirectly by an adjusted savings rate, is positive when averaged over a period of years, then society is on a sustainable path. If negative, society is depleting its assets – if this situation persists, society will not be able to sustain the same level of well-being. The national sustainability indicator is the national savings rate adjusted for depletion and degradation of environmental assets. It is by this indicator that many developing countries, which rely heavily on depletion of natural resources, can be seen to be on an unsustainable path. Their well-being will decline in the future, on the basis of present trends; yet their national income, traditionally measured, would not reveal this – as it has recently been rising. Sustainability indicators are illustrated for Sub-Saharan Africa and the OECD group of countries, and one for the UK.

The data situation in Ireland for the task of preparing environmental indicators is patchy though reasonably good in parts. The Environmental Protection Agency (EPA) is charged by the Environmental Protection Act[2] of 1992 with a statutory obligation to establish and maintain a data base related to environmental quality. The Central Statistics Office (CSO), under the Statistics Act of 1993, has the authority to co-ordinate official statistics compiled by public authorities, to ensure adherence to statistical standards and the use of appropriate classifications. Co-operation between these two bodies therefore is necessary, and may lead to cost savings where their data collection, collation and dissemination activities are related. Furthermore, any green national accounting has to be closely associated with the CSO's traditional national accounting. Attention to the environment would also be strengthened by close association with the central statistics agency, if experience from abroad is an indication.

There is no single type of indicator above all others which should be developed for Ireland, because the different types of indicator have their uses in different fields. As to the choice of themes to be covered, the international work has a wide and varied range of coverage. In fact the themes are fundamentally similar, though grouped under different heads or using different terminology. The Environmental Protection Agency has listed some refinements to the measures used by OECD, in order to reflect Ireland's particular conditions. In addition, soundings from a survey of the public, and from non-governmental organisations (via their conference topics), reveal concerns similar to those of the international agencies, with the addition of survival of the built heritage, which might loosely be termed a social-environmental theme. While work on environmental indicators needs to proceed on all fronts, a few could be highlighted and presented in a way

[2] Government of Ireland (1992).

that most people would understand, covering either aspects of or the entirety of: Eutrophication, Acidification, Toxic Contamination, Urban Quality, Built Heritage, Species Survival and Biodiversity, Depletion of Resources, Global Warming and Ozone Depletion. These indicators would be accompanied by clear explanations.

PART II. Social Indicators

Social indicators seek to go beyond traditional measures of development derived from the national accounts, first, by focusing on *distribution* of economic resources as well as on national aggregates or averages, and secondly by extending measurement to include *non-economic aspects of social life* such as health, literacy, social integration and crime. The task of selecting social indicators to achieve these purposes first requires a set of agreed definitions and priorities so that there is a common understanding of what the goals of development are. Such consensus can be achieved only by negotiation and agreement within a shared framework of values and cultural traditions, and is as much a political as a scientific process. As well as technical assessment of the feasibility, reliability or informativeness of particular social indicators, one should also expect political or ideological debate about their relevance to competing societal preferences or priorities.

Various approaches to social indicators have emerged within the social sciences since the 1960s and 1970s, some of them self-consciously concerned with fundamental questions about the nature of progress and development, others focused more on technical issues of conceptualisation and measurement within a taken-for-granted view of what development means. Examples are the concern with subjective social indicators in the 1970s (based on surveys of attitudes, perceptions and satisfaction levels among samples of individuals), the "capabilities" approach advanced by Sen and his colleagues, the "basic needs" approach and the Human Development Index (HDI) developed by the United Nations Development Programme. All have their limitations as bases on which social indicators for Ireland might be constructed. Some are difficult to operationalise (e.g., the capabilities approach), others were devised with particular reference to poor countries (e.g., the basic needs approach), others were designed to provide global rankings of rich and poor countries rather than sensitive measures of social progress within richer countries (e.g., the HDI), while others have problems of reliability and validity across time and place (e.g., subjective social indicators).

Of the options available internationally, the present report points to the OECD List of Social Indicators as the most useful starting point for the development of a set of social indicators for Ireland. This list contains 33 indicators covering health,

education, employment, quality of working life, free time, leisure, the distribution of income and wealth, housing and physical environment, social environment and personal safety. The list is broadly applicable across developed countries, is reasonably comprehensive and is generally feasible in measurement terms.

In building on the OECD list, questions remain about the social categories across which inequalities on the items on the list should be measured (region, social class, gender and generation are the most obvious options). The possibility of adding items to the list also needs to be considered. Should aspects of family structure be included, such as the marital breakdown rate or the rate of lone parenthood? What about crime? Under the heading "social integration", the OECD list includes one indicator – suicide – but further candidates for consideration could include such things as drug addiction, or degree of neighbourliness.

The availability of data is a major immediate constraint in implementing the OECD list and in adding new items. On many items, existing data sources are adequate, while on others either no data exist or they are collected too infrequently to be of use for present purposes. A comprehensive set of social indicators would therefore require considerable additions to existing data sources.

Recommendations

Environmental Indicators

1. Some indicators for individual environmental themes can be readily produced, and a selection which is representative of the main themes should be presented for widespread public consumption. Detailed indicators would be contained in the environmental data base. (Tables 4.1, 2.1 and Appendix V give preliminary lists, but a complete and regular inventory of data availability and quality should be produced.)
2. Green national income (with satellite accounts) and national sustainability indicators, are worthy of attention. Work abroad should be monitored.
3. Monetary valuation needs to be developed, since policy decisions implicitly use values. Use of non-monetary weights should proceed with care.
4. Co-ordination between the Environmental Protection Agency, the Central Statistics Office and other major providers and users of environmental information needs to be put on a firm basis.

Social indicators

5. Given that the range of options available in deciding on social indicators is so wide, consultative and decision-making mechanisms should be set up to

determine selection. These mechanisms should have a substantial component of technical expertise (drawn from agencies such as the Central Statistics Office) but should also represent as wide a range of social and economic interests in Ireland as possible.

6. The OECD List of Social Indicators should be adopted as the starting point for a scheme of social indicators for Ireland.

Data

7. The quality of the underlying data determines the quality of indicators. While there are many areas where data are good, there are gaps in the information which are priorities to be addressed, such as solid waste, built heritage, species and so on. A new annual Social Indicators Survey should be initiated by the CSO, possibly on the basis of a sub-annualisation of the existing Labour Force Survey.

Chapter 1

INTRODUCTION

The government parties are committed[3] to

> ... working towards a new set of indicators of sustainable economic development which will take account of environmental and social factors. These indicators will be used alongside the existing measures of economic activity such as GDP.

This commitment clearly rests on the belief that existing measures of economic activity such as Gross Domestic Product or national income are inadequate both from an environmental and a social point of view. This publication provides a preliminary review of the conceptual and methodological issues which arise in working towards a more adequate way of quantifying development and summarises the main approaches currently being developed in other countries and institutions. The aim is to set out the main options and to make suggestions as to the steps which might be followed in carrying out the commitment.

In working towards this aim, the first issue we had to consider was the relationship between environmental and social indicators, both in general and in the particular context of the present review. The grouping together of environmental and social factors in the government's policy statement could be taken to imply that these two sets of concerns could be treated together as different dimensions of a single underlying concept of sustainable development. Such an approach would envisage an integrated treatment of environmental and social indicators, aiming towards the attractive prospect of comprehensive quantitative measures of development which would simultaneously encapsulate environmental and social concerns, alongside those issues which are already incorporated into ordinary economic data and standard national accounts. However attractive the integrated approach might be, the reality is that environmental and social concerns about development have emerged from different institutional and intellectual

[3] A government of Renewal (1994).

backgrounds, and have tended to be treated in some isolation from each other. Each dimension has proved to be difficult enough to quantify on its own: the task of bringing them together into a single integrated framework has hardly yet begun. This reality points to a segregated approach to the two strands, perhaps with a view to eventual integration but with no expectation that such integration is immediately at hand. The present publication therefore treats the environmental and social dimensions of development separately, each being dealt with in a more or less self-contained essay. The two essays are summarised together in the General Summary which prefaces this volume, but otherwise they stand apart.

The difference between the environmental and social strands of concern about conventional measures is exemplified in their relation to the notion of "sustainability", which features in the government commitment and in much of the analysis and rhetoric of the relationship between economic growth and the environment. At a sufficient level of generality, sustainability can be defined in a way which encompasses environmental and social concerns. One such definition is that a system is sustainable if it allows the well-being of future generations to be at least as high as that of the present generation. However, in practice the concept of sustainability can be much more readily applied to environmental issues, and a core concern for environmentalists has been that current patterns of economic activity are running down the asset base at a rate which cannot be sustained. Sustainability in this sense is sometimes qualified as being "weak" or "strong". Under strong sustainability, some environmental assets are seen as being essential, like the ozone layer, and not having any close substitutes. Under weak sustainability it is assumed that the items under consideration do ultimately have substitutes, so that the main focus will be on maintaining the aggregate stock of assets. The concept of sustainability as it relates to the environment will be discussed in more detail in Part I, but it would not, in our view, be productive to try to apply any broader notion of "social sustainability" at this point.

Of the two essays which make up this volume, the first or PART I, dealing with environmental aspects (by Sue Scott) is the longer because of recent strongly voiced concerns about the current path of economic development The issue was highlighted by the Brundtland Commission[4] and by the Rio Earth Summit[5] which charged governments with adopting the concept of sustainable development. To do so we need to know whether and where there is, or is likely to be, unsustainable development. As it transpires, there are few calculated indicators which can strictly inform us about the sustainability of a thing or process, and a lot of

[4] World Commission on Environment and Development (1987), *Our Common Future*, Oxford, New York.

[5] The United Nations Conference on Environment and Development (UNCED) (1992).

information is a prerequisite to any assessment of sustainability. This information therefore becomes included in the umbrella term "sustainability indicator". It is apparent that people often use this term to mean some measure of an asset or theme where sustainability is an issue, though the measure itself only very indirectly throws light on whether use of the asset is sustainable. We should not be disturbed by this loose use of the term, though we need to be aware of more rigorous definitions, discussed later.

PART I comprises three chapters. Chapter 2 draws on experience elsewhere to outline the main methodologies and options available, distinguishing environmental indicators for individual themes, Green national accounts, and national sustainability indicators. Chapter 3 describes the Irish situation as regards data and information structures for each of these categories. Chapter 4 suggests a list of themes and sets out recommendations on environmental indicators.

The second essay or PART II, by Brian Nolan and Tony Fahey, turns to social indicators, exploring what these indicators can add to conventional measures and seeking to learn from international experience about how best to improve the information base available for evaluation of Ireland's socio-economic development.

The term "**indicator**" refers to some message which in a succinct way conveys information about an item of significance, or perhaps communicates a trend from a complicated ensemble of data. There seem to be two motivations for producing such indicators. One is that the physical and social environments seem to miss out in the release of regular indicators, like releases on consumer prices, unemployment, GDP, house prices and the like, or else they can be subject to unrepresentative media treatment. The other is that composite indicators have not emerged that draw together all the relevant social and environmental threads to summarise the situation adequately. Both these aims can be criticised - whatever about regular release, there are firm slots in the media, which ensure regular spotlighting of individual problems, and a new composite indicator would in turn suffer the criticisms of all composite indicators, like GDP. The policy analyst who is trying to address a worsening situation highlighted by an indicator would immediately want to see how it was derived[6]; the underlying data are therefore still the most crucial aspect. However the composite indicator might do the alerting. It might also give a sense of balance.[7]

[6] E.g., the consultant to NESC (1975) who examined inflation in Ireland (Paper No. 10) started by checking how the Consumer Price Index measured and weighted the components.

[7] To quote an environmental example, one river might have suffered serious and extensively reported damage, but what is the general condition when you aggregate all our rivers? How do they compare with rivers abroad?

The actual benefits to be derived from the construction of indicators are not easy to assess. The many calls for indicators suggest that there is a demand on the part of policy makers and of the public. The case for social indicators lies in the inadequacy of income measures as measures of welfare, because neither across countries nor over time can one assume that welfare is evolving in line with income per head. The case for environmental indicators lies additionally in the fact that much of the environment is outside the market such that harms can accrue to third parties, unlike in the rest of the economy where the market largely ensures that payment and compensation occur. Consequently indicators for the environment are perhaps more necessary than for the ordinary economy where there is less hidden threat of unsustainability.

Underlying these essays is the reality that, however much of the spectrum of indicators one would wish to assemble, data assembly has a cost. In addition to the sizeable compliance costs incurred by the people who complete questionnaires and provide supporting material, the gathering of statistics, collating, writing up and publication of results is expensive. The annual budget of the Central Statistics Office, for example, amounts to some £10 million. The obligation must therefore be to concentrate initially on the steps which will yield indicators on the basis of data that are already available, while taking stock of developments and further requirements, and seeing how best they can be satisfied.

PART I: ENVIRONMENTAL INDICATORS

S. Scott

Chapter 2

OPTIONS AND METHODOLOGIES

The government commitment quoted at the start of Chapter 1 raises two especially interesting issues which one should aim to address. The first, the issue of "sustainability" has entered the popular domain quite forcibly and, though people may have but a vague idea of what it means, they would profess to be in favour of it. In Ireland, economic discussions of the early 1980s were largely concerned with the problem of sustainable economic development in the face of growing foreign debt, so the idea of sustainability has a familiar ring. It was a similar problem: we were running down our assets and it became clear that we were making things worse for the future if we continued as we were. In one useful definition, a system is said to be sustainable if it allows the well-being of future generations to be a least as high as that of the present generation. There is evident concern that the current path of economic development, with its heavy use of the environment, is affecting the potential for future well-being.

Unsustainability implies that there is a limited supply of something, which is being over-used. Indeed, a major and frequent cause of over-use can be underpricing – correct pricing or regulation may help to address the problem. However one must also be aware that the non-survival of some aspects of the environment may not be a deprivation to future generations. A flourishing smallpox virus, for example, is obviously not a candidate to be sustained (except in a laboratory), but what about, say, the architecture of the 1930s? We are immediately confronted with the issue of the worth of what is being maintained and the many calls on the resources that would be required to maintain it. Sustainability, by invoking the idea that the maintenance of something will bring future well-being, is implying that it has a future worth, which is not always true. Because the item being maintained is frequently outside the market, its present worth, let alone its future worth, can be a subjective matter.

The second issue is "economic development". We know that trends in national income, or national income per head, measured by GDP or NNP, are used as a barometer to represent a country's economic development, though they are but

measures of market transactions. They are used to rank nations, to judge their economic performance and determine international subsidies, dues, or quotas. These measures have always been recognised as wanting in several respects. The phrase "not by bread alone" is a qualification of materialism that is ingrained in our culture, and though most individuals aspire to higher incomes, they would include other things in this income. One proposed definition[8] of true income is that it indicates present and future economic well-being: "income " would be the measure you arrive at "not reducing your productive capacity", an idea which we recognise as embodying today's notion of sustainability. Evidence of the inadequacy of the current measures of income[9] and the increasing calls to incorporate the state of the environment[10] stem from the intensity and more noticeable results of human activity. These have effects which are only sometimes picked up in measured income, and then in limited and haphazard instances. For example, pollution causes illness and renders a person unable to work, or hurts tourism, which indirectly reduce measured income. However there needs to be a much more systematic approach.

The indicators which will now be described in turn are as follows: (a) environmental indicators for individual themes, (b) green national income, which includes the measurement of resource depletion, environmental degradation and restoration (or so-called defensive) expenditure, and (c) national sustainability indicators. We used the term "spectrum" for the choice of indicators, which implies some sort of order. The ordering chosen here is, roughly speaking, ascending order of aggregation or monetary measurement. The more an item is capable of being expressed in monetary terms, the more easily can there be aggregation without resort to other, possibly subjective, weights. Of course, monetary aggregation amounts to using money weights, which can also provoke

[8] Hicks (1946).

[9] "Some have presented the extreme view that there has been no real economic growth at all in the US. economy over the recent past, as the apparent growth in measured product has been eaten away by an increasingly important set of negative growth elements manifested by a massive deterioration in our physical and social environment. ...more police, fire and other protective services, or greater military hardware and personnel, or a larger fleet of garbage removal trucks clearly represents increased output ... but if these expanded flows of product do no more than simply maintain existing 'stocks' of personal security, national security, and ecological purity, it is hard to see where economic welfare has been increased." FT. Juster in the Forward to Nordhaus and Tobin (1972).

[10] E.g., the conference *Taking Nature into Account* organised by The World Wide Fund for Nature, the Club of Rome, the European Parliament and the European Commission "to create a new global momentum for making GDP and related indicators better reflect the costs of our economic policies and practices."

disagreement. Work on both forms of weights is progressing at a pace unthinkable a few years back, and while green-adjusted national income was much discussed in the last ten years and saw big strides in its development, it is indicators expressed in physical terms which are now gaining more attention at official levels.

2.1 Environmental Indicators for Individual Themes

Indicators for individual themes can be constructed at various levels of refinement and can be expressed in physical terms. Not only can fairly simple indicators be very informative, but the basic data required for their construction are usually necessary in their own right. In addition they may form the foundation of future work on possibly more sophisticated indicators.

We shall look at four sets of such indicators currently being produced. The first is the Core Set of Environmental Indicators recently published by the OECD. Secondly we shall describe similar indicators by Jesinghaus of Eurostat, which, though at an earlier stage of development, may form the basis of a system to which Ireland is likely to want to contribute and conform. Thirdly there are the *Indicators of Sustainable Development for Decision-Making Processes*, by Adriaanse, which we will later show to be incorporated in the Netherlands integrated environmental and economic accounts.[11] Fourthly, we will look at some focused national indicators in which the idea of sustainability is more explicit but which still relate to individual themes. A feature that is common to all indicators is that their construction entails first deciding on which themes to cover and how they should be covered.

2.1.1 OECD's Core Set of Environmental Indicators

The OECD categorises indicators for each theme into three broad types, namely pressure, state and response. The distinctions, which by their nature are not always clearcut, are illustrated by OECD in Figure 2.1 below.

The Pressure-State-Response framework is widely used as a way of grouping information on the environment. "Pressures", such as traffic density and waste emissions, are exerted by human activities on the environment. They change its quality and the stock of natural resources, for which the current situation or "state" can be described. In the present context, the "response" is used only for societal (not ecosystem) response, through environmental, economic and sectoral policies. In fact there are many frameworks[12] for the organisation of statistics on the environment and, as with all such multidimensional topics, it is unlikely that the perfect framework can be found. The Pressure-State-Response framework[13] has the advantage that it answers three simple questions: What is the state of the environment and its evolution? This is answered by state indicators. Why is it

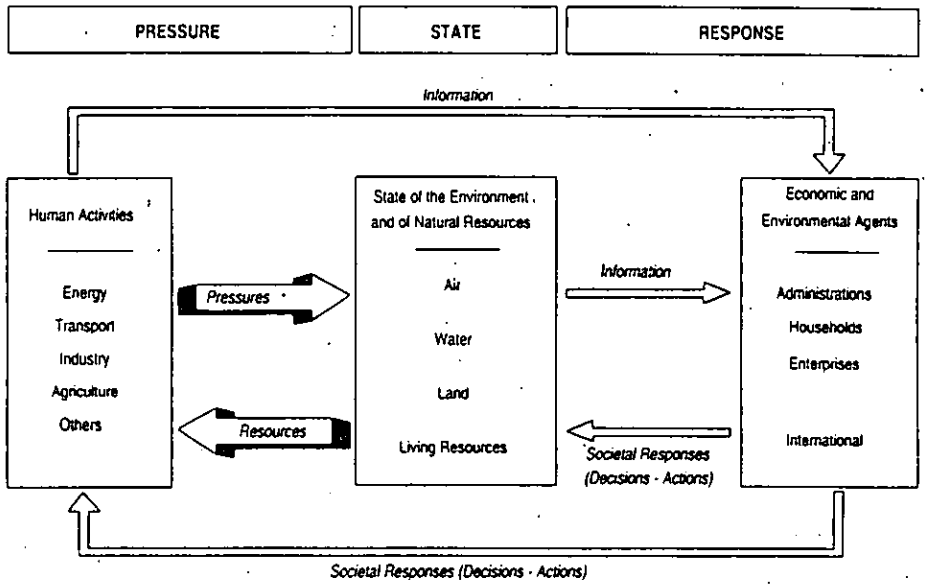
[11] Of de Haan and Keuning (1995).

[12] Some of these are described in Statistics Canada (1991).

[13] Evolving from work by Friend and Rapport 1979.

changing? This is answered by pressure indicators. What are we doing about it? This is answered by response indicators. The ultimate focus of interest is the state of the environment as this is what affects well-being. Pressures *per se*, unless related to the tolerances of the receiving medium, are not so informative. This is because emissions in some circumstances may have a negligible effect and in others the effect could be highly detrimental. However, it is to the pressures[14] that policy is usually applied and in any case the pressures are often more easily measured. For example, the emission by Ireland of ozone-degrading gases can be estimated more simply than the present thickness of the ozone layer and its likely thinning as already-released gases have their effect.

Figure 2.1. *The Pressure-State-Response Framework*



Source: Figure 1a OECD page 11.

The themes and frameworks under consideration by the United Nations Environment Programme and by the World Bank are shown in Appendix I. As summarised in a recent[15] report published by the World Resources Institute, material and data to construct indicators are usually most available for pressure

[14] It appears that Eurostat concentrates more on pressure indices whereas the European Environment Agency lays more emphasis on information relating to the state of the environment.

[15] By Hammond *et al.* (1995).

indicators and sparsest for response indicators. Indeed the selection of response indicators could also be better focused: basing response indicators more closely on the policy instruments available to society could be more informative. These policy instruments, which public authorities can avail of, mainly include:

- information and education to affect attitudes and behaviour (indicators could show, for example, trends in knowledge that there is a link between energy use and greenhouse gas release, or knowledge of where to deposit recyclables, CFC containers *et cetera*);
- economic instruments and correct incentives (e.g., applying the Polluter Pays Principle in higher taxes on leaded petrol, charging for waste collection);
- regulation, including enforcement measures, and extent and results of monitoring;
- direct government action (e.g., government construction of waste water treatment plant).

Such information on response might be more relevant than "% of NNP spent on vaccination" or "protocol signatory".

The themes and framework chosen by OECD are as follows. The first nine can be classified as "sink-orientated", whereas the others are "source orientated".

Climate change
Ozone layer depletion
Eutrophication
Acidification[16]
Toxic contamination
Urban environmental quality
Biodiversity
Landscapes
Waste
Water resources
Forest resources
Fish resources
Soil degradation (desertification and erosion)

General indicators (e.g., population growth or economy-wide environmental expenditure)

The OECD is not at present involved in producing aggregated indicators. They state that interest in sustainable development has stimulated governments to

[16] Emissions of sulphur and nitrogen compounds are transformed in the atmosphere into acidifying substances such as sulphuric and nitric acid. On reaching the ground as particles, rain, fog or snow, acidification of soil and water arises, which may lead to damage to forests, aquatic plant and animal life, human health, buildings and monuments. Definition derived from OECD (1994).

re-examine their capacity to assess and monitor the state of the environment and detect changing conditions and trends. They emphasise that indicators should be viewed as but one tool for evaluations, and need to be supplemented by other qualitative and scientific information in order to avoid misinterpretation. They also advise caution when making inter-country comparisons, though their aim is standardisation. Great variation in measurability between individual indicators is noted, some being immediately measurable, others need additional effort before they can be presented, and a third group will only be measurable in the long term, due to absence of data. So they have concentrated on the immediately measurable indicators. Furthermore the indicators are likely to change as knowledge and perception of environmental problems evolve. The varying relevance and different contexts, depending on the country, are emphasised.

A summary of OECD indicators by environmental issue is given in Table 2.1 below, with symbols S, M, L to denote that the information is available in the short, medium and long term respectively. Main indicators are pointed out by a double asterisk. Indicators already available and published are printed in italics.

Information for many OECD countries is published in the document, including for Ireland in most cases. Information for Ireland is supplied (mainly by the Department of the Environment) in the form of time series as well as in formats which facilitate comparison between countries. It is usefully emphasised that individual countries will have different circumstances and therefore different tolerances. Each environmental issue is briefly explained and the measurements are clarified, technical annexes giving more detail. Their category of "indicators of societal responses" would be incomplete without information on whether societies were making progress towards rectifying the undercharging of environmental damage – a major cause of environmental problems in the first place. In fact, the differential in tax rates on leaded versus unleaded petrol is illustrated, and water and waste water charges will also be listed in the medium term, which additions go some way to addressing this criticism. The strength of the OECD approach is that the information is, or should be, readily available, as a result of monitoring processes and the like. It is also of such a fundamental nature that it is required in any case, for policy decisions at various levels and, importantly, owing to the limited amount of weighting required, it is largely uncontentious.

The OECD also incorporates the core indicators into the environmental performance reviews which are being conducted for member states. An example for Iceland is given in Figure 2.2 below.

Table 2.1: *Summary of OECD Indicators by Environmental Issue*

Issues	PRESSURE Indicators of environmental pressures		STATE Indicators of environmental conditions		RESPONSE Indicators of societal responses	
Climate change	• Index of greenhouse gas emissions ** • *CO2 emissions*	M S	• *Atmospheric concentrations of greenhouse gases* ** • Global mean temperature **	S S	• Energy efficiency ** • *Energy intensity* • Economic and fiscal instruments	M/L S M
Ozone layer depletion	• Index of apparent consumption of ozone depleting substances ** • *Apparent consumption of CFCs and halons*	M S/M	• *Atmospheric concentrations of ozone depleting substances* ** • Ground level UV-B radiation **	S/M M	• CFC recovery rate **	M
Eutrophication	• Emissions of N and P in water and soil (–> nutrient balance) ** • *N from fertilizer use and from livestock* • P from fertilizer use and from livestock	L S S	• *BOD/DO, concentration of N and P in inland waters* ** and in marine waters **	S/M M/L	• % of population connected to biological and/or chemical sewage treatment plants ** • *% of population connected to sewage treatment plants* • User charges for waste water treatment • Market share of phosphate-free detergents	M/L S M S/M
Acidification	• Index of acidifying substances ** • *Emissions of NOx and SOx*	M/L S	• Exceedance of critical loads of pH in water and soil ** • *Concentrations in acid precipitation*	M/L S	• % of car fleet equipped with catalytic converters ** • Capacity of SOx and NOx abatement equipment of stationary sources **	S/M M/L
Toxic contamination	• Emissions of heavy metals ** • Emissions of organic compounds ** • *Consumption of pesticides*	M/L L S/M	• Concentration of heavy metals and organic compounds in env. media and in living species ** • *Concentration of heavy metals in rivers*	L S/M	• Changes of toxic contents in products production and processes ** • *Market share of unleaded petrol*	L S
Urban environmental quality	• Urban air emissions: SOx, NOx, VOC ** • *Traffic density* – urban – *national* • Degree of urbanisation	M/L M S S/M	• Population exposure to: – air pollution ** – noise ** • Ambient water conditions in urban areas **	L M M/L	• Green space ** • Economic, fiscal and regulatory instruments ** • Water treatment and noise abatement expenditures	M/L M S/M
Biodiversity / landscape	• Habitat alteration and land conversion from natural state **	L	• *Threatened or extinct species as a share of total species known* **	S	• *Protected areas as % of national territory* ** and by type of ecosystem **	S L
Waste	• *Waste generation:*** – *municipal* – *industrial* – *nuclear* – *hazardous*	 S S S S/M	Not applicable		• Waste minimisation ** • *Recycling rate* • Economic and fiscal instruments, expenditures	L S/M M
Water resources	• *Intensity of use of water resources* **	S	• Frequency, duration and extent of water shortages **	M/L	• Water prices and user charges for sewage treatment **	M
Forest resources	• *Actual harvest/productive capacity* **	M	• Area, volume and structure of forests **	S/M	• Forest area management and protection **	M/L
Fish resources	• *Fish catches* **	S	• Size of spawning stocks **	M	• Regulation of stocks (quotas)	M
Soil degradation (desertification & erosion)	• Erosion risks: potential and actual land use for agriculture ** • *Change in land use*	L S	• Degree of top soil losses **	M/L	• Rehabilitated areas **	M/L
General indicators, not attributable to specific issues	• *Population growth & density* ** • *Growth of GDP*** • *Private final consumption expenditure* ** • *Industrial production* ** • *Structure of energy supply* ** • *Road traffic volumes* ** • *Stock of road vehicles*** • *Agricultural production* **	S S S S S S S S	Not applicable		• Environmental expenditures** • *Pollution control and abatement expenditure* • Public opinion **	M/L S/M S

Source: Environmental Indicators, OECD Core Set, p14-15, OECD (1994a)

** Main indicators. *Italics:* Indicators which are published.

S: short term, M: medium term, L: long term availability.

Figure 2.2: *Example for Iceland of Core Indicators in Environmental Performance Reviews (OECD 1994).*

Air pollution

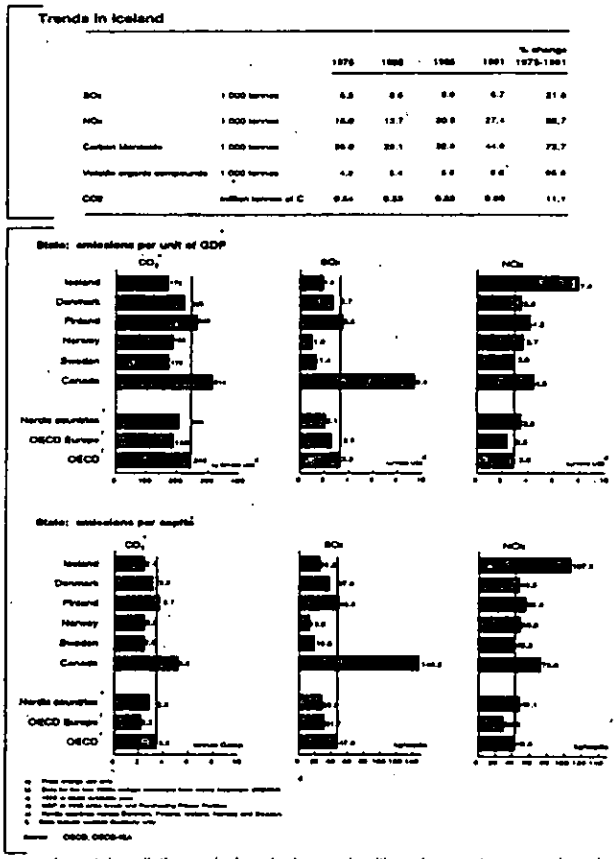
Although Iceland's per capita consumption of energy is high and is higher than that of any other OECD country, its unusually high proportion of hydro and geothermal energy contributes substantially to maintaining pollution at low levels. Total primary energy supply (TPES) per unit of GDP in 1990 was 84 per cent above the OECD average and 69 per cent above the average for the other Nordic countries. TPES per capita was 71 per cent greater than the OECD average and 57 per cent higher than the average for other Nordic countries. The Icelandic authorities successfully reduced oil consumption through substitution of renewable resources. Electricity generation is generated almost exclusively from hydropower and geothermal energy contributes a high share of space heating.

Context and supplementary information

Country-specific indicators and data

Core indicator

Assessment



The implications of these increases in certain pollution emissions for human health and ecosystems may be minor due to the assimilative capacity of the environment. For example, in spite of the sharp expansion in NOx emissions, the level of depositions is at least three times lower than in any European country. Thus, the Icelandic authorities have drawn special attention to the need to consider pollution concentrations and ambient levels in implementing international commitments.

Source: Box 1, p. 4, OECD Environmental Indicators, Overview of Work Programme and Publications, November, 1994.

Naturally there are many other bodies constructing environmental indicators of their own, for instance in Canada and the UK. It is interesting to scan their lists of themes and to note how they reflect the existence of special assets or problems in each region. This is a good feature for the selection of indicators to have.

2.1.2 Eurostat Physical Indicators: Pressure Indices

The issue of weighting systems is given considerable thought in Eurostat discussions of indicators (Jesinghaus, 1995). The three valid possibilities are described and total reliance on any particular one is not suggested, the three being monetisation, experts' assessments and compliance with official/popular policy goals. Monetisation includes use of such methods as evaluating people's willingness to pay or willingness to accept, and market prices, such as house price changes and travel cost approaches (as used for green national income). The criticism levelled against these methods is that they are dependent on income levels and on how well-informed people are. Also, for example, it is stated that individuals' willingness to accept yields systematically three times the value of willingness to pay. Secondly, expert assessments are suited to where the issue is technical, such as the relative importance of NO_x versus SO_2 to atmospheric quality. There can be reasonable agreement, even when the experts come from different sectors of society. The weights in the Pressure Indices would measure urgency or need for political intervention. The third weighting scheme, is public opinion polls, where the weights are based on the notion of concern, "much concern", "little concern", etc.

The plan of action in the Pressure Indices Project, to be implemented in close collaboration with the national statistics offices, the European Environment Agency and other official data providers, consists of ten sub-projects for each of the following ten themes, chosen because they are considered to be problem areas.

Climate change
Ozone layer depletion
Loss of biodiversity
Resource depletion
Dissipation of toxics
Waste
Air pollution and acidification
Marine Environment and coastal zones
Water pollution and water resources
Urban problems, noise and odours

These problem areas are also close to the seven themes of *Towards Sustainability*, Europe's 5th Environmental Action Programme,[17] but the main criterion was the perceived need for action, especially by central institutions. An

[17] Commission of the European Communities (1992).

ambitious hierarchical organisation of tasks is proposed for each problem area, with a specialised environmental institute co-ordinating work on each and co-operating with partners in a national statistics office, a national environmental agency, a national environmental ministry, the European Environment Agency and its relevant topic centre, the section of the European Commission most relevant to the field and the European Joint Research Centre (ISPRA). Contributions from peer groups, groups of scientific advisers and the like will be sought in a formal structure of work. To construct the pressure index for any given theme, use of weights which are acceptable to the scientific community and to the general public is proposed, via an Expert Topic Assessment System (or EXTASY as it is named) consisting of a group of experts which decides on weights.

The final output will be published as a Pressure Indices Handbook, with a chapter for each problem area and arrangements will be made for the annual calculation of pressure indices, based on official data. The timescale envisaged for the project is two years, excluding the time for implementation of tasks by institutions providing data and by parties to agreement.

2.1.3 Adriaanse's Indicators for the Netherlands

During preparation in 1987 of the National Environmental Policy Plan (NEPP) it became clear that some information mechanism was needed to assess the overall situation for the main environmental topics in the Plan and to help with the follow up later. Attention was given to considering who the users would be and what they would want. It was envisaged that the main users would be Members of Parliament and decision makers, so that the indicators should be policy-oriented and annual, and published with the government budget proposals. There was also concern that interrelations (between air, water and soil for example) should not be overlooked in policy, and that the policy process integrate the fields: economy, energy, transport, agriculture and the like. The themes were chosen to be manageable segments as follows:

1 change of climate
2 acidification of the environment
3 eutrophication of the environment
4 dispersion of toxic substances
5 disposal of toxic waste
6 disturbance of local environments
7 dehydration of soils
8 squandering of resources

The main economic sectors which were seen as target groups of environmental policy were agriculture, the transport sector, industry, the energy sector, refineries, the waste removal sector, the construction industry, consumers and the retail trade. In addition, a regional approach was laid down because of the way in which areas

differ. Furthermore, given that in the Plan, policy targets were mandated to act as norms, it was deemed that indicators be developed which would enable an evaluation in relation to the norms.

Indicators were distinguished under the three headings we saw before, which Adriaanse (1996) describes as:

- **Pressure** or stress on the environment. These would cover certain flows, such as emissions, materials depletion, and interventions such as infrastructural activities.
- **State** or quality of the environment, probably at a point in time.
- **Response** in terms of the quality of the environment to measures taken by human action to improve the environment.

It is noted that "response" here is not just societal response, as in OECD's indicators. There would be a relationship between a reduction in pressure and response, after a time lag, though in areas like ozone depletion the lag may be decades and the effect of one country undiscernible. The success of government policy on ozone would in fact need to be judged by the decline, or otherwise, in the pressure index of emissions.

Important steps in the construction of each indicator are, first, the selection of the main contributing compounds. Next, the evaluation unit in which the compound will be measured has to be decided. The choice will often comprise emissions, depositions or effects. Thirdly, the compounds need to be aggregated to give one final indicator for each theme. Within each theme, weights are required to transform emissions measured in physical units into contributions in "theme equivalents", based on available scientific evidence.

The contribution of each economic sector to each theme was also calculated. In most cases, however, the sector would tend to affect about three themes mainly. The weight for each theme was based on the distance-to-target principle, thereby making the validity of the sector's indicator dependent on the validity of the targets set for each theme. Some people[18] might hesitate to use this approach on the grounds that targets should not be an input to the evaluation process and should perhaps be shown separately as in Figure 2.3(b). There are two ways to set targets which are considered feasible. One is to set the target at a "no change" level, which in some cases would be akin to the principle of strong sustainability. The second is simply the target set by politicians, which, of course, could be subject to the usual influences. Further weighting is undertaken to obtain, after scaling, an overall environmental pressure index for the sector. An emission factor can also be derived from simply dividing the environmental pressure by the sector's output, such that it indicates the trend of environmental pressure per unit of economic output.

[18] E.g., Scherp (1994).

The results are communicated in numbers as well as in graphs. The first part of the graph below, Figure 2.3(a), shows time series for the agriculture sector of economic performance along with environmental performance. We will see that the annual volume changes in each sector's contribution to each theme will be incorporated in Table 2.7, in the section below on integrated accounts. The system could probably be expanded to include some social indicators, in like manner. The system does not in fact tell us how serious is the damage, or the relative seriousness of different aspects.

However, for some themes, to the extent that the scientific issues have been settled, it is possible to construct useful indicators. Figure 2.3(b) shows an indicator of acidification in the Netherlands, in which the three main acidic substances, sulphur dioxide, nitrogen oxides and ammonia are converted into acidification equivalents per hectare per year. The targets and "sustainability level" are also illustrated on the chart. Different countries will have different levels of vulnerability with regard to acidification. For these indicators to be accepted it is important that the weights or conversion factors be uncontentious and that local or national levels of vulnerability be agreed.

2.1.4 Other Indicators for Individual Themes

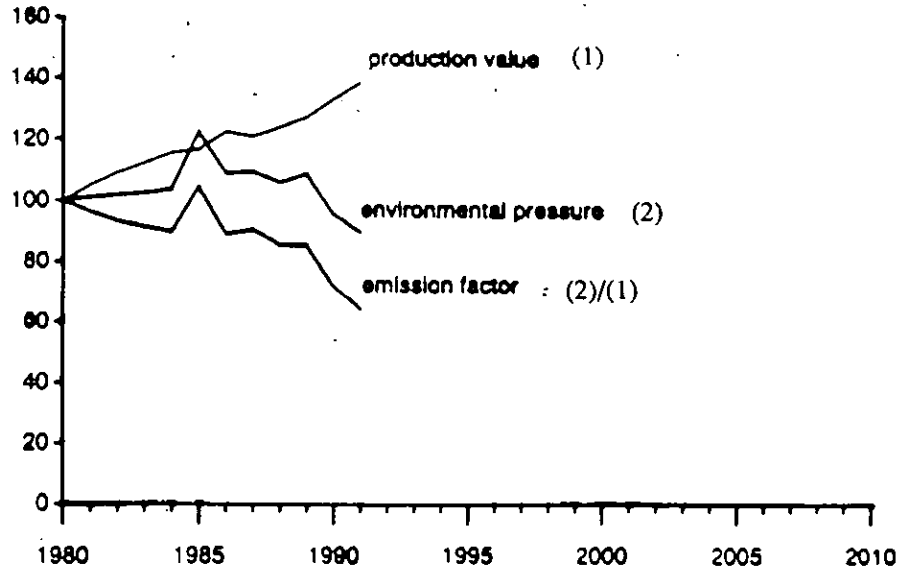
Other indicators would tend to be constructed for specific themes, such as fisheries, wetlands and the like. It is especially appropriate that countries work on these where an asset does not have close substitutes, that is, where strong sustainability might apply. An example will be given for water, by Pearce (1993).

The quantity of water that is available for use in any period is equal to precipitation minus evapotranspiration (this remainder is called effective runoff), plus any stocks of water held on the surface or underground. In the absence of international trade in water, the sustainability rule that we should not reduce stocks becomes: water demand should be met out of effective runoff only. It is sustainable in the sense that it does not rely on any finite stocks for support. Figures can be compiled which take account of the annual resource input each year and the annual net demand, giving average surplus for an average year and for a drought year, as shown in Table 2.2 below.

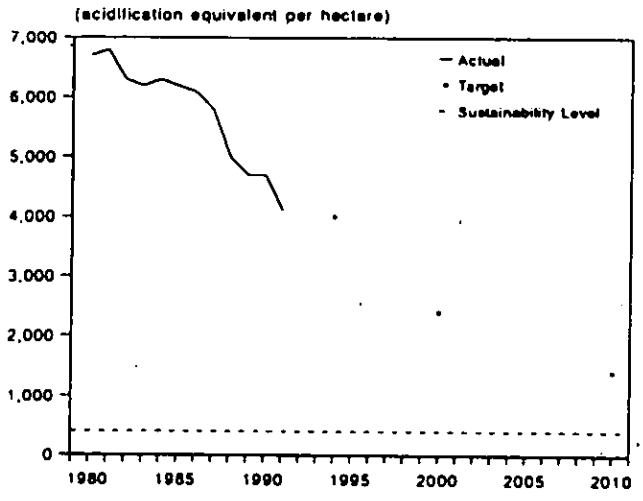
The figures in the table show how close to, or far from, sustainability is the situation in each region in 1990. Resort to some of the stocks of water could have long-term quality effects on the stocks, reducing the levels in lakes or rivers for example, though in some circumstances this will be justifiable if the users are willing to pay the full costs they impose. Temporary importation can also be arranged, as by Yorkshire in the dry summer of 1995. Table 2.2 does not actually indicate that this would have been necessary, which illustrates the margins of error which can occur after five years. This indicator is not suggesting a policy prescription, it is an information aid.

Figure 2.3: *Two Examples of Adriaanse's Indicators for the Netherlands*

(a) Economic and Environmental Performance of Agriculture



(b) Acidification Indicator



Source: (a) Adriaanse (1996) page 17 Figure 5, (b) Hammond, *et al.* (1995) p. 19 Figure 8.

Table 2.2: *Regional Water Resources and Demands in the UK in 1990 (Ml/day)*

Regions	*Surplus in an Average Year*	*Surplus in a Drought Year*
Anglian	7,640	1,253
Northumbrian	7,529	2,977
North West	22,455	12,387
Severn Trent	14,956	5,940
Southern	5,344	1,135
South West	17,345	8,894
Thames	4,946	-279
Welsh	34,537	19,285
Wessex	7,296	3,056
Yorkshire	10,190	3,260
ENGLAND AND WALES	132,238	57,908

Source: Derived from Pearce (1993).

This example of focused indicators for themes of interest illustrates how flexibly the idea of sustainability can be interpreted. The use of water resources in the Thames region may not be sustainable. In general terms, over-abstraction does not just reduce future supply, but can also cause losses of amenity, wildlife habitat, recreational possibilities and the like. However substitution of water supplies can take place up to an extent, by importing from other regions which have a surplus, again assuming that the inhabitants of the importing region are willing to pay the infrastructural and other costs. In fact in some cases one suspects that users might not be willing to pay.

Turning to the quality aspect of water, the sustainability rule that current users should not impose costs on future users would imply that water quality should be non-declining over time (Dubourg, 1992). Therefore where effluent levels exceed critical loads causing declining quality, water quality needs to be improved. From the indicators (not shown here) which show reductions in quality in the UK, it is considered that the quality dimension of the water stock is hardly being used in a sustainable manner in the sense that quality decline is a reduction of the asset. Whether this warrants action is a different matter, but at least the situation is brought to light.

Strong sustainability in the case of depletable resources, such as fossil fuels, would require checking that replacement assets kept pace with extraction. The assumption is that energy as a whole has no substitute. In practical terms, the

indicator would need to measure to what extent a portion of the net price or "rent" was being reinvested on fuel replacement assets, such as renewable energy. This amount would be analogous to the "user cost" discussed under "depletion" in the next section on green national income, but instead of being like a mere depreciation measure, it would be earmarked for spending on renewables.[19] This does not mean that the extraction agency has to invest in renewables, but that this matching investment is occurring within the state. In this way the strong sustainability assumption is applied, that energy assets *per se* must be maintained.

2.2 Green National Income

Measurement of green national income, that is income which is adjusted to take environmental considerations into account, is still in the early stages. In fact, measurement of *traditional* national income[20] has only recently celebrated its 50th birthday. The USA produced the first National Accounts in 1942 and Ireland produced its first National Accounts in 1946 (Stationery Office). The Central Statistics Office publishes the official accounts. The ESRI and the Central Bank publish quarterly forecasts, which are widely reported. These figures in fact merely measure the level of economic activity, which in turn is only *indirectly* related to human welfare. They are recognised as being a weak measure of welfare, but they exist and they are fairly comparable across countries. The method of compiling the National Accounts currently follows the procedures spelt out by the UN in their manual of 1968, which was updated in 1993.

[19] The question of whether the investment is worthwhile ought to be posed, though it is not posed in the case of investment in produced capital.

[20] National income is officially called Net National Product, or NNP, at factor cost. Other frequently reported traditional measures are Gross National Product (denoted GNP and in Ireland about 14 per cent higher than NNP) and Gross Domestic Product (denoted GDP and about 32 per cent higher than NNP). NNP is equal to GNP less depreciation of assets. In turn, GNP equals GDP less net factor flows to the rest of the world, such as profit outflows and national debt interest. The table below for 1993 (in £ billion) illustrates the relationships between various measures of Product at factor cost. The figures are reported in Tables 1 and 2 of *National Income and Expenditure 1994*, an annual publication of the Central Statistics Office.

	Gross	Less Depreciation	Net
Domestic	GDP: 29.0	3.1	NDP: 25.9
less factor flows	4.0		4.0
National	GNP: 25.0	3.1	NNP: 21.9
			National Income

It is worth noting that there is a consistent conceptual framework for national income, beyond the accounting framework in which the measurement sits. The aim of policy should be to maximise the well-being of society, not just over the next few years but over an infinite timespan. When theoretical models of the economy are constructed to do this for a simple economy and without consideration of environmental externalities and other important welfare aspects, the results show that NNP is indeed what a planner would choose to maximise.[21] If the goal is to confer the most well-being to society over the long term, you should aim to maximise consumption plus investment, that is NNP.

NNP only has an adjustment for depreciation of produced capital. The next step therefore is to adjust the framework,[22] to take account of the environment. There are three major flaws in the traditional measure of national income and these would need to be addressed in order to create green measures. These flaws are as follows:

(i) Traditional National Income ignores the depletion of natural assets. Produced assets, on the other hand, such as buildings and equipment are "used up" over their lifetimes and their depreciation *is* entered as a minus figure in the calculation of National Income. Natural resource assets are not so valued: "A country could exhaust its mineral resources, cut down its forests, erode its soils, pollute its aquifers, and hunt its wildlife and fisheries to extinction without affecting its measured national income", to quote Repetto's famous statement (1992). He adds that "It is a bitter irony that the low-income countries most dependent on natural resources for employment, revenues, and foreign exchange earnings are instructed to use a system for national accounting and macroeconomic analysis that almost completely ignores their principal assets." So this loss of capital, as natural resources are used beyond their capacity to recover, probably as a

[21] Weitzman (1976) showed that net national product is equal to that constant level of product the present value of which equals the present value of consumption along an efficient path for a competitive economy.

[22] The theoretical models are called Optimal Control Models. An example, which does incorporate environmental externalities, might be to maximise $\int_0^\infty U(C,B)e^{-rt}dt$, that is, the present value of utility, which is a function of traditional consumption, C, and the benefits of the environment, B, subject to technical economic and environmental constraints, to deal with cumulative effects of pollution, etc. The resulting measure of economic welfare consists of the traditional sum of consumption and investment, less emissions valued at marginal social costs plus the level of environmental services valued by consumers. It is the definitions of the correct and consistent specifications of how environmental items should be valued, namely the shadow prices, that are important features of this ongoing work.

result of being under-priced, is not recorded in national income and investment accounts.

(ii) Traditional National Income ignores the negative impact on welfare of environmental damage which has not been put right. This damage can be very difficult to measure. In some cases one would need to avoid double counting if the damage has been remedied. The deterioration in river quality owing to agricultural effluent, or to take a less tangible example, the replacement of moss, heather and lichen by mud on the hills in the West of Ireland as a result of overgrazing by sheep: these would not feature as minuses in the traditional national accounts. We know, however, that people are concerned about them. In a recent survey, a majority said that they were "very concerned" about the general appearance of their area, and water pollution was the highest first-mentioned and second-mentioned problems of concern (Murphy, *et al.*, 1994). Environmental damage also has the potential for reducing future welfare, by reducing economic activity through its asset degradation effect, just described.

(iii) Traditional National Income could be overstated by final expenditures by households and Governments which merely remedy the environmental damage of the production process. These so-called "defensive" expenditures should perhaps not be counted as output, but simply as production costs, like repairing machinery or buying insurance cover. At present if, say, government or households have to spend money on countering the asthma suffered by people living alongside a lorry route, this expenditure on health adds to National Income, while in fact the expenditure has arguably merely restored the inhabitants to their original level of well-being. National Income perhaps should not rise. The misallocation to output rather than to costs would not arise if the enterprise or producer carried out the remedial work, incurring current costs as part of the production process.[23] That said, the producer would have to raise the value of output to cover the extra costs, so that the net effect on measured national income could be immaterial. Another argument[24] proposes that if we want our green national income to represent welfare, it should include a measure of the value of the quality of, or of the services provided by, the environment, net of defensive expenditures by households and government. If one knew; somehow, that

[23] This has not always occurred: we need only remind ourselves of unrehabilitated mine sites – which owe something to the fact that the tax code for mining does not treat end-of-life remedial work like other costs for tax purposes – an example of faulty incentives. Regulations on rehabilitation are in place now.

[24] By Hamilton and Atkinson (1995) p. 5 and footnote 3.

the welfare derived from the environment had not changed, it might be theoretically feasible merely to subtract defensive expenditures. In any event, measurement of defensive expenditures can sometimes be difficult to isolate, if they form a part of the upgraded features in some process, say.

We know that these are the problems. The question, which is not yet fully answered, is how should one make the alterations which are in fact correct. Returning to the optimising models, it is but a small step to add environmental constraints into the traditional framework and work on this is proceeding. The incorporation of resource depletion,[25] that is the theoretical approach and practicalities for adjusting the national accounts for the discovery, depletion and growth of commercial natural resources is considered to be settled, though there are some outstanding issues discussed below. With the high dependence of developing economies on natural resources, the adjustment will be noticeable there. The incorporation of environmental degradation is also advancing, in particular in relation to pollution with cumulative effects, multiple pollutants and abatement costs.[26] The importance of these exercises is that they indicate the way that valuation should be aimed at, when it comes to the practical task.

Having reported on the substance of the theoretical developments, we can summarise the practical guidelines emanating from the UN's recent work. The UN was involved with the early National Accounts guidelines, the handbook used until recently being dated 1968. Along with the Commission of the European Communities, the International Monetary Fund, the Organisation for Economic Co-operation and Development and the World Bank, the UN have published *System of National Accounts 1993* (or SNA 1993). In the comprehensive list of suggestions are recommendations for the inclusion of, for example, degradation of land, water resources and other natural assets from economic activity, including damage to land from improper agricultural practices, etc., which may deal with some problems pertinent to Ireland's case. The general thrust of the recommendations is, however, that any new approaches should be incorporated, not into the existing core System of National Accounts, as the loss of continuity would be a distinct loss, but as "satellite accounts".

2.2.1 Satellite Accounts Integrated into the National Accounts Framework

The next few pages give a simplified overview of the approach[27] to satellite accounts which is suggested in *System of National Accounts 1993*. The aim of this section is to provide a summary of what "integration in the national accounts" means to readers who do not wish to be distracted by detail, but at the same time

[25] For example, by Hamilton (1994) and the World Bank (1995).

[26] By Hamilton and Atkinson (1995).

[27] This overview of satellite accounts in SNA 1993 is based on McGilvray (1996).

wish to be conversant with the basic procedures and with the calculation of green national income. Without losing the thread of the discussion, however, readers can skip to sub-section 2.2.2 which follows, with examples of integrated national accounts, and then proceed to the discussion of national sustainability indicators. It is worth noting that a link between green national income and national sustainability indicators is that they both incorporate a measure of depletion and degradation of natural assets. While green national income is a measure of well-being, national sustainability indicators show the rise or fall in assets. A decline in assets will reduce future well-being.

The authors of SNA 1993 state that their work should be considered as state of the art, which may evolve as a result of continuing discussions. Being satellites, the environmental accounts can be separate from the SNA, but they are integrated in so far as they fit logically within the SNA framework and, in particular, add to stocks and flows arising from the interaction between the economy and the environment.

Table 2.3 below is reproduced from SNA 1993. The shaded parts of the table are meant to represent the traditional national accounts, though in fact the first row and last three rows are absent from Ireland's national accounts. We can orient ourselves by noting that existing Net Domestic Product is in the cell marked NDP at the start of row v. Along the remainder of that row are the components of NDP, when it is measured by the expenditure method, that is exports minus imports plus final consumption (by consumers and by government) and net investment.[28] Also, part of existing SNA, is row i under the heading Assets, which records the year's opening stock of Produced or man-made and of Non-produced or natural assets (minerals, cultivated forests etc.).[29] Row ii gives total supply, namely production P and imports M. Row iii shows how supply is used: as intermediate consumption Ci, for further production, as exports X, final consumption C or gross investment Ig. Turning to the columns of the existing SNA, the first column shows how product P is the sum of intermediate consumption Ci, depreciation or the consumption of fixed produced capital CFC, and value added which is NDP. Note

[28] As well as being recorded in the Central Statistics Office's *National Income and Expenditure*, it is basically this row which forms a central part of the forecasts regularly published in the *Central Bank Bulletin* and in the *Quarterly Economic Commentary* of The Economic and Social Research Institute.

[29] In practice, not even the Produced assets part, row i (and rows ix to xi) has been widely estimated. Tables giving stocks are scarce though the situation is improving. Figures of stocks of produced assets, that is column 4 of row i, are currently being estimated for 5 European countries, according to Eurostat, which hopes to publish the stock tables in 1996. The countries are France, Germany, Italy, the Netherlands and Belgium. Other countries are being encouraged to produce their own stock tables while estimates are being calculated for them with their co-operation.

that NDP + CFC would equal GDP. Netting out consumption of fixed capital CFC to get NDP is simply following the concept of income which Hicks defined in 1946: correctly measured income is that income which is in excess of asset consumption, however the assets consumed in this case are only man-made assets. In column 4, consumption of fixed capital appears as a negative item and, after subtraction from gross investment Ig, we are left with net investment I.

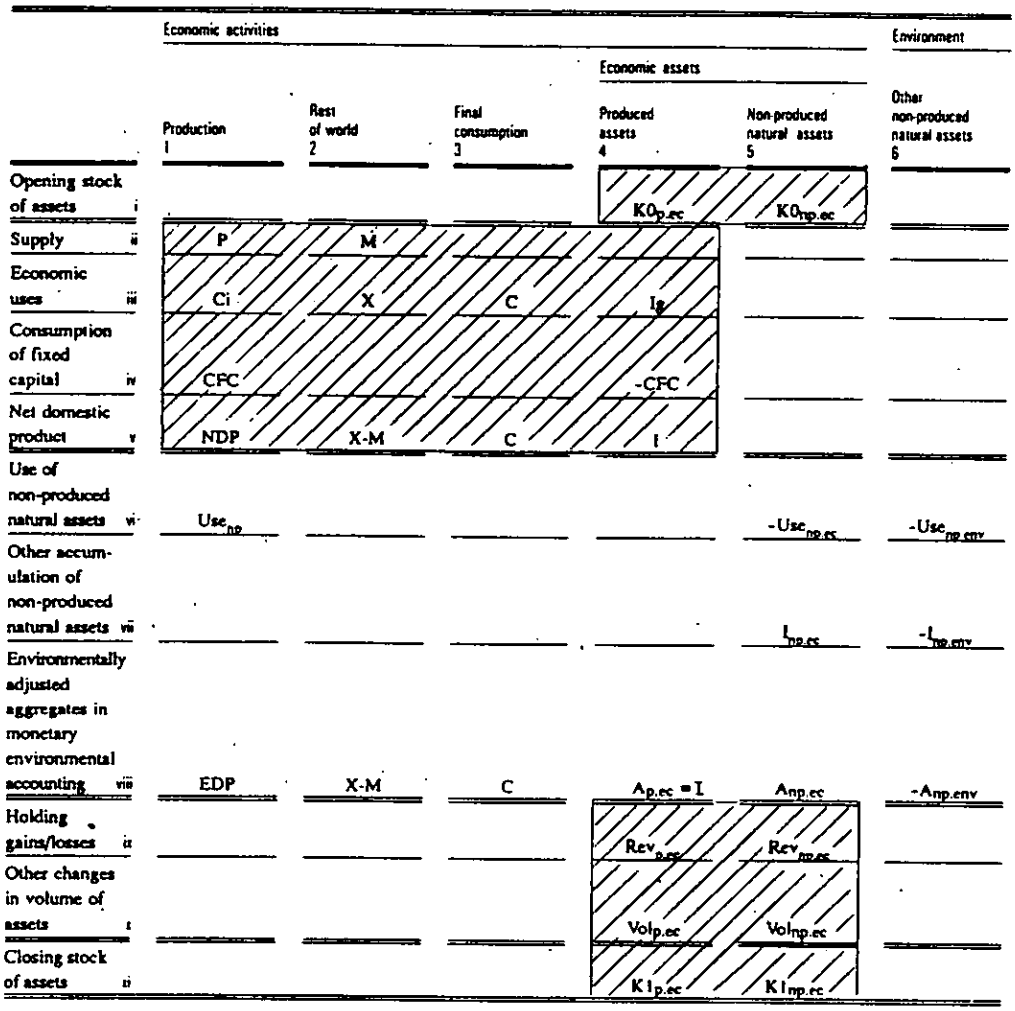
Proceeding down the table but focusing still on the existing SNA, rows ix and x include various other adjustments to the stock of produced and non-produced assets. Row ix is revaluation of assets and row x is volume changes, such as destruction due to natural disaster and other changes affecting stock levels. For produced economic assets column 4, opening stocks row i plus net investment row v, plus or minus revaluation and volume adjustments of rows ix and x, give closing stocks row xi. Turning to environmental assets, for non-produced economic assets, column 5 has no investment item, changes in known economic reserves entering in row x, that is, they feature outside the calculation of consumption of fixed capital or of national income.

Entries in the unshaded parts of the table indicate where satellite environmental accounts can be inserted or constructed apart, in physical or monetary units – if in monetary units they can be used to obtain green national income or environmentally adjusted domestic product, or EDP, at the start of row viii.

We will now describe how EDP is obtained with the addition of entries in the unshaded cells of the table. The additional column 6 covers natural capital which is non-produced and does not enter economic or market transactions (like air, ecosystems, surface waters, virgin forest or the like). It has a minimal number of entries because recording opening stocks, particularly undiscovered stocks, is not practical. The additional row vi records the use or consumption of non-produced natural assets. This is the depletion and degradation of natural capital, analogous to CFC for produced capital. The first entry in the row Use_{np} is the sum of $Use_{np.ec}$ (depletion of non-produced economic natural assets such as managed forests, minerals, etc.) and $Use_{np.env}$ (the degradation by economic activities of other non-produced environmental natural assets, like non-sustainable extraction of fishstock from rivers, effects of emission of residuals on the quality of air, water, wild forests, species habitat and so on), both of which are negative items in columns 5 and 6, reducing the stocks of natural assets.

The next row, row vii, Other accumulation of non-produced assets, simply records the transfer of assets from the non-economic (column 6) to the economic category (column 5), the row summing to zero. The conversion of fish stocks to economic control or the net additions to proven mineral reserves would be

Table 2.3: *Traditional National Accounts (shaded) and Satellite Accounts*



Source: United Nations, System of National Accounts, p. 511.

Note: The important item here is Use_{rp} in row vi, which will also appear in the calculation of national sustainability indicators, in section 2.3. It is the sum of depletion of non-produced economic natural assets (like forests and minerals) and degradation by economic activities of other non-produced environmental natural assets (like effects of emissions). This item is subtracted from Net Domestic Product to give environmentally adjusted domestic product or EDP.

examples, and the quantity or value of the increase in column 5 would be matched by an equal but negative entry in column 6.

When rows vi and vii are filled in, if these are entered in physical units, the integration of the environment in the national accounts is achieved to some extent (though of course the level of detail and inclusiveness will vary, depletion and degradation being described in more detail below). We would still just have NDP, as before, but supplemented by physical measures of the use of non-produced assets, Use_{np}. The results can be read as "this is your national income, and here are the associated physical effects on non-produced natural assets". No monetary valuation has been required. An approximate example of this from the Netherlands[30] Central Bureau of Statistics will be described later.

However if rows vi and vii can be monetised, we can proceed to the next step of measuring an environment-adjusted net domestic product, or EDP. In column 1 subtraction of Use_{np} from NDP gives EDP. Columns 2, 3 and 4 remain unchanged (accumulation of produced economic assets, $A_{p.ec}$, equals I). Columns 4 to 6 give all net accumulation including produced and non-produced natural assets. Net accumulation of non-produced natural assets is the sum of depletion and degradation in row vi (which are negative), and additions to economic reserves in row vii column 5 (which are positive). So net accumulation of non-produced economic assets, $A_{np.ec}$, can be positive or negative. Net accumulation of other non-produced natural assets, $A_{np.env}$, is negative.

We then have the identity in row viii:

$$EDP = X - M + C + A_{p.ec} + (A_{np.ec} - A_{np.env})$$

which says that:

> Environmentally adjusted domestic product = exports minus imports plus final consumption plus investment plus net accumulation of non-produced economic assets and of other non-produced natural assets.

Since the two I terms in row vii cancel out, the term inside the brackets is equal to the total use of non-produced natural assets, Use_{np}, which is also the difference between NDP and EDP in column 1, thus maintaining the identity.

This approach ensures that the environmental accounts are integrated and consistent with the traditional economic accounts, without interfering with the presentation of conventional NDP. Furthermore the environmental satellites can be added in whatever level of coverage (provided that the coverage is made clear), and improvements to them can be incorporated as they become available. It needs

[30] By de Haan and Keuning (1995).

to be emphasised that SNA 1993 states that the procedures outlined could be subject to change.

It is evident then that the annual production of EDP would be superior to the present publication of NNP, but for the considerable problems of putting a monetary value on those items which appear in the satellite accounts. Until accounts can be expressed in monetary terms they cannot be integrated fully into the national accounts. The ultimate requirement is a monetary value of Use_{rp}. Remarkable work has been undertaken in this field in recent years, however the fact that debate is rife is an indication that problems remain. Difficulties arise mainly in evaluating depletion, degradation and defensive expenditures, each of which will now be looked at in turn.

Depletion in the National Accounts

Valuation of depletion is considered to be easier than valuation of degradation. In valuing the depletion of non-produced assets, two main valuation methods are utilised in practice.[31] One is the so-called *net rent* approach used by Repetto (also called "Hotelling rent" or "excess profits" method, a variant being the "reserve depreciation" approach used by Repetto). It values the units extracted on the basis of the difference between the value of output and all costs – including labour costs and a normal profit margin – incurred as a result of depletion. This difference is the net rent and the whole of it is counted as depletion.

The other method of valuing depletion is the so-called *user cost* approach, which values the units extracted on the basis of only a part of net rent. This approach[32] is based on the idea that an amount of the income from the resource should be set aside each year and invested. In that way the resource would be supplying a perpetual steady stream of income (a "true" income) both during the life of the resource and after the resource has been exhausted. We can see that this fits in with the concept of sustainable development. "True" annual (perpetual) income therefore is rather less than the annual income receipts earned during the finite life of the resource, the difference in fact being the amount to be invested, the "user cost", which is the measure of depletion. The share of user cost in revenue works out at $1/(1+r)^{n+1}$, which is inversely related to the lifetime, n, of the resource given the current rate of extraction and r, the rate at which resource owners discount future revenues. (Appendix II describes how this is obtained). If the resource is abundant relative to current use, then n will be large, the user cost share of revenue will be small and true income (perpetual) income will be close to the revenue. For an infinitely lived resource, the user cost share is zero, the whole of revenue is true income, which is intuitively correct. Current national accounting

[31] Bryant and Cook (1992) experiment with several methods, which are illustrated later.

[32] Advocated by El Serafy (1989).

practice, by treating natural resource revenue as income in NNP, in effect implicitly treats natural resources as inexhaustible. Turning to the discount rate, r, if a lower value for r is chosen, reflecting lower earnings from the funds set aside and a higher weight given to the well-being of future generations, this makes the user cost share rise closer to one. A larger share of the net revenue will be excluded in adjusting NNP.

Whatever method is employed for valuing depletion, there are several issues here to be addressed concerning the price or net revenue to be used. These issues do not appear to have been settled. It is not clear how one should deal with the possibility of a downward bias to the calculated rent, if the resources have been sold off cheaply compared to other possible sales, present or future, or if some of the factors of production have garnered these rents. An import price or world price should probably be used in such cases. Then there is the problem of wide variations in net revenue or rents which may have occurred because of temporary political or administrative reasons such that current net revenues do not reflect underlying economic reality. In the same way that it is sometimes recommended that costs be smoothed in pricing, so might consideration be given to smoothing the rent in calculating the value of depletion. A third issue is the fact that the price of a depleting resource, which in theory has no substitutes, can be expected to rise in the long run. Valuing at the current price would appear to be too low. On the other hand, markets will be aware of the finite nature of the resource and will take this into account in pricing. One study[33] allows for a price rise in the depleting resource and shows that, with a particular likely type of price rise, the net rent method with its higher estimates of depletion, used by Repetto, is correct. This issue of valuation is still the subject of debate.

In contrast with depletion, new discoveries probably should not affect NNP. Apart from the problem of wide fluctuations which discoveries could cause to NNP estimates, we saw in the national accounts framework how discoveries can be simply viewed as a reallocation from unknown to known reserves.[34]

Degradation in the National Accounts

At present no deduction is made in the calculation of national income to reflect the consumption of natural capital which occurs when the soil, air, water or other aspects of the environment are polluted or left in a degraded state at the end of the accounting period. Degradation can affect natural assets that are economic assets such as land under cultivation and controlled forests, or non-economic assets such as wilderness areas, water, air, non-cultivated land and species diversity. The

[33] Bartelmus, *et al.* (1992) show that if one assumes that the net rent rises at the rate of interest, in the manner of a Hotelling rent, then the increasing revenue neutralises the effect of the discount factor and depletion should be measured by the net rent.

[34] Repetto *et al.* (1989) in fact did include new discoveries.

degradation may include deterioration as a result of their use as a "sink" or as a consequence of recreational use, say. Degradation effects would be item $Use_{np.env}$ and included in item Use_{np}.

This is perhaps the most difficult area to measure and monetise. The three main possible methods to value degradation, which will be summarised, in turn are:

(a) Willingness to pay to make good or to avoid the degradation
(b) The cost of preventing the degradation
(c) The cost of making good the degradation

Willingness to pay can be ascertained by surveys and aggregation of the responses. The usual problem with this approach is that some people overstate what they are willing to pay since they do not actually have to pay, and some may refuse to state an amount on the grounds that they have a right to an undegraded environment, or indeed that others should pay. It is possible to obtain implicit willingness to pay, by looking at surrogate markets. Use of hedonic prices is an example, whereby the variation in property prices in locations with different environmental conditions, can be said to reflect the value that people put on different levels of environmental quality. A major difficulty with willingness to pay methods is that the amount will vary from location to location, and aggregation across a population for all aspects without under- or over-counting may be elusive.

The cost of prevention may be vastly different, in either direction, from the cost of making good the degradation. There are some cases where damage may be irreversible and therefore the cost of restoration is infinite. It would be preferable to avoid such possible arbitrary valuation of degradation.

In fact neither the cost of prevention nor the cost of making good is strictly correct for valuing environmental degradation. It can be shown[35] that the marginal social damage costs (which also measure the marginal social benefit of abatement) should be used for valuing degradation. If the economy is polluting above the so-called optimum level[36] then marginal social damage costs will be higher than the marginal cost of abatement. Work is progressing on assembling data on the marginal social costs of air pollution, based on willingness to pay, for example. We will describe some of this work later.

Defensive Expenditure in the National Accounts

It is not yet settled how defensive expenditures are to be dealt with in the integrated framework, but in any event such expenditures are to be more clearly

[35] By Hamilton and Atkinson (1995) p. 7.

[36] In the sense that to abate would cost less than the value of the benefit that would ensue. Hamilton and Atkinson state that, in these circumstances, marginal social damage costs should be viewed as an upper limit estimate.

defined in a detailed breakdown of environmental protection activities. The detail suggested by the UN is shown in Table 2.4. It is proposed that protection activities which are undertaken by firms, maybe on-site, be separately enumerated, so that total such expenditure can be identified more easily. However, such separate identification will not always be possible, when, for example, environmental protection features are incorporated in new industrial machinery. In the national accounts table, Table 2.3, this finer detail would be recorded as a further breakdown of the production activities in column 1 in the rows of supply, ii, and of economic use, iii. Supply and use both increase but the increases cancel out and NDP is not affected by this treatment.

Table 2.4: *Categories of Environmental Protection Services Suggested by UN (ISIC 2 digit)*

Code	*Category*
37	Re-cycling
90	Sewage and refuse disposal, sanitation and similar activities
90.1*	Collection, transport, treatment and disposal of waste
90.2*	Collection and treatment of waste water
90.3*	Cleaning of exhaust gases
90.4*	Noise abatement
90.5*	Other environmental protection services n.e.c.
90.6*	Sanitation and similar services

Source: SNA 1993, p. 518, UN (1993). * Proposed SEEA breakdown.

Important work has been undertaken by the United Nations and published in 1993 as *Integrated Environmental and Economic Accounting* or SEEA. The United Nations investigate, among other topics, different possibilities for disaggregating the *System of National Accounts* flows and assets from the point of view of environment-related questions. For example there is extensive discussion on classification of environmental protection activities, with a more detailed breakdown than that of Table 2.4 above, published in their Annex C. An accounting system of environmental and economic interrelationships in physical terms is presented, that is derived from the concepts of materials/energy balances and natural resource accounts, along with other discussions of input-output[37]

[37] Input-output tables are tables which show flows from a number of distinct origins to a number of distinct destinations. The flows might be measures of goods and services, or pollutants, or whatever.

tabulations, as well as the imputation of environmental costs. A comparable handbook *European System for Integrated Environmental and Economic Accounting* or ESEA is being prepared by the European Commission, but taking into account European considerations.

We have covered some of the main conceptual and methodological issues which arise in the task of integrating the environment in the national accounts to give a measure of sustainable income or EDP. We have also reported on the main discussants in this area. As some of these issues are only now being teased out, one cannot expect application to have taken off. That said, there are many examples of experiments which are providing useful feedback and some of these will be presented now.

2.2.2 Examples of Integrated National Accounts

Several projects on integrated national accounts have been undertaken in the last decade. One of the champions of the cause is Repetto (1989) who adjusted the national income accounts in developing countries, notably in Indonesia and in Costa Rica. He was concerned to incorporate depletion of natural resources, which form such a prominent part of income generating assets in developing economies. The depletion method used was the "reserve depreciation" method which in fact gives the highest depletion figure of the methods described. However he also added in new discoveries as part of income, which is not considered now to be correct. The overall thrust of his conclusions is probably not in doubt – that the Indonesian economy's strong growth rate has been overstated. Between 1971 and 1984 the adjusted annual rate of growth on his calculations would be some 4 per cent, compared to the rate of 7.1 per cent from traditional national accounts. This example has served a useful purpose in pointing out a weakness of traditional accounts.

Turning to another exercise, Bryant and Cook (1992) of the UK Central Statistics Office calculate depletion by each of the methods described above. These are the User Cost method reflecting the amount which has to be invested to maintain a perpetual income, the Reserve Depreciation method, used by Repetto, which gives the highest depletion figures and (a variant) the Excess Profits (or net rent) method. Their estimated value of depletion falls sharply in 1986, with the halving or so of crude oil prices, such that what is being depleted is not worth so much. This raises some of the concerns mentioned before that use of current prices causes large temporary changes in value, which might not reflect the underlying situation.

Bryant and Cook proceed to construct adjusted national accounts for the UK, in physical terms, and then in monetary terms illustrated[38] in Table 2.5. Depletion

[38] But with their misprint for Sustainable Domestic Product corrected to exclude Depreciation of Man-made Capital.

is valued by the User Cost approach. While they had at their disposal figures for defensive expenditures which are subtracted, they decided not to tackle the measurement of degradation. In other words, their adjustments deal with two aspects, namely depletion of commercial resources and defensive expenditure. Their estimate of EDP or Sustainable Domestic Product is an upper limit. Even so it is nearly 5 per cent lower than traditional NDP.

They make the important point that adjustments ought to be made for trade in exhaustible resources. A resource importing country is not depleting its own resources but it is depleting global resources. Concentration on national calculations generally neglects this problem,[39] though if all countries do their own calculations then the aggregate for the world will be correct.

Table 2.5: *A Simplified and Estimated Experimental Account for the UK in 1990 – Money Terms, £m*

	Economic Activities			*Economic Assets*		
	Production	*Rest of World*	*Final Consumption*	*Produced Assets*	*Non-produced Economic Assets*	*Environmental (non-produced Assets*
Opening assets						
Produced				1,457,500		
Oil					R (oil)	A
Natural Gas					R (gas)	B
Coal					R (coal)	C
Water						0
Air						0
Economic supply	(938,000)	147,728				
Economic uses	(459,000)	127,197	403,050	97,210		
Gross domestic product (at current factor cost)	479,452					
Depreciation	61,126			-61,126		
Net domestic prod.	418,326					

Table 2.5 (*continued overleaf*)

[39] Proops and Atkinson (1993) estimate resource use embodied in imports, and Atkinson and Hamilton are engaged in developing this work.

	Economic Activities					
				Economic Assets		
	Production	*Rest of World*	*Final Consumption*	*Produced Assets*	*Non-produced Economic Assets*	*Environmental (non-produced Assets*
Environmental Uses						
1. Depletion						
Oil depletion	3,793				-3,793	
New finds					3,711	-3,711
Gas depletion	1,855				-1,855	
New finds					1,613	-1,613
Coal depletion	N.A.				N.A.	
New finds					N.A.	N.A.
2. Defensive expenditure/Degradation						
Land remediation	240					-240
Environmental expenditure						
Water	6,700					-6,700
Air	2,400					-2,400
Others	5,300					-5,300
Oil pollution removal	1					-1
Degradation	D					-D
Sustainable domestic product	398,037-D					
Closing Assets						
Produced				1,539,000		
Oil					R(oil)-82	A - 3,711
Natural Gas					R(gas)-242	B - 1,163
Coal					R(coal)	C - 0
Water						-6,700
Air						-2,400

Notes:-

1. Monetary values of non-produced assets of oil, gas and coal are not made because of problems estimating reserves. These are repeated by R (oil), R (gas) and R (coal) respectively.
2. A, B and C represent the monetary values of "possible" + "potential additional" + "undiscovered" reserves.
3. Figures for produced economic assets should be net capital stock at current replacement cost. These ought to be at 1990 prices but figures are not available.
4. D represents environmental degradation.
5. Figures in brackets are estimates extrapolated from 1989 input-output analysis.

Source: Bryant and Cook (1992), p. 110.

In another example, the EDP for Mexico has been estimated by van Tongeren. *et al.* (1993) in a thorough green accounting study, illustrated in Table 2.6.

Table 2.6: *Eco Domestic Product for Mexico, 1985 (Million new pesos)*

GDP	47 392
Depreciation of man-made capital	-5 331
NDP	42 061
Depletion of natural resources	
Oil depletion	-1 470
Net forest depletion	-164
Deforestation losses	-763
EDP1	39 663
Degradation	
Soil erosion	-449
Solid waste	-197
Ground water depletion	-192
Water pollution	-662
Air pollution	-1 656
EDP2	36 507

Source: Hamilton (1994) adapted from van Tongeren *et al.* (1993).

The top three lines present standard national accounting aggregates, GDP, depreciation of produced assets and resulting NDP. Next follow the depletion of commercial resources to give EDP1, which is nearly 6 per cent lower than NDP. The final section of the table corresponds to degradation of the environment. Soil erosion is valued as the cost of providing fertilisers to replace lost productivity. Ground water is treated as a depletable resource, and is valued at its cost of replacement. Water and air pollution are valued at the cost of restoration to an acceptable level of environmental quality, finally giving EDP2 which is 13 per cent lower than traditional NDP. There are points of detail on which experts would disagree, for example marginal damage costs rather than average restoration costs might have been used for degradation valuation, however these are still

experimental exercises. As such they are giving a clear message that national income is not as high as we thought it was, and that in developing countries especially, the growth rates as currently presented are subject to exaggeration in the presence of natural resource depletion.

The final example which we present in this section refers to the Netherlands and shows how an exercise which goes along the route of integrating the environment into national accounts can yield worthwhile indicators, without going so far as monetising the satellite accounts. The Netherlands Central Bureau of Statistics is expanding the national accounts in two directions. In one direction, personal income distribution and demand and supply of different categories of labour, by sex and education level are integrated in the system, using the Social Accounting Matrix (SAM). In the other direction, statistics on the environment are connected in a National Accounting Matrix including Environmental Accounts (NAMEA), which in addition combines the environmental information into a number of summary environmental indicators. There is evidently co-ordination between the environmental and economic data gathering agencies. These summary environmental indicators are at present based on six themes:

Greenhouse effect:	CO_2, N_2O and CH_4 (global warming potentials)
Depletion of the ozone layer:	CFCs etc. (ozone depletion potentials)
Acidification:	NO_x, SO_2 and NH_3 (acid equivalents)
Eutrophication:	P and N (eutrophication equivalents)
Accumulation of waste:	(million kilograms)
Natural resource use:	gas and oil (joules)

Within each theme, weights are required to aggregate the components and these weights are based on research[40] on the effects of different substances on environmental quality. The first two themes which are global in their effects, appear in a global account and the rest appear in an account relating to national territory, giving national accumulation of pollutants from domestic pollution plus imports minus exports of pollutants.

Underlying the economic accounts are the breakdowns of net domestic product by branch of industry, and of household consumption into Transport and Other. Emissions, wastes and resource use by each of the sub-branches also require to be tabulated by source and by destination, an example is given in Appendix III, such that consistency is ensured. In turn these substances can be aggregated into their effects on each theme (natural resource use is omitted). Table 2.7 below shows the results of this exercise, which presents the information in terms of average annual volume changes between 1989 and 1991. The economic indicators

[40] By Adriaanse (1993).

Table 2.7: *Average Annual Volume Changes for Some Economic and Environment Indicators, 1989-1991, per cent*

	Economic Indicators		*Environment Indicators*					
	Net Domestic Product	*Labour Volume*	*Consump-tion Expenditure*	*Green-house Effect*	*Damaage to Ozone Layer*	*Acidation*	*Eutrophi-cation*	*Waste*
	(Factor Costs)							
CONSUMPTION EXPENDITURE			3.8	2.9	-12.3	-4.9	2.5	-2.1
Personal transport			2.8	-1.1	-	-6.3	-7.9	-
Other			3.8	6.0	-12.3	4.8	4.7	-1.7
PRODUCTION	3.3	1.8		1.8	-12.4	-1.8	-4.0	3.2
Agriculture and fisheries	6.5	-0.4		6.8	-	-1.5	-3.9	1.2
Mining and quarrying	4.8	0.0		-	-	-	-	5.2
Manufacturing	1.9	0.8		0.7	-12.5	-1.0	-3.0	4.4
Food, beverages and tobacco	3.7	0.3		2.0	-	-	-	9.0
Oil industry	4.8	0.0		0.3	-	2.3	-	-
Chemical industry	0.0	0.0		0.9	-3.1	-5.6	-13.6	3.2
Metal industry	-1.9	-1.7		-3.8	-	-2.2	-	-
Other manufacturing	2.1	1.1		3.6	-18.4	-1.3	-	1.5
Public utilities	3.2	-2.2		0.4	-	-7.0	-	-
of which: electricity plants	2.2	-1.9		0.1	-	-7.7	-	-
Construction and installation	0.0	0.0		-	-	-	-	-3.9
Transport storage and communication	6.7	2.9		2.8	-	-0.5	-	5.0
Environment cleansing companies	1.9	3.8		2.7	-	-	-	-
Other services	3.3	2.5		1.1	-	-0.7	-	9.4
TOTAL	3.2	1.8	3.8	2.0	-12.4	-2.2	-3.5	1.8

- : Contribution too small for a reliable estimate of change.

Source: Table 2, p. 9 of de Haan and Keuning (1995).

are simply the annual growth rates in the product of sub-branches of industry (column 1) and in consumption expenditure (column 3). The second column gives extra information, on employment changes. The remaining columns are indicators of the five environmental themes relating to pollution of some sort, which were listed above. They are also expressed in terms of average annual increases. The row at the bottom gives the overall totals, for NDP growth, employment growth, growth in personal consumption expenditure and pollution growth under the five themes.

The table shows that pollution has declined or grown less fast than NDP, information which is summarised in the final row. In particular ozone depleting pollutants have decreased by 12.4 per cent, the volume of waste on the other hand grew by 1.8 per cent and greenhouse gas emissions by 2 per cent, all significantly lower, however, than the 3.2 per cent increase of NDP. The volume of consumption, shown in the top row, increased by 3.8 per cent but produced 2.1 per cent less waste and caused 4.9 per cent less acidification. However greenhouse gases and eutrophication from consumption rose, and by more than those from industry. The "decoupling" of environmental degradation and economic growth[41] in some areas is made apparent. In addition to imparting this kind of information, the exercise yields an accompanying table (not reproduced here) showing the shares of each item in the relevant total in 1991. For example, it shows that 86 per cent of eutrophication by production comes from agriculture, which contributes 4 per cent to GDP.

These tables are informative. They show the relative contribution of the sub-branches to environmental problems. While the exercise requires information on the sub-branches of production, and good economic/environment co-ordination to produce an environmental input-output table, there is no need for monetary valuation. That said, one has to be satisfied with the correctness of the weighting of, say, emissions to add up their contributions to each theme. One also has to acknowledge that the resulting indicators for each theme can still not easily be graded: is a 2 per cent increased contribution to the greenhouse effect any worse than a 1.8 per cent rise in waste? Whatever about the inadequacies, the method supplies information which can subsequently be used for further integration in monetary terms, at a later date, if one wishes to proceed to measuring EDP. It is like a halfway house, but yielding valuable information on environmental themes.

According to a report by the European Parliament (1995), the public are interested in this approach. The Central Statistics Office in the UK is also

[41] The term "decoupling" (much used after the OPEC oil price hikes of the 1970s) describes the breaking of a previous relationship, such as the reduction in the growth of, say, waste production (or energy consumption) relative to the growth of the economy. The growth rates of such series move in tandem at times, leading some observers mistakenly to believe that they would not decouple after relative price changes.

considering this method. The European Commission is undertaking a similar exercise, but with a different method (by Jesinghaus) of compiling the index for the environmental indices, as we saw.

A few comments will conclude this section on integrated national accounts. It is noticeable that the aspect of the monetised accounts on which people are concentrating most attention is the depletion aspect, probably correctly. There is a good argument, from the point of economics alone, that depletion should be counted as eating up our capital, and "the valuation of resource stocks and depletion is do-able".[42] This is where work can make most headway immediately. Degradation requires more investigation by the natural science disciplines, and indeed this is going on, more so in that arena, again correctly. Meanwhile estimates of defensive expenditures are being made in many quarters.

Initial demand for green national income figures probably arose from the perception that authorities and politicians would ignore depletion and degradation so long as national income kept rising. There is also the feeling that if we are not as well off as we thought we were, we ought to be told. EDP does approach what our "true" income is, by subtracting degradation and counting only sustainable income from depletion.[43] However, a new *level* of income, though useful in the example for Indonesia above, might not always signal unsustainable development. Rates of change are of course what are habitually produced in policy analyses by the Department of Finance, the Central Bank, the development authorities, the ESRI *et cetera* – but as we saw, EDP growth in Indonesia was still positive, so that it may not have told us much about sustainability, a concept to which we now turn our attention.

2.3 National Sustainability Indicators

The idea of sustainability is straightforward. A forester who cuts down trees at a faster rate than the rate of growth of the new wood is not operating the forest in a sustainable way. The asset which generates the income will dwindle so that future income will decline. Assets or wealth at the end of each year would be a good measure, including the stocks of living and non-living, man-made and natural resources, then wealth per head would be an indicator of sustainability. If wealth declined it would indicate that future well-being would decline. Keeping capital resources intact is therefore the aim. The criterion can be applied with all the assets aggregated – but this assumes that all assets can be aggregated and it would only be suitable if all assets are substitutable. If they are not, the measure needs to be used separately in the areas where substitution possibilities are low or

[42] Newson (1995).

[43] Many would argue that such measures satisfy the Hicksian requirements for "income" and are therefore intrinsically important.

non-existent. The criterion can also be re-expressed as the requirement that the growth in wealth must be at least as fast as the growth in population.[44]

It need hardly be said that measuring wealth would be a massive task in this context, where we are including environmental assets as well. Fortunately there is a short cut which can help to some extent. This relies on the fact that *changes* in wealth are equal to investment, by definition, and investment is more easily measured than wealth. Within an accounting period, net investment, which can be positive or negative, is the addition or decrease of man-made and, in this green context, of natural capital. Furthermore, in any accounting period, savings equal investment (as they each constitute that which is not consumed, whether by the personal sector or by government), so that net savings can be used as the change of wealth. Therefore provided that net savings are greater than or equal to zero, net wealth is non-declining and the economy is on a sustainable path. In the traditional accounts we know that savings equal national income (or NNP) minus consumption (or C), so the extended criterion taking natural assets into consideration is:

$$S = NNP - C - \text{depletion of natural assets}$$

and this measure of saving needs to be non-negative for sustainability to prevail. In fact, while this looks more simple, the item "depletion of natural assets" includes degradation and is basically the item Use_{np}, from the green national accounts in Table 2.3. We saw that depletion of commercial natural resources could be readily valued but that degradation was not so easily dealt with.

Sustainability is sometimes qualified as being "weak" or "strong" sustainability. We have here been describing what would be called weak sustainability. We simply specified that the aim should be to keep the aggregate capital stock constant, which assumes that different types of capital can substitute for each other, for example a forest for a cement factory. To some extent this substitution is possible, one might point to the forest clearance in Ireland over the last millennium. An example of non-substitution might be oil reserves for motor vehicle factories, if oil were scarce. Vehicle production capacity would be no substitute for fuel – after all, vehicles and fuel are complements in consumption. A moment's reflection, however, would reveal that owing to relative price movements in those circumstances, the capital value of the factory (having a poor outlook) would be rather small, and for the oil depletion it would be rather large – so that the net savings measure would be much reduced and non-sustainability is

[44] For total wealth W and population P, the sustainability criterion is: $[\Delta(W/P)]/(W/P) = \Delta W/W - \Delta P/P \geq 0$. Hamilton (1994).

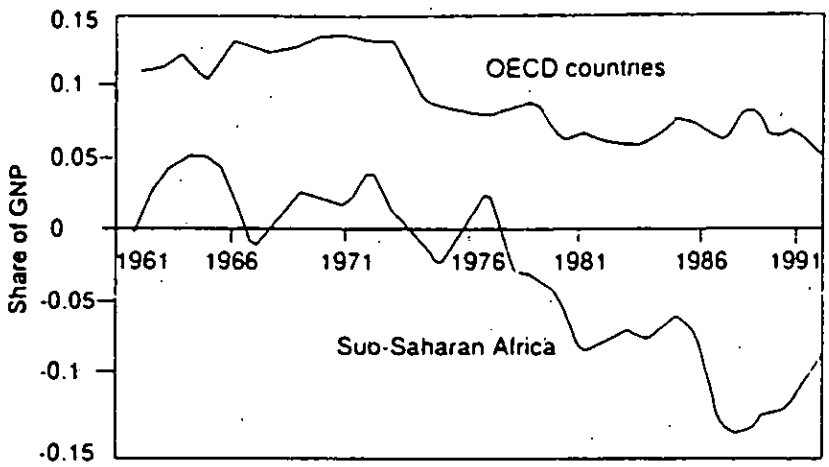
more likely to be signalled. In other words, price movements will to some extent deal with the non-substitution issue.

That said, there are areas where substitution between environmental and man-made assets is limited and in others, totally impossible. Some environmental assets can be considered essential to human well-being, if not to survival.[45] This has been termed *critical natural capital*. Examples cited are the ozone layer, the carbon cycle, also biological diversity, the loss of which may threaten the primary life support functions of ecological systems. We should therefore apply the strong sustainability rule to critical capital. That is, we should additionally ensure the maintenance of individual items of critical capital. Irreversibility is slightly different in that the item might not be critical capital. Natural capital often falls into the category of irreversible capital. Man-made capital in general does not because it can be made again, with exceptions such as historic architecture and other artefacts, and skills and cultures which cannot be recreated.

2.3.1 Examples of Application of the National Sustainability Criterion

A preliminary exercise in calculating the sustainability criterion was undertaken by the World Bank. In this study OECD countries were examined and contrasted with sub-Saharan Africa. The measure of depreciation of natural assets merely included depletion of commercial resources valued at an assumed rental rate plus an estimate of damages in each country from CO_2 emissions. The resulting net savings expressed as a share of GNP are illustrated in Figure 2.4.

Figure 2.4: *The Sustainability Criterion: Net Savings in OECD and Sub-Saharan Countries*



Source: Hamilton (1994), p. 166, from World Bank.

[45] The reasoning here has been developed by Pearce (1993).

As the figure shows, net savings in the OECD countries are positive. They dropped at the time of the 1973 oil price hikes, because depletion became valued more highly. The 1990s' savings rate is 6 per cent or so. Meanwhile sub-Saharan Africa's course has been precarious, followed by unsustainability since the late 1970s. These countries are less industrialised and therefore rely heavily on natural resources, so that natural resource depletion would impact strongly on the savings figures. In policy terms it points to the need to re-invest portions of net receipts from depleting natural assets. Exploitation of natural resources is liquidation of the asset, so that wealth declines if an equivalent of part of the proceeds is not invested in other productive assets. There is a message here perhaps for governments that collect royalties on minerals extracted. The UK government has been criticised for using such gains to increase current consumption rather than ensure that investment build up new industry or technology. A balance of payments surplus on trade represents a rise in savings, but if the exports are largely based on natural resources, the attributable saving will be reduced by the depletion element.

For use as an indicator, it is not argued that net savings should be positive in every year. In times of national emergency there may be sound reasons for dipping into one's assets. However as a general principle, the net savings indicator should be positive, taking one year with another. If it is persistently negative, well-being will decline.

As pointed out, while it appears that this is a much easier indicator to derive, in fact the difficulties which arose in connection with green national accounts also arise here. Measuring the depreciation of natural assets may be straightforward enough where depletion of marketed natural resources is concerned, but depletion of non-marketed resources and the degradation or regeneration of the environment also ideally should be incorporated. It is worthwhile, however, proceeding piecemeal with the adjustments that are possible, always of course qualifying the results by explaining what has been taken into consideration.

That said, some aspects of degradation have been valued, as we saw with the above example which incorporated estimates of damage from CO_2 emissions. We will describe now this exercise[46] in valuing air pollution. Estimates of the marginal social costs per tonne emitted are shown in Table 2.8. The columns are the pollutants which include carbon dioxide, sulphur dioxide, nitrogen oxides and particulate matter. The rows of the table are the receiving agents. The figures show the ultimate effects of polluting activities on human health (respiratory problems), forestry (forest death), material and buildings damage (general soiling

[46] Drawn from an evaluation of the social cost of fuel cycles within Europe by CEC/US (1993), described in Hamilton and Atkinson (1995).

and corrosion) and on climate change. We do not need to be reminded that there is uncertainty surrounding some of these processes.

Table 2.8: *Marginal Social Costs per tonne of Air Pollutant Emitted ($).*

	CO_2	SO_2	NO_x	PM_{10}
Health		2,290	705	15,520
Forestry		1,760	1,220	
Materials/buildings		480	320	320
Climate Change	7			
Total	7	4,530	2,245	15,840

Note: CO_2 = carbon dioxide, SO_2 = sulphur dioxide, NO_x = nitrogen oxides, PM_{10} = particulate matter.

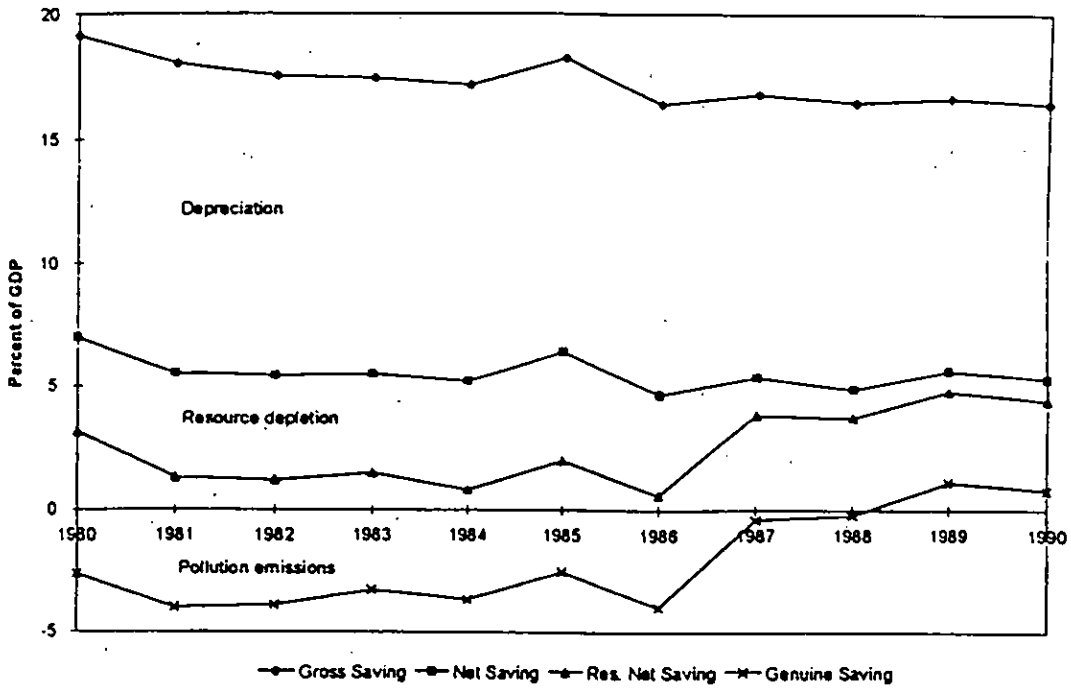
Source: Table 1 p. 10 of Hamilton and Atkinson (1995) drawn from CEC/US (1993).

Summing each column gives the total damage caused by each pollutant per tonne emitted. In their calculations the authors used a variety of techniques, including willingness to pay for a decreased risk of dying. The figures refer to damages both inside and outside the polluting country. These marginal social costs were estimated by analysing the incremental emissions from two hypothetical representative power stations in specific locations in Germany and in the UK. Dose-response functions, dispersion modelling techniques, details of population densities and population characteristics were all called upon in the analysis.

Using these prices for pollution emissions, Hamilton and Atkinson value the degradation from pollution for the UK. They proceed to calculate the sustainability indicator by subtracting the degradation costs, to obtain a lower, genuine, savings rate. This is illustrated in Figure 2.5 below. The variable graphed at the top of the figure is gross savings. When depreciation of man-made capital is subtracted this gives net savings[47] traditionally measured, which is the next variable down. Next we see genuine or net savings adjusted for resource depletion and, finally, adjusted for pollution emissions.

[47] Gross and net savings are items 113 and 110, respectively, in the national accounts for Ireland (CSO, 1994).

Figure 2.5: *UK Sustainability: Genuine Savings Rates for 1980 to 1990 (per cent of GDP)*



Source: Hamilton and Atkinson (1995), Figure 2, p. 13.

The graph of genuine savings indicates that the UK was on an unsustainable path during most of the 1980s. While the authors state that the cost of pollution emissions may have been overstated in their calculations, they point out that there were other emissions, to water courses for example, the costs of which were not considered. Although the figures are tentative, they make the point that there is no room for complacency.

This completes our rundown of the various types of indicators. In the next chapter, an overview of environmental data and information structures in Ireland is given.

Chapter 3

OVERVIEW OF ENVIRONMENTAL DATA AND INFORMATION STRUCTURES IN IRELAND

In this chapter we will be looking first at the main collectors of information relating to the environment. We will then assess the capability of the current structures to undertake the production of each of the three major categories of indicators outlined in the previous chapter.

The main bodies collecting and disseminating data on environmental issues at present are:

Environmental Protection Agency
Department of the Environment
Department of Energy (within Transport, Energy and Communications) and the Irish Energy Centre
Central Statistics Office

In the past, within the Department of the Environment, the Environment Research Unit (ERU) was an important source of information. It in turn would call upon the data resources of bodies such as the Office of Public Works. Its role was largely superseded by the Environmental Protection Agency in 1993. ENFO, the Department of the Environment's information service, is charged with making environmental information accessible to the public.[48] The relevant contribution of the four main bodies will be described in turn. Other departments and their agencies also play an important role, for example Forbairt (previously called EOLAS and, previous to that, called the Institute for Industrial Research and Standards or IIRS), an agency of the Department of Enterprise and Employment, provides information relating to industry. Other important sources include the Department of the Marine, the Department of Arts, Culture and the Gaeltacht and the Office of Public Works. In some instances, local authorities would be the primary source of information.

The *Environmental Protection Agency* is charged with a statutory obligation to establish and maintain a data base related to environmental quality, by the

[48] And provides a Directory of Environmental Sources (Hughes, 1992).

Environmental Protection Agency Act of 1992. Given its role as the licensing and monitoring agency it is uniquely placed for the task. The areas of information to be covered are (a) ambient air quality, (b) the quality of inland waters, estuarial and coastal waters, and groundwaters, (c) soil quality, (d) noise levels, (e) inventories of emissions to the environment, and (f) such other matters as may be prescribed. The Act provides that the Environmental Protection Agency may compile a register of sources of data related to environmental quality. It is also required to prepare and publish a report every five years on the quality and condition of the environment in the State. Its first such report is *The State of the Environment*, published in early 1996. It has inherited some of the existing data bases, for example it has charge of the data on water and air which had previously been the responsibility of the Environmental Research Unit.

The Agency's functions include liaison with the European Environment Agency (EEA) and it sees its role and position as outlined in Box 1.

A study by consultants on the development of an integrated environmental information system for Ireland, funded under the ENVIRONET Programme, was completed in 1994. Based on the findings of the study, a proposal was submitted by the EPA to the LIFE fund for the implementation of central aspects of the information system. The application was successful and work has commenced on the LIFE project, which comprises four major tasks to be carried out within a three year period. These are as follows:

1. Database for Integrated Pollution Control (IPC), Licence Applications and Licence Data.
2. Referential Database of Environmental Data Sources.
3. Databases for Environmental Quality (air and water) and Compliance Data.
4. Environmental Protection Agency Network.

To date the main focus of the work has been on task 1 above.

Until recently the most comprehensive information on the environment has been provided by the *Department of the Environment*, from the ERU, in its documents of 1986 and 1993 entitled *Irish Environmental Statistics*. The 1993 publication is structured with the pressure-state-response layout, described above. One is reminded here of the advice of OECD, and of the observations of ERU, that the categorisation is not rigid and can be uncertain. Taking forestry as an example, in some cases it might come under the heading of "state", but in other cases under the "pressure" heading because large-scale planting of new forests can put pressure on the environment and conflict with other aims. Classification is not clearcut and, like a librarian, one must compromise and make a decision: some environmental actions *per se* do not necessarily constitute improvements in state or increases in pressures, though depending on the receiving medium, some change, especially intensive change, can constitute a pressure on the environment.

Box 1. The EPA's Role in Liaising with the European Environment Agency (EEA)

The EPA is the National Focal Point in Ireland for the EEA with responsibility for co-ordinating the linkages and the flow of information between Ireland and the EEA. A total of forty organisations were notified to the EEA as the main component elements of the European Environment Information and Observation Network (EIONET) in Ireland.

Two organisations in Ireland are members of European Topic Centre (ETC) Groupings. The Marine Institute is a member of the grouping involved in the scoping study on the marine and coastal environment. The Environmental Protection Agency is a member of the grouping for the ETC on inland waters. Both organisations are participating actively in the work of the respective Topic Centres.

The National Reference Centres (NRCs) for specific topics have been notified by the EPA to the EEA as follows:

Air Quality:	Environmental Protection Agency
Air Emissions:	Environmental Protection Agency
Inland Waters:	Environmental Protection Agency
Marine and Coastal:	Marine Institute
Nature Conservation:	National Parks and Wildlife Service
Soils:	Teagasc
Forests:	Forest Service
Contaminated Sites:	Environmental Protection Agency
Data Sources Catalogue:	Environmental Protection Agency
Land Cover:	Ordnance Survey

The Environmental Protection Agency is providing a significant proportion of the National Reference Centres required so far. This reflects the wide range of statutory functions of the EPA in Ireland.

The ERU document contained over one hundred tables, graphs or maps, a large proportion showing information over time or in comparison with some base year, with explanatory notes accompanying each theme. A list of the tables contained in that report is reproduced in Appendix IV, which, broadly speaking, can be summarised as covering air quality, water resources and water quality, land, forestry, national heritage, noise, waste, and global climate (in that energy use and carbon dioxide release have global implications). The bodies supplying data included Aer Rianta, Bord Failte, Central Statistics Office, Coillte, CIE, the Departments of Agriculture and Food, Transport, Energy and Communication, Health, Tourism, Dublin Corporation, Dublin County Council, Forbairt, the

Meteorological Services, National Parks and Wildlife Service and the National Parks and Monuments Section of the Office of Public Works, the Radiological Institute and Teagasc. The *State of the Environment* by the EPA is now the most up-to-date source on the Irish environment.

The *Department of Energy* has produced an important document entitled *Energy in Ireland 1980-1993, A Statistical Bulletin*. This gives information on production, imports and consumption, broken down by main consuming sector and by main fuel. One area merits comment however. The Department would not claim that figures for private peat extraction are any more than an estimate. Intensive private turf extraction has implications for habitats and scenery and there is a potential inadequacy here, with implications for sustainability. Some of these sorts of problems derive from the compartmentalising of responsibilities: energy, heritage and environment are the functions of separate departments. The Department of Energy's figures for fuel consumption form the basis of calculations of combustion emissions of carbon dioxide and so on. It was on the recommendation of the National Statistics Board that this series on energy was recommenced after a gap of a few years, and future issues will cover five year spans. The recently established Irish Energy Centre will be engaged in programmes which involve measurement of the impact of energy efficiency measures and the like. In the course of this work, selected results will be published.

Despite the wide coverage of environmental statistics afforded by the above-mentioned bodies, there are still occasions when the user will need to resort to other bodies, some of which were listed above. For example, the Department of Enterprise and Employment, through its agency, Forbairt, produces reports from time to time. It has in the past been the only source of data at national level on industrial emissions relating to air, water, noise and waste.

There are invariably gaps in information. For example, the authors of the ERU document state that under "pressures", information on emissions to water by agriculture is not readily available. There is information on silage, however. For an overview of solid waste,[49] one still has to rely on the 1984 survey by Boyle (1987). Though there have been subsequent surveys, consistent annual series are not available. Similarly under "response", information is not available on levels of insulation in houses,[50] which would reduce fuel needs and reduce emissions of sulphur dioxide, carbon dioxide, etc. Also under "response", the only data on "prosecutions taken" is for contravention of the Local Government (Water Pollution) Act 1977. While there were some 5,500 tonnes of abandoned cars, annually, in the early 1980s, information on prosecutions is not given. Coverage

[49] According to Barrett and Lawlor (1995).

[50] Except for a once-off survey (Scott, 1995).

could include prosecutions for harm to Natural Heritage Areas, car emissions, littering et cetera, but this of course raises the problem of non-prosecution where prosecution should occur. On the other hand the figures for prosecutions might indeed tell a good part of the story about "response". The built environment appears under National Monuments in the ERU's coverage, but other aspects of the built environment were not included, probably not being part of the ERU's brief. Other aspects could include listings of buildings.[51] The regional dimension is also important in so far as local conditions affect the tolerances of emissions within an area, which can be measured by, for example, wind speeds (Meteorological Office) which are given, or the geology (Geological Survey) which is not. Policy analysis based on this information is also constrained in many cases by the exclusive concentration on information on quantities. The lack of information on price or revenue means that many analyses cannot be readily undertaken which investigate incentive effects or responses to price changes, for example the effects of a carbon tax. "Price paid" is like the other side of "quantity". An item's price essentially tells us what quantity of something else people are willing to give up to get that item. Some price series which exist are not compatible with the quantity series and are not readily usable, and some of what is compatible requires revision and updating.[52]

The *Central Statistics Office* (CSO) is charged by the Statistics Act of 1993 with the collection, compilation, extraction and dissemination for statistical purposes of information relating to economic, social and general activities and conditions in the State. It has the authority

> to co-ordinate official statistics compiled by public authorities to ensure, in particular, adherence to statistical standards and the use of appropriate classifications (section 10 (2)),
> to assess the statistical potential of the records maintained by public authorities and, in conjunction with them, to ensure that this potential is realised in so far as resources permit (section 10 (3))
> and
> shall maintain close and regular contact with the principal users and suppliers of statistics (Section 11 (2)).

The National Statistics Board guides its strategic direction and deals with issues arising between the Central Statistics Office and other public bodies. The Central Statistics Office may request any public authority to grant access to

[51] Along the lines of McParland and Robinson (1977), Glin, *et al.* (1988), Mansergh (1992) and the Architectural Heritage Inventory Post-1700 (Lindsay, 1992).

[52] E.g., aggregated energy prices at the point of final consumption, by Scott (1990).

records, and should be consulted by public authorities which propose to introduce, revise or extend any system for the storage and retrieval of information or make a statistical survey. These requirements are intended to ensure that data systems are compatible and it is important that they be adhered to and that no ambiguity arises. In this way the information collected and provided by the public authorities should be capable of being integrated in the data of the Central Statistics Office, if required.[53] The Central Statistics Office is interested to ensure that its respondents do not receive such an amount of questionnaires that they become weary of completing returns, making the CSO's job subsequently harder. Co-operation between the CSO and any public body with similar data interests is likely to be beneficial to both parties.

Two issues relating to surveys arise frequently in this area. One is the issue of overlap of topics – if the Central Statistics Office is already collecting information on a topic which is similar or related to areas of interest of another body, a judgement must be made as to whether further information should be gathered by the CSO or by the other body. For example, the Census of Industrial Production asks firms about their payments for fuel and water – should the questionnaire also ask for quantities of waste and payment for waste services, or should the EPA or Department of the Environment (through local authority returns) find this out? Similarly, the Household Budget Survey asks householders such minutiae as how much they spend on firelighters and on other small items – should it also ask whether they have hot water cylinder insulation, or would it be better for the Irish Energy Centre, for example, to find this out?

The second issue is often related to the first and concerns the extent of coverage of surveys. Sample surveys are, of course, cheaper than surveys aiming at total coverage, and useful information may be obtained which is almost as good, and in any case may be good enough for the purpose in hand. Calculations of the marginal cost to the Central Statistics Office of expanding surveys should consider respondents' time and inconvenience, as well as the general effects of length of surveys on respondents' future co-operation. Each case needs to be considered on its merits. Co-operation is helpful in many ways. An example of where co-operation ought to have existed, for the sake of consistency, was in relation to the figures for consumption of coal by households. Figures in the Household Budget Surveys for 1981 and 1987 imply that households use some 50 per cent more coal than the Department of Energy's figures in *Energy Balances* stated. In

[53] An example where co-ordination has not occurred, with a private body, is the survey of businessmen's predictions carried out by the Irish Business and Employers' Confederation (IBEC). Because there is no guarantee that the industrial classifications are the same as those used by the CSO, IBEC's forward-looking series does not automatically link to the Central Statistics Office's series on recent industrial production, employment and the like.

so far as the funds for gathering information come from the public purse, if via different and indirect routes, it is sensible to conceptualise the nation's data tasks as an array of options, where the question of who undertakes some specific tasks is decided on its merits.

The comments of *Towards Sustainability*, the 5th European Environmental Action Programme, are noted:

> Work ... has highlighted the lacunae and deficiencies in the available environmental information in the Community and the Member States: in most Member States there is a number of different institutions or organisations involved in data collection and analysis; differences in nomenclatures, criteria, methodologies and interpretation militate against both compatibility and comparability ... there is a serious lack of base-line data, statistics, indicators and other quantitative and qualitative material required to assess environmental conditions and trends, to determine and adjust public policies and to underpin financial investments; ... it is imperative that ... a high level of priority be assigned to ... exploiting and strengthening the experiences and capacities of the European statistical system to deliver environmentally relevant statistics on a regular basis, which will be comparable to and linked to the traditional official statistics in the economic and social fields. (7.1)

Despite reservations about the data and the structures for its collection and dissemination, some of which have just been described, there is a firm basis of environmental and social information in the state. It is evident however that some re-organisation and patching of the system is required. We will next describe how the current information structure would fare in relation to the task of constructing indicators, under the three categories of environmental indicators described, that is (a) environmental indicators for individual themes, (b) green national income, and (c) national sustainability indicators.

3.1 Environmental Indicators for Individual Themes

Many indicators for individual themes exist or can be readily assembled for Ireland. However in the areas where weighting of components is required to sum up to aggregates, indicators may not be very acceptable, unless the question is largely technical and undisputed. An example of weights which would be technical in nature would be the relative contributions of different gases to the Greenhouse Effect. Requiring virtually no weights, and therefore less contentious, are the indicators such as the OECD core set and some indicators of national themes. The OECD core set already exists and has been produced, and many of the tables listed in Table 2.1 above have been presented for Ireland, in a readable format in OECD's document. Some might need to be adapted and updated for release here.

A good example of an existing worthwhile focused indicator for Ireland is the table by the ERU on quality in selected rivers, which shows quality of water, over time, reproduced below as Table 3.1. It shows that the proportion of seriously polluted rivers has declined but that of slight to moderately polluted rivers has risen. It shows sufficient detail so that the reality is not masked. Some might argue that it should be amalgamated into a single series, but then worthwhile information about the different trends would be lost. It might actually be desirable to have two or more forms of presentation. One document might present such information in a form which is more immediately comprehended: for example as a shares graph, with three colours for the three different levels of pollution and similar treatment for other themes, for visual impact. The other document would give the data.

Table 3.1: *Quality of Water in Selected Rivers, 1971, 1981, 1986 and 1990*

	1971		1981		1986		1990	
Quality Status	km	%	km	%	km	%	km	%
(a) Generally Unpolluted	2,400	83	2,250	78	2,000	69	1,900	65
(b) Slight to Moderate Pollution at Times	300	10	530	18	820	28	950	33
(c) Serious Pollution at Times	200	7	120	4	80	3	50	2
TOTAL	2,000	100	2,900	100	2,900	100	2,900	100

Notes: The table relates to 2,900 km of river channel selected on a priority basis in 1971. The classification system used in Ireland is somewhat stricter than that used in the rest of Europe, also nearly all Ireland's rivers are of sufficiently high quality to support salmon and trout.

Source: ERU (1993), *Irish Environmental Statistics*, Second Edition, Table 7.

The immediate task in the production of these focused indicators is the choice of themes. This could involve an open-ended debate. It would seem sensible to combine the informed knowledge of the professionals in the field, that is of (1) the official bodies, such as the EPA and others mentioned in this section, (2) the people who are practitioners in the field of the environment, such as the contributors to such conferences as *Promise and Performance: Irish Environmental Policies Analysed* (Resource and Environmental Policy Centre, 1983), *Environment and Development in Ireland* (UCD Environmental Institute, 1991) and to the *National Sustainability Indicators Forum* in 1995 (Convery and

Feehan, 1996), with (3) public opinion as revealed in surveys, such as Murphy, *et al.* (1994). These three groups may differ as to their selection of themes, or at least as to their ranking of themes. Some of the public might implicitly assume that "someone else" would be doing the work of constructing the indicators and be paying for them, and so the public could be considered an unreliable guide – though of course, the public is in fact paying. In other cases, the public may be very closely involved, be financially supportive and very expert. They are worth consulting in any case.

A scan through the three conferences, just mentioned, reveals the following themes. In 1983 these were air and water, conservation of species (birds), conservation of bogland, forests, the archaeological resource, urban environments and the Medieval City. In so far as they impact on the environment and on resource depletion, agriculture and energy were also the subject of several papers. In the 1991 conference, global issues came to the fore, greenhouse gases and oceans, the built environment had a strong showing (having also been the subject of two other specialised conferences *Replace or Retain? Irish Policies for Buildings Analysed* (Resource and Environment Policy Centre, 1988) and *The Role of Fiscal Policy in Urban Renewal* (Foundation for Fiscal Studies, 1991)), air and solid waste became prominent topics (the latter was also the subject of several seminars, e.g., *Wasting Away* (Democratic Left, 1994)), plant protection, forestry, marine resources, freshwater resources, species protection and natural areas also featured. Agriculture, energy and, this time, tourism were analysed in their roles as pressures on, and beneficiaries from, the environment. The 1995 conference featured climate change, air, water, soil (acidification was an explicit topic this time), noise, and also social development, the inclusion of which would have been prompted by the statement of the government parties.

Turning to public opinion as revealed by the opinion survey by Murphy, *et al.*, the first result to report is that 49 per cent of respondents felt that the quality of the environment "is deteriorating". Only 19 per cent thought that it was improving and the remainder felt that it is staying about the same. On balance, therefore, this indicator would show that the public perceive a deterioration overall. In the long run, a continued deterioration would indicate an unsustainable path, though it may be presumptuous to impute public opinion as saying that we are on such an unsustainable path.

Respondents were asked, without prompting, to name the main environmental problems which concerned them. They were given the opportunity to mention three problems, the first-mentioned problem is tabulated in Table 3.2a below. Second- and third-mentioned problems are tabulated in the next two tables. Numbers and percentages of respondents are shown. While respondents' replies did not differ much on the basis of sex, there was some variation on the basis of

age of the respondent. Younger respondents tended to be more concerned about global pollution, which may be a pointer to future interest.

It should be noted that these figures are ranks rather than weights. The fact that "water pollution", say, was first-mentioned by five times more people, than was "loss of nature", does not indicate a fivefold greater importance. What these figures do show is that water pollution, air pollution, rubbish on the streets and general waste management are foremost in people's minds. In so far as the other themes were also first-, second- or third-mentioned by a discernible number of people, it indicates that these are issues of some importance too.

The overall span of themes mentioned by the public agrees closely with that of the ERU and of the people with some sort of environmental track record. A brief summary would include: water, air, waste (including hazardous waste and litter), global pollution, urban quality (including noise), depletion of non-renewable resources and of species, and landscapes. As we saw, some basic data on these themes are to some extent already being collected. However there is some serious work still required to fill the gaps and overcome the quality problems.

3.2 Green National Income

The Central Statistics Office is informally keeping a watchful eye on developments in this field. While the question of environmental statistics might have been considered by the National Statistics Board when preparing the Strategic Plan 1993-1997 for the Central Statistics Office, environmental statistics are not on the agenda in that plan. The issues are already on the agenda in the international fora (the UN, OECD and Eurostat) of national statistics offices and, in the normal course of events, the CSO would not want to close off any options which it might wish to pursue in the future. The constraints on finance and personnel however prevent any practical applications, such as those by Bryant and Cook of the UK CSO discussed above. This is not to preclude individuals from taking initiatives in this field, who feel that they can readily apply the methods described for estimating depletion of Ireland's reserves, and who would be in a position to tackle the estimation of environmental degradation. As the latter require monetary valuation, certain skills are needed as well as an awareness of advances in methodology. It is highly feasible for these topics to be the subject of an economics post-graduate degree thesis, for example.

It is to be noted that some work has already been undertaken in Ireland which would be a step in the "halfway house" approach of de Haan and Keuning for the Netherlands, which was illustrated in Table 2.7 above. They required pollution emissions by sector, essentially an environmental input-output table appended to the national input-output table. Bacon (1980 and 1982) constructed an environmental input-output matrix for Ireland showing levels of certain pollutants (17 to water and 13 to air) per unit of output of certain sectors (17 sectors). He

Table 3.2a: *Main Environmental Problems of Concern: First Mentioned*

	AGE				Total
	18 - 29	30 - 44	45 - 59	60 +	
Water pollution	42 24.4%	67 21.7%	73 29.4%	69 32.5%	251 26.7%
Air pollution	28 16.3%	63 20.5%	40 16.1%	46 21.7%	177 18.8%
Rubbish on streets	29 16.9%	47 15.3%	52 21.0%	40 18.9%	168 17.9%
Waste management	23 13.4%	55 17.8%	35 14.1%	26 12.3%	139 14.8%
Global pollution	30 17.4%	33 10.7%	11 4.4%	4 1.8%	78 8.3%
Loss of nature	11 6.4%	15 4.9%	11 4.4%	10 4.7%	47 5.0%
Factories - chem	4 2.3%	11 3.6%	11 4.4%	12 5.7%	38 4.0%
Pesticides	3 1.7%	10 3.2%	11 4.4%	2 .9%	26 2.8%
Buildings	1 .1%	2 .6%	3 1.2%	3 1.4%	9 .9%
Using up natural resources	1 .6%	5 1.6%	1 .4%		7 .7%
Total	172 100%	308 100%	248 100%	212 100%	940 100%

Table 3.2b: *Main Environmental Problems of Concern: Second Mentioned*

	AGE				Total
	8 - 29	30 - 44	45 - 59	60 +	
Water pollution	20 13.7%	60 22.1%	45 21.6%	53 29.1%	178 22.0%
Waste management	29 20.0%	52 19.1%	43 20.7%	27 14.8%	151 18.7%
Air pollution	28 19.3%	34 12.5%	35 16.8%	20 11.0%	117 14.5%
Rubbish on streets	15 10.3%	38 14.0%	27 13.0%	32 17.6%	112 13.9%
Global pollution	12 8.2%	36 13.2%	11 5.3%	6 3.3%	65 8.1%
Loss of nature	14 9.6%	21 7.7%	14 6.7%	13 7.1%	62 7.7%
Pesticides	10 6.9%	12 4.4%	15 7.2%	18 9.9%	55 6.8%
Factories - chem	12 8.3%	11 4.0%	12 5.8%	7 3.8%	42 5.2%
Intrusive/derelict buildings	3 2.1%	6 2.2%	4 1.9%	5 2.7%	18 2.2%
Using up natural resources	2 1.4%	2 .7%	2 1.0%	1 .5%	7 .9%
Total	145 100.0%	272 100.0%	208 100.0%	182 100.0%	807 100.0%

Table 3.2c: *Main Environmental Problems of Concern: Third Mentioned*

	AGE				Total
	18 - 29	30 - 44	45 - 59	60 +	
Waste management	18 21.7%	44 25.4%	26 22.0%	17 14.9%	105 21.4%
Water pollution	18 21.7%	30 17.3%	24 20.3%	21 18.4%	93 19.0%
Rubbish on streets	11 13.3%	24 13.9%	18 15.2%	24 21.0%	77 15.7%
Air pollution	8 9.6%	22 12.7%	15 12.7%	20 17.5%	65 13.3%
Loss of nature	8 9.6%	15 8.7%	17 14.4%	10 8.8%	50 10.2%
Pesticides	6 7.2%	10 5.8%	8 6.8%	14 12.2%	38 7.8%
Global pollution	10 12.0%	14 8.1%	5 4.2%	4 3.5%	33 6.7%
Factories - chem	4 4.8%	9 5.2%	2 1.7%	2 1.8%	17 3.5%
Intrusive/derelict buildings		2 1.2%	2 1.6%	3 2.6%	7 1.4%
Using up natural resources		3 1.7%	2 1.7%		5 1.0%
Total	83 100%	173 100%	119 100%	115 100%	490 100%

was able to combine information on water pollution from IIRS (again with reclassification required owing to the difference of classification used by IIRS and CSO). Air pollution was incorporated from information supplied by IIRS and by the input-output table of energy by Henry and Scott (1977). Bacon's information refers to the year 1973. He concludes that the data requirements are considerable and that consequently such models can only be produced after a time lag. That said, his work demonstrates that the task is broadly feasible and with improved information on the environment and better data-processing equipment, the task should be easier now. Unfortunately the most recent input-output table of the economy produced by the CSO is for the year 1985, and the table for 1990 will not be available until mid-1996. Even then it may be advisable to do a shorthand update, to 1995 say, using one of the established methods.[54] A word of warning should be sounded on the use of input-output analysis: the coefficients are expressed in averages, however the main damage caused by emissions or waste may only arise at the margin, that is from extra units in sensitive areas, for example. In any event, such work does not feature on CSO's present agenda, which is already stretching its resources.

3.3 National Sustainability Indicators

We saw that this entailed taking national net savings and subtracting depletion of natural assets. Figures for national savings are generally available so that the depletion of natural assets remains to be estimated. As this task is the same as the monetary estimation of depletion, including degradation, required for green national income, the same considerations apply as for (b) above. It can however be undertaken in stages.

Before concluding this chapter, it is worth giving an outline of the programme of work which the European Commission recently initiated. It is a five-year programme for the development of "green accounting" (COM (94) 670). Our information agencies and official bodies will be involved in this programme, which is described in Box 2.

It can be seen that the European programme parallels much of what we have been describing, so that we can expect a supportive ambience for whichever route Ireland decides to choose as its priority.

[54] Such as RAS (Henry, 1973).

Box 2. European Commission's Five-year Programme for Development of "Green Accounting"

The European Commission has initiated a five year programme which revolves around green accounting, which can be described in six parts. It will form part of the framework within which Ireland will want to co-operate.

1. **ESEA** A common reference for accounting for all activities of the EU in the area of green accounting will be the *Handbook on a European System for Integrated Environmental and Economic Accounting* or *ESEA*, which will be comparable with the UN handbook SEEA, but will take into account European considerations.

2. **ESEPI** A *European System of Environmental Pressure Indices* or *ESEPI* (described under physical indicators, by Jesinghaus (1995) of Eurostat) which will help to set priority themes, collect indicators and establish weights for aggregation to pressure indices.

3. **ESI** *The European System of Integrated Economic and Environmental Indices* or *ESI*, to produce comparable integrated environmental and economic indices for the EU (and comparable with de Haan and Keuning (1995)).

4. **A Satellite Programme** Continuing and enlarging the work on satellites to national accounts, such as environmental expenditures, natural resource accounting, etc.

5. **Monetary Evaluation Programme** for improving the methodology and enlarging the scope of monetary valuation of environmental damage with a view to bringing such information into the Satellite Programme.

6. **Co-ordination of Activities** with economic actors as well as NGOs in order to promote collaboration and transparency, via regular meetings.

Chapter 4

SUMMARY AND RECOMMENDATIONS ON ENVIRONMENTAL INDICATORS

Three major types of environmental indicator have been explained and discussed in this essay. The concept of sustainability featured in these indicators to varying degrees. This is because the term is sometimes used loosely to relate to anything that contributes to environmental or social protection. In stricter terms we saw that sustainability means that one is not continually running down one's capital, man-made and natural. Each of the main types of environmental indicator will now be summarised.

4.1 Types of Indicators

(i) The first indicator discussed was that group which covers *individual themes* and we saw various extensive exercises undertaken, for example, in the OECD, the Netherlands and in Eurostat. Focused indicators of sustainability relating to themes of national interest seemed promising and relevant. An example was given above for water quantity in the UK. One could see there that in some regions over-abstraction could occur in drought years. Another indicator of river quality in Ireland was shown, which gave a representative picture. That said, the information was conveyed in tables, rather than as simple trend lines or single indices, which may (or may not) be closer to what the public would comprehend more easily. In the Netherlands, single indicators are constructed for individual themes and are oriented to the public. While they are called sustainability indicators, in so far as sustainability targets are specified, their targets are more by way of politico-scientific rather than economic-scientific goals.

(ii) The next indicator to be discussed was *green national income*. The formulation of this indicator essentially involves making three adjustments to existing national income accounts, namely, adjustments for depletion of resources, for environmental degradation and for "defensive" (or abatement) expenditures. At the Rio Earth Summit in June 1992, governments were called upon to:

> expand existing systems of national economic accounts in order to integrate environment and social dimensions in the accounting framework,

including at least satellite systems of natural resources in all member States (8.42).

This falls somewhat short of estimating green national income. However, we saw that green national income had been estimated in a preliminary and partial way by the UK Central Statistics Office, for example, to take account of oil and gas depletion. The concept of sustainability was applied by them to depletion of non-renewable resources. The method for doing this is to consider the finite stream of net income that is derived from extracting and selling the resource: by investing that stream it can be converted into a *perpetual*, smaller, stream of income, which is a "sustainable" income. In conventional accounts the whole of net income from extraction is counted as income, which is an overstatement. The task of making an adjustment for commercial natural resource depletion is tractable. As for actual stock accounts, it appears[55] that no national statistics office has produced complete national accounts of stocks of natural resources, as part of National Balance Sheet Accounts, as recommended by the UN (1977). In Canada it was decided in 1990 that the wealth accounts would be expanded to measure natural resources, as a step in the direction of measuring sustainability. Two natural resource accounts, one non-renewable (petroleum and gas) and one renewable (forestry), are being used as pilot projects to develop and test the conceptual framework.

Depletion of non-commercial resources or the degradation of the environment are more difficult matters, requiring monetary valuation before they can be subtracted from conventional income. Despite this, we saw that many analysts were responding to the challenge. A serious exercise is the valuation of air pollution, in terms of the costs imposed on others per tonne emitted, taking account of the effects on health, forestry, buildings et cetera.

That said, the impression should not be given that the exercise is plain-sailing bar a few outstanding tasks. In many cases, work actually achieved to date at official level is more modest than one is led to believe. There are still several important conceptual issues and loose ends to be addressed. In Canada's accounting project for example, mentioned above, monetary estimates of environmental damage (by contrast with environmental protection expenditures) are not explicitly part of the work, although research in this area is foreseen. As for work in Germany, the derivation of "eco-national product", analogous to GDP was not viewed as practical, by the Advisory Council to the Minister of the Environment in 1992.

Without going to the full extent of estimating green national income, we saw that the Netherlands' Central Bureau of Statistics has linked economic growth and *physical environmental effects* in integrated accounts. The results of this exercise

[55] Hamilton, *et al.* (1994) conducted a survey of the use of natural resource and environmental accounting in seven countries. Some of their findings are quoted here.

enable one to say, to give an example, that Net Domestic Product (or output of a certain industry) has grown by x per cent, but that associated acidification has grown by y per cent (of which z per cent was due to that industry). Canada is also progressing along this route, by integrating information on the negative by-products from production and consumption activities. Generation of wastes and pollutants in relation to other economic variables at industry or commodity level along with other accounts under preparation on natural resource use, will provide inputs to policy models by linking economic activity to physical flows in the environment. In France, by contrast, work in the past on the "patrimony" accounts, a comprehensive and ambitious environmental accounting exercise using physical units, does not appear to have fed significantly into environmental decision making. The French Institute of the Environment formed in 1991, is recommencing work on the patrimony accounts and is co-operating with the French Statistical Office, INSEE, on conceptual issues. In Germany, work on the system designed by the German Federal Statistical Office for Environmental-Economic Comprehensive Accounting was announced in 1990, priority being placed on the collection and integration of physical data.

The Netherlands would appear to be one of the few countries which examines the connection between domestic economic activity and the use of the environment in countries supplying imports to the Netherlands. Increased interest in global environmental issues could provide an impetus to more widespread attention to the international dimension.

(iii) The next indicator which was discussed, the *national sustainability indicator,* alerts us to the trends in the capital stocks of natural plus produced capital. A national test of sustainability is to check that aggregate national savings less the depletion and degradation of natural assets is positive, taking one year with another. Depletion, and degradation in particular, are not easily measured, however. This test embodies the assumption that assets can be valued and that they are substitutes for each other. It is a "weak" sustainability test and is the more difficult of the two sustainability tests to measure. If different forms of capital are deemed not substitutable, which is likely in so far as some forms are essential or "critical" capital, then the natural capital stocks *per se* can be the test measure. This is the strong sustainability test and brings us full circle back to individual themes. The ozone layer or the carbon cycle would be examples of critical capital, as would be some eco-systems. Uncertainty concerning the extent to which they might be regenerated if damaged, encourages use of the strong sustainability approach. In any event the distinction is not always clearcut. For example, some[56] would maintain that, even under the weak sustainability assumption of substitutability between produced and natural capital, in the case of

[56] E.g., Pearce (1993).

natural resources that are in fixed supply such as fossil fuels, depletion should be accompanied by investment in substitute resources in renewables or energy conservation and the like.

Negative or a long-term decline in net savings indicates an unsustainable path. These indicators have been calculated for the OECD and sub-Saharan Africa, and for the UK, for example. The indicator for sub-Saharan Africa did indeed show that in recent years its path has been unsustainable, suggesting that future living standards will be lower. It is in resource rich countries, with high levels of exploitation and little asset replacement that such indicators are very worthwhile. In the case of some developing countries, the message is stark and fairly indisputable: that well-being will decline. There might not be quite the level of interest in calculating aggregate national sustainability indicators in developed industrial countries, possibly because the message is less stark. The amount of work entailed in calculating these national indicators fully could be nearly as great as for green national income, however one can estimate them some of the way, making it clear that certain types of degradation have been ignored. In fact we saw that there is a lot of current work in the field of valuation of degradation and the like.

4.2 Data Availability

There is a good foundation of information on many environmental and social issues, produced notably by the Department of the Environment's Environmental Research Unit in the past, by the Environmental Protection Agency from now on, by the Department of Transport, Energy and Communications, which has responsibility for energy, and by the Central Statistics Office. In some cases there are problems which arise owing to insufficient co-ordination between the bodies. In several cases, information is available but only as a result of a once-off or infrequent survey. Notable examples are the information on discharges to water, the information on solid waste, the extraction of peat (as well as the inadequacy for policy analysis of information on prices, where these are relevant).

With these observations on the availability of data in mind, we saw that progress on the production of indicators was possible, in several directions. Individual environmental indicators can be readily assembled for several themes. Many others are already presented in the OECD's Core Set. Some people may consider that this information is already too extensive and that a reduced number of composite indicators is what is required. To reduce the number very considerably would require applying weights, which can be readily used, where available, for technical aspects. For non-technical aspects, the issue of aggregation should be approached with care. If to construct, say, an index of urban quality one decides to combine noise, pedestrianised area, and air quality or whatever, it is advisable that the relative importance attached to each item be stated explicitly.

Meanwhile the work on weighting being undertaken elsewhere should be followed with interest.

Steps could be taken towards valuing green national income and national sustainability by starting with adjustments for depletion of commercial natural resources. Though valuation of degradation cannot immediately be presented, its pursuit as an academic exercise needs to be encouraged, because this work is bearing fruit elsewhere. In any case the work is necessary because, whether we realise it or not, in forming policies and laws, implicit assumptions are often being made as to the worth of what is being promoted or protected by the law. Indeed, the UK Environment Agency is required to show, explicitly, that the benefits of a regulation outweigh its costs. This is a tough requirement, but then regulations do impose costs and ought in theory to be justified. Furthermore, well-based valuation may stem the possible anti-environment backlash, such as we are witnessing in the US, with the dismantling of environmental regulations.

Physical indicators can go a step further and integrate with the national accounts, provided that one has an up-to-date input-output table of the economy. As has been attempted before in Ireland, one can obtain sectoral pollution emissions for construction of an environmental input-output matrix, for linking to the national economic performance. This route has recently been followed to good effect by the Netherlands Central Bureau of Statistics.

4.3 Choice of Themes

There seems to be a core list of agreed themes chosen internationally, though they might look different and some agencies may list extra themes reflecting special interests. The choices by OECD and Eurostat, shown above, are quite similar though the terms used and categorisations differ. The United Nations' list of themes, shown in Appendix I(a), is similar to that of OECD except for the addition of Oceans and Coastal Zones. The World Bank has the pressure-state-response grouping of information but another way of grouping the issues, as seen in Appendix I(b), and the European Environment Agency in its overview entitled *Europe's Environment*[57] uses a fairly different categorisation to group its chapters. In these circumstances it would be appropriate to recognise that basically similar information is being imparted whatever the categorisation, that one will have to be flexible and that the underlying aim is to impart relevant information.

It would seem sensible for Ireland to conform broadly to the indicator themes as arranged by OECD and Eurostat, which have been the subject of much thought and from which some experience has been gained by working on them. We can benefit from this. Our membership of international organisations means that Ireland will probably be contributing to the international data sets in any case.

[57] Known as *The Dobris Assessment, 1995b* (edited by Stanners and Bourdeau).

There will be further information required for appraisals of how we are performing in relation to targets, such as for the themes (Appendix I(c)) set out in *Towards Sustainability*, the 5th European Environmental Action Programme (CEC, 1992). However, Ireland would have an added interest in what are the special characteristics of its environmental endowment, or in items which it has which are in decreasing supply worldwide – its quality of water and air, its landscape and wilderness areas, its resources of fish and other species, certain features of its built and natural environment and its culture, for example.

To fulfil the spirit of the commitment in *A Government of Renewal* there should be emphasis on those assets where sustainability is in fact threatened or potentially threatened, as these are aspects of concern. These include species, the built heritage and landscapes (e.g., wetlands). Different audiences require different levels of detail. Therefore a small number of indicators, perhaps a dozen, could be highlighted. These would be presented in a way that they are easily understood by the majority of the population. These might be indicators which show what is happening to the main assets of interest over time and would be like "state" indicators (in the "pressure-state-response" context). For some themes state indicators might be less feasible – like for ozone depletion, the relevant Irish indicator has to be emissions of ozone depleting substances (i.e., pressures, also if there is a timelag before the result manifests itself), or less direct – one might wish to show over time the state or extent of fishlife in rivers, but the measurements available might only tell us whether or not the quality of water is capable of supporting fish. There would be advantages to having a few easily assimilated indicators, enabling people to state "x per cent of our beaches have clean water for bathing" or "y per cent of this heritage or that species survived/disappeared in the last five years". The difficulty with a small number of indicators lies in trying to give a representative picture. That said, even with a large number, the picture is still dictated by how representative are the available data or by the tractability of the subject.

Apart from the desirability of producing a few highlighted, easily assimilated, indicators, there remains the necessity for a comprehensive set of background information. This suggests the assembly of data on state, pressures and responses to answer the questions: what is the evolving state of our environment, why, and what are we doing about it. Under the heading of responses, the categorisation could include more information on the policies used, that is on government action on providing information to enable people to behave in an environmentally aware manner, as well as more indication on use of economic instruments, on regulation and monitoring as well as on direct government action, such as investment in waste water treatment plants. At the same time, a sense of proportion needs to be maintained: with scarce financial resources the state needs to balance whether to

spend them on information to people (e.g., on where their local recycling facilities are) or on finding out the extent to which people know the information, i.e., on indicators. A balance is needed. The ideal would be to combine the two: testing and imparting information.

In the *State of the Environment* report, the Environmental Protection Agency has made a similar argument for addressing those aspects of themes which are of special interest to Ireland. Some of the refinements proposed by the EPA are shown in Appendix V. It also suggests refinements to some of the OECD indicators to take into consideration the fact that in certain areas or at certain times, receiving media are more vulnerable than at others. (For example they recommend an indicator on "extent of nutrient removal in sensitive areas"). This addresses the problem mentioned before, that information on emissions or abatement *per se* is sometimes uninformative without some indication of their potential harm or good. The report also lays emphasis on the evolution of the physical and socio-economic background[58] to the environment, or "driving forces". It lists urbanisation, population growth, afforestation, agricultural practices and the like, some of which might actually be responses to fiscal incentives.

In addition to considering the lists of themes covered by the OECD, by Eurostat and the United Nations, one ought to consider expressed themes of popular interest. An examination of topics covered at some conferences in Ireland run by non-governmental organisations (NGOs) during the last decade, as well as the results of a survey of public opinion, were discussed above. These showed a strong popular emphasis on water and air pollution and on litter and waste management topics, similar to the themes of the international bodies, though not with the same names (e.g., "water" instead of "eutrophication"). The conference topics and the NGOs' areas of interest additionally feature the built environment, including historic buildings, and resource depletion. Without restricting workers in this field by specifying the precise indicators to be used, the following is a combined list of the candidate areas to be highlighted.

[58] Carty (1996) of the EPA states that emphasis should be put on the close relationship between the environment and the economy.

Table 4.1: *Potential Environmental "State" Indicators for Ireland*

Themes	*Aspects of concern*	*Indicator (Time series)*	*Availability of data*
Eutrophication (from agriculture and sewage etc.)	Water quality Health Fish Visual quality Amenity Marine waters	Concentrations of DO, N and P in inland waters. Quality of water at bathing areas. Fish populations.	All quite good
Acidification (from SO_x & NO_x emissions, mainly energy use.)	Air Water Soil Health (respiratory) Building damage	Acidity of rain. Ph in soil and water.	Recent data good.
Toxic contamination (e.g. from pesticides & hazardous waste)	Contamination of food chain Health Damage to eco-systems (Also radiation)	Quality and composition of solid waste. Hazardous waste. Contamination from pesticides, etc. Soil contamination	Patchy.
Urban quality	Health: air Quality of life: noise, congestion.	SO_2, nitrogen compounds, particularly NO_2, lead, tropospheric ozone, VOCs, PM_{10} in air. Water quality. Urban noise index. Traffic density or travel times. Dereliction.	Quite good. " " Poor. " "
Built heritage	Survival History	Disappearance of built heritage. Loss of historic sites. Damage to monuments.	Patchy: audit required.
Species/ Biodiversity	Threatened birds, mammals, amphibians, plants etc.	Population trends. % threatened. Habitats, eco-systems (as landscape).	Birds, fish, amphibians: good. Mammals: patchy. Insects, fungi: poor.
Landscapes	Visual quality, habitats. Coastal zones.	Views. Wetlands, peatlands. Semi-wilderness areas.	Difficult. Not good. Quite good.
Resources	Water, forest, soil (incl. overgrazing).	Sufficiency/shortage of water. Afforestation. Soil erosion.	Patchy.
Finite resources	Depletion of minerals	Extraction. New economic discoveries.	Patchy.
Waste	Hazardous waste. Landfill area and quality.	Hazardous waste. Solid waste.	Fair/ improving
Global warming	Weather extremes, lowland flooding, international social disruption.	Emissions of GHG per head (over time v OECD or EU average).	Good in some respects.
Ozone depletion	Health. Effects on natural environment.	Release of ozone depleting substances per head (over time v OECD or EU average)	Poor

Note: DO = dissolved oxygen, N = Nitrates, P = Phosphorus, GHG = greenhouse gases.

Much of the data listed in the table would be of variable quality, however we can expect gradual improvements. This stems not only from its licensing role but also from the requirement that the EPA (under Section 63 of the Act) exercise general supervision over the performance of local authorities, in relation to drinking water, collection and treatment of waste water, collection and disposal of waste, and ambient monitoring, among other tasks. Work on indicators should, however, be but the small visible part of a general co-ordinated effort to get the provision of environmental data firmly launched.

It is usual and helpful in publications on indicators to include a brief description of the theme or issue, e.g., why it is an area of concern. In the descriptions given in the OECD Core Set or the ERU Statistics, there is an explanation of the units and weights as well as sources of information and advice on the issue. Some of the data and issues are described in more detail in the conference papers edited by Convery and Feehan (1996).

In keeping with the idea of sustainability, that is of the trend of assets over time, Table 4.1 lists mainly time-series of state variables, in compliance with the commitment on environmental indicators by the government parties. However, as mentioned, much background information is also required in order to clarify the causes and give deeper understanding of the state. For example, information on the state of eutrophication in water is good, as noted in the table, even though pathways leading to eutrophication are not fully understood. Indicators of response also require upgrading and performance in relation to targets will also be needed. If, in addition, the information is reclassified to give sectoral detail, and regional detail, the volume of data has become unavoidably large.

4.4 Environmental Indicators and Policy – Lessons from Abroad

Before concluding the discussion of environmental indicators, it should be mentioned that the approach abroad[59] is quite varied as are the aims. Countries tend to start on themes which are important to them. For example, in Norway the main focus is on air and energy, whereas fisheries, minerals and forests receive less attention. Data that are useful for policy analysis would be more important to them than sustainability indicators. Green national income is not a goal either but physical accounts can be helpful in monitoring specific policies. There are some recent efforts to give monetary valuations to oil and other depletable resources and to the benefits from air pollution control, in order to analyse tax proposals based on the Polluter Pays Principle. In the case of Canada, a key goal of the work is to make progress towards measuring sustainability. However, they emphasise that this is a complex concept, and perceive existing work on wealth accounts as a useful step in the right direction.

[59] As described by Hamilton *et al.* (1994).

We saw that data collection, assembly and presentation are expensive tasks. This fact, allied to the extra pressures imposed by the requirements for access to data, suggests that efficiency in the overall information system should be an objective of the agencies involved. Co-operation between the agencies should be encouraged as it would be mutually beneficial, and not just for financial reasons. There would appear to be formal co-operation in the structure of some of the bodies involved abroad. Explicit recognition of the environment-economy relationship and a concerted effort to increase the economic orientation of the work on environmental statistics in Canada, led them in 1991 to place the environment statistics programme in the National Accounts and Environment Division of Statistics Canada. In Germany since 1990, work on Environmental-Economic Comprehensive Accounting (UGR) is carried out by a sub-division of the Federal Statistics Office, with a task force co-ordinating its work with the national accounts, especially input-output tables, and the information systems division. In Norway, physical resource accounts are closely linked to macro-economic models used for planning Norwegian social and economic growth. The Central Bureau of Statistics assumed responsibility for the Norwegian Resource Accounting System (NRA) in 1978, working in co-operation with the Ministry of Finance and the Ministry of Environment. The NRA generally uses secondary data collected by other institutions directly involved with the environment, mainly the State Pollution Control Authority. Because the Central Bureau of Statistics is responsible for developing macroeconomic planning models for the Ministry of Finance, it is close to the policy-makers. The NRA in turn is close to the Ministry of Environment, thereby facilitating the introduction of environmental issues in conventional economic planning.

It would appear to be useful to have links between the data providers at the environmental level and at central economic policy level. In Ireland's case the question of the collection of much primary environmental data is largely settled on the EPA. There needs to be good linkage between primary data gatherers and the CSO, the body with ultimate responsibility for data, to ensure compatibility for economic policy analysis. It is suggested that there be a small task force, with representatives of the main relevant bodies to ensure that this linkage operates well. In Sweden, for example, collaboration between Statistics Sweden, the National Institute of Economic Research and the Environmental Protection Agency is organised in the form of a consultative group which also includes representatives both of research in the field of environmental economics and of the ministries concerned.

The manner of publication is an important issue also. It is interesting to note that several Scandinavian countries publish environmental data closely alongside their national statistics. Statistics Norway has a research department, in which

one of the four divisions is the Natural Resources Division, so that the quarterly journal *Economic Survey* frequently includes environment-related articles. Statistics Sweden with the National Institute of Economic Research has published *Swedish Economic and Environmental Accounts*. Similarly in Finland there is a close link between the supply of official economic and environmental data. If a high profile is desired for environmental matters in Ireland, the publication of environmental indicators might be timed to coincide with the release of the Department of Finance's *Economic Review and Outlook*, which gives preliminary estimates of recent national income growth, or with the Central Statistics Office's release of *National Income and Expenditure*. When progress has been made on national environmental accounting, the latter might include an annexed table of environmentally adjusted national income or tables of volume-based environmental effects associated with economic output, such as Table 2.7 above from de Haan and Keuning. Provided that they are constructed in a valid manner, such tables, as qualifications of national income, can justifiably be produced alongside publication of national income.

4.5 Recommendations on Environmental Indicators

In conclusion, we will describe the recommendations for the task ahead arising from the discussion so far.

There is no one type of environmental indicator which is to be recommended for development above all others. There are indicators for individual themes, environmentally adjusted (or green) national income and national sustainability indicators. Indicators for individual themes can be most readily developed. The environment is such a multi-faceted subject that again there is no one single best categorisation of themes. The people constructing these indicators are advised to give space to aspects that are special features in Ireland and to keep an open mind about other categorisations that are used elsewhere.

An inventory of important themes should be constructed and updated regularly showing the availability and quality of data for each theme. Indeed there could be alteration of themes. Table 4.1 is a preliminary example for state indicators, OECD's list is another example, given in Table 2.1.

A selection of perhaps a dozen environmental indicators, representative of the themes listed in Table 4.1, could be presented in a form which is readily understood by a wide section of the public. In addition to these highlighted indicators, there is a requirement for regular publication of environmental data, the pressure-state-response categorisation being a useful framework though categorisation may occasionally be ambiguous. Sustainability is about trends in environmental assets, therefore the sustainability indicators chosen should largely focus on environmental assets over time. Even if some assets may not on balance be considered worth maintaining, it does not detract from the fact that we should

know what is happening to them. Many worthwhile indicators for Ireland can already be produced along the lines of those which are suggested in the EPA's *State of the Environment* report, in the OECD core set, in the Pressure Indices project of Eurostat, and in the headings of the report (European Environment Agency (1995a)) for review of *Towards Sustainability*, the 5th European Environmental Action Programme.

Aggregation of information is facilitated if one can evaluate environmental assets in monetary terms. However the difficulty in so doing means that a potentially massive amount of information is generated, while everything is expressed in physical units. This has led to interesting work on aggregation of data with the aid of non-monetary weights to give fewer, more user-friendly, indicators. The use of weights based on accepted technical considerations does not present problems. However the use of other weights should be made explicit, and the use of contentious weights is probably best avoided. Similarly any targets used should have an understandable rationale and be made explicit.

Monetary valuation is only developing. Without being aware, however, people are already implicitly using weights based on monetary valuation in their choices of policy and law-making. Most environmental policies and laws do involve costs (and benefits) which society has implicitly approved by the action of passing the policy or law. For many policy decisions to be soundly based therefore, it is clear that monetary valuation needs to be developed and improved.

Indicators of individual themes, environmentally-adjusted (or green) national income and national sustainability indicators are interlinked, and similar basic data are required for all of them. Green national income and national sustainability indicators additionally require monetary valuation of depletion and degradation. The national sustainability indicator measures the change in total assets, while green national income measures environmentally adjusted final consumption. Attempts at these measures for Ireland can proceed in steps. Though work abroad in this area is still somewhat tentative, progress in recent years has been good. For this and other reasons, Irish agencies should be encouraged and enabled to keep abreast of international developments in these fields.

Work can proceed on aspects of green national income and national sustainability, which begins by taking account of depletion of marketed natural resources. Satellite accounts can start to be constructed to incorporate degradation measured in physical terms, by emissions and the like, for integration with sectoral outputs in the national accounts, as by de Haan and Keuning. The manner of publication and timing should overtly present these indicators as qualifications to national income figures. They could be timed to coincide with the *Review and Outlook* or *National Income and Expenditure*, and when tables compatible with

national accounts become available, these could be annexed to the latter publication.

A structure needs to be in place to ensure good co-ordination between the agencies providing information as well as with policy makers and researchers using the information. This should avoid potential ambiguity arising from the CSO's role as co-ordinator of official statistics (with ultimate responsibility for national accounts) and the EPA's obligation to establish and maintain a data base related to environmental quality. Such co-ordination will pay dividends and would involve, at the minimum, the EPA, the Department of the Environment, the Central Statistics Office and also representatives from environmental research.

There is a good foundation of data in many areas, but work needs to be done to make the information more up-to-date and to fill the gaps. Important gaps that need to be filled include regular information on emissions to water and on solid waste generation. Provided that resources are available, the EPA and the CSO will be able to fill these gaps with the help of other primary data gathering agencies. Other gaps may require more fundamental work, such as information on the built environment, some species, intact peatlands and the like. The contribution by the primary data suppliers, that is the agencies, the local authorities and the public as respondents, is of critical importance because the quality of indicators will ultimately depend on the quality of the basic data.

PART II: SOCIAL INDICATORS

B. Nolan and T. Fahey

Chapter 5

SOCIAL INDICATORS

5.1 Introduction

The commitment in the 1994 Programme for Government to work towards "a new set of indicators of sustainable economic development" makes explicit that this will take into account not only environmental factors, on which this study has focused so far, but also social factors. Social factors have to be considered because economic growth, even if environmentally friendly, does not always lead to improvements in human welfare or the social quality of life. National accounts aggregates such as Gross Domestic Product or National Income, no matter how well adjusted to take "green" issues into the reckoning, are designed as measures of economic activity, not as measures of welfare. Welfare is determined not only by economic activity but also by a wide range of additional dimensions of social life. The purpose of social indicators is to try to identify and quantify those dimensions.

In this chapter we first discuss some conceptual and methodological issues which arise when we seek to go beyond existing measures of economic activity such as GDP to measure welfare. These issues include the cultural relativism of concepts like welfare or development, as well as more technical problems which arise in trying to define and operationalise those concepts. We then set out a framework which might be adopted in devising social indicators for Ireland, focusing especially on the list of social indicators proposed by the OECD. In many cases these can be derived from information already available, which would be brought together and presented within a new framework of social indicators. However, there are areas where the need to enhance the available information base is emphasised, and suggestions are made as to how this could be done.

5.2 Concepts of Welfare

5.2.1 Dimensions of Welfare

In going beyond the aggregate level of economic activity to measure welfare in any broader sense, we are confronted with an enormous range of possibilities. We could choose to confine our attention to material aspects of life such as income and poverty, housing, nutrition, the quality of either the natural or built environment

and so on. In addition, we could consider social relationships, as reflected in the nature or quality of family relationships, community solidarity, alienation, crime, respect for rights, etc. We could, indeed, go on to consider any of a wide range of cultural, aesthetic, spiritual or moral dimensions of life. This multiplicity of options means that we will inevitably have difficulty in arriving at a widely shared definition of welfare, of what are the central good things in life. The underlying problem is that the choices we make in this area will be dictated not by some objective rational standard but by the traditions, cultural background and social context from which we come.

The influence of social and cultural context on the concept of welfare is evident from the many challenges to the secular, technocratic and individualistic values which shape mainstream western assumptions on this question. Cultural outlooks as diverse as Islamic fundamentalism, various strands of conservative Christianity and the more radical forms of feminism provide widely divergent standards for determining what is valuable in human life. Conflicts between these standards have been evident even within the relatively homogenous cultural context of Ireland. It is not that long ago, for example, since religious perceptions competed with material ones in defining human well-being in Ireland, so that the numbers of people going to religious services on Sundays might be regarded as just as important an indicator of social quality of life as the economic growth rate. Likewise, feminists today might propose quite a different set of priorities in defining well-being than conventional male-dominated approaches to the same question.

There are those who assume that some dimensions of welfare (such as material living standards or health status) are more "neutral" or "value-free" than anything pointed to by these alternative views and who therefore argue that these merit a more central position in defining welfare. Others will respond that no dimension of welfare is inherently superior in these ways – there is no rational basis for deciding that we should value economic growth over social justice, individual liberty over social solidarity, rational scepticism over traditional religious faith, or the preservation of national or ethnic traditions over the spread of globalism. "Scientific" knowledge can often make the debate on such questions more informed, but it cannot resolve the underlying conflicts of value and ideology from which these kinds of oppositions emerge. In this view, to claim neutrality or detachment from cultural values for a particular approach is simply to fail to recognise the implicit value choices which underlie it.

Within the confines of this chapter, we cannot deal with the cultural or philosophical problems which arise in defining or measuring welfare. Rather, we largely evade those problems. We take a certain cultural context as given, even while we recognise the contingent, relative character of the discourse and

world-view underlying it. That context consists principally of western-led social science and the policy-making process of secular, democratic states, as well as of the international agencies which those states have generated (United Nations, ILO, OECD, European Commission, etc.). A tradition of thinking about welfare definition and measurement, of which the social indicators literature is a major part, has emerged within that context. Even though we confine our discussion within that frame, however, we do not entirely solve the problem of cultural context and the influence of values. Many of the ostensibly technical questions in the social indicators literature can ultimately be resolved only by reference to ideologies and values, and some of these we will refer to later in the present chapter.

5.2.2 Defining and Measuring Development

Research on social indicators grew out of dissatisfaction with the common practice of relying on conventional national accounts aggregates such as GDP or national income as measures of welfare. This dissatisfaction emerged from a number of different sources. One was the development debate which arose from the 1960s onwards in connection with those countries which were moving from what was then termed "under-developed" or "less-developed" to "developed" status. This debate eventually gave rise to serious efforts to produce measures of "human development" which would serve as an alternative to GDP. A further source of dissatisfaction was the feminist critique of the way in which conventional national accounts obscured or under-valued women's contribution to the economy, particularly by way of unpaid housework but also by way of part-time or informal participation in market activities. Finally, environmental concerns have of course focused attention on particular shortcomings of conventional measures. As these have been dealt with in Part 1 of this study, we shall not dwell on them here.

Much of the feminist and environmental concerns with measures of income focused on the narrowness of the concept of economic activity on which they rested. Even if those concerns were addressed, a more fundamental criticism of the use of measures of economic activity and resources as indicators of development often remained: the focus on income tended to confuse means with ends. The ends of development are of course difficult to define, and arriving at a definition which can be operationalised is even more problematic. The United Nations Development Programme, in its recent influential World Development Reports, defines "human development" as

> both the *process* of widening people's choices and the *level* of their achieved well-being (UNDP, 1990, p. 9).

From this perspective, growth in total income, no matter how comprehensively it is measured, has two key shortcomings as an indicator of human development. The first is that income is only one of a number of inputs which determine

development and the second is that measures of total income (or of average income per head of population) fail to reflect the distribution over the population. Increasing average income could thus be associated with no improvement, or indeed a deterioration, in the quality of life of much of the population. In devising alternative measures, therefore, the two key concerns were, first, to focus on non-monetary as well as monetary factors influencing welfare and, second, to measure the distribution of those factors across society (the degree of equality and inequality) rather than the overall level.

Developments of this type have for many years sought to move the emphasis away from per capita GDP as an indicator of the development of living standards. In the 1970s, a distinction was drawn between "objective" and "subjective" measures which might achieve this purpose.[60] Objective measures referred to externally observable factors such as life expectancy, nutrition, housing density, crime rates and so on. Subjective measures referred to "subjective perceptions, attitudes and evaluations by individuals of aspects of their lives, including perceptions of their objective conditions" (Davis and Fine-Davis, 1991, p. 107). The interest in subjective indicators arose because people's subjective sense of well-being seemed to be poorly correlated with their objective conditions. For many researchers, it therefore seemed necessary to track subjective welfare separately from objective conditions and to give equal standing to subjective indicators in assessing welfare. However, the vogue for subjective indicators, though well-founded on theoretical grounds, failed to overcome the challenge of measurement. It proved difficult enough to provide valid and reliable measures of externally observable conditions. Measurement of states of mind that would be comparable across time and place proved largely unattainable, and led to a decline of interest in subjective indicators in more recent years.

A more significant influence on the indicators literature emerged in the 1980s from the widespread perception that much of the developing world fared even less well during that decade than aggregate economic growth rates would suggest. The "basic needs" literature highlighted the importance of monitoring success in attaining for the population a set of minimum standards in areas such as nutrition, housing, water and sanitation, and education, and (less successfully) argued that government strategy should be organised around the provision of these basic needs (e.g., Streeten 1984). The related literature on "adjustment with a human face" sought to frame economic policy in terms of its impact on measures of welfare such as infant mortality rather than simply on economic growth and fiscal aggregates (see, for example, Cornia, Jolly and Stewart, 1987).

[60] For an effort in this direction in Ireland, see the suggestion for an Irish "Continuing Social Survey" which was advanced in the late 1970s (reported in Davis and Fine-Davis, 1991).

5.2.3 Capabilities or Outcomes?

More recent formulations of development aiming to refocus attention from income per capita and growth in production towards quality of life owe much to the "capability approach" to social evaluation proposed by Amartya Sen (see, for example, Sen 1984, 1985, 1989). The core notion is that what we care about is that people have the capability to choose freely to be and to do things that are valuable. The capability approach aims to provide a distinctive theoretical framework which sees evaluation focusing not on realised achievements or outcomes (which Sen terms "functionings"), but on the set of opportunities facing individuals, the extent to which they have the freedom to choose one kind of life rather than another. Growth (properly measured) plays an instrumental role in promoting development because it increases the range of human choice, but is not to be taken for the end-product itself. Proponents see this as a move away from a commodities-oriented view of development, which even "basic needs" would be, towards a view which "puts people first" (see, for example, Griffin and Knight, 1989, p. 9). In concrete terms, however, it is far from clear how this framework could be made operational (see, for example, the illuminating review by Sugden 1993), and Sen's own work provides relatively little guidance.

5.2.4 Human Development Index

Thus, although heavily influenced by Sen's conceptual approach, the UNDP in introducing a new summary measure of "human development" in 1990 relied on input and outcome measures to supplement income per capita. The Human Development Index (HDI) is a composite of life expectancy, adult literacy/schooling and GDP per capita, but these components are constructed in an innovative way and combined in a single measure. The HDI sets a minimum and a maximum for each of the three dimensions, and a country's score on that dimension on a scale going from 0 to 1 reflects where it stands in relation to these: for example, the minimum used for life expectancy is 25 years and the maximum is 85 years, so a country where life expectancy is 55 would score 0.5 on that dimension. The "knowledge" dimension is constructed in a similar manner using information on both the adult literacy rate and mean years of schooling. Finally, for mean income per capita in Purchasing Power Parity (PPP) terms the specified minimum is $200 and the maximum is $40,000, but income above the average is adjusted using a progressively higher discount rate. Thus a move from $500 to $1,000 mean income per capita will have a much more substantial impact on the HDI than one from $20,000 to $20,500, on the basis that once a country gets beyond the world average, any further increases in per capita income are considered to make a sharply diminishing contribution to human development.

Table 5.1: *Ranking of Developed Countries by Human Development Index and GNP per capita*

Country	*HDI Rank*	*GNP per Capita Rank*	*GNP-HDI Rank*
Canada	1	11	10
Switzerland	2	1	-1
Japan	3	3	0
Sweden	4	4	0
Norway	5	5	0
France	6	13	7
Australia	7	18	11
USA	8	9	1
Netherlands	9	16	7
UK	10	19	9
Germany	11	12	1
Austria	12	14	2
Belgium	13	15	2
Iceland	14	8	-6
Denmark	15	7	-8
Finland	16	6	-10
Luxembourg	17	2	-15
New Zealand	18	24	6
Israel	19	25	6
IRELAND	20	27	6
Italy	21	17	-5
Spain	22	23	0
Greece	23	35	10

Source: Human Development Report, 1994, Table 5.2, p. 93.

As shown in Table 5.1, there are significant differences between the way developed countries are ranked by the HDI and by income per capita. Canada has the highest HDI in the world, well above its ranking of eleventh by GDP per capita. Finland and Denmark, by contrast, are ranked much more highly by income than by HDI. The HDI portrays Ireland in a positive light: ranked 27 by income per capita, Ireland moves up to 21 by HDI. Thus, compared with other countries, Ireland performs better on the other dimensions of the measure – life expectancy, adult literacy and schooling – than our income level alone would lead one to expect. In developing the HDI, the ways in which it can be disaggregated by region, gender or ethnic group, and adjusted for the level of income inequality, have also been explored by the UNDP (see below for comments on the GDI – the Gender-related Development Index – which the UNDP has developed from the HDI).

Many criticisms can and have been made of the conceptual underpinnings and empirical basis on which the HDI is constructed (see, for example, Srinivasan, 1993; Stern, 1994), which the adjustments made to the procedure since its introduction do not adequately address. The value of combining disparate measures into an aggregate index in a necessarily rather arbitrary manner has to be questioned (Nolan, 1990). The HDI is also more suited to measuring progress in developing countries rather than developed countries – many of the latter now generally have such high scores on items like literacy and infant mortality that the HDI does not provide a sensitive measure of progress or lack of it in social life as a whole. For a number of reasons, therefore, the HDI seems unlikely to attain its hoped-for status as an alternative to GDP for measuring relative socio-economic progress, particularly in developed countries.

5.3 Multiple Indicators

Rather than seeking a single summary measure, developing a framework within which a range of indicators can be set seems the more productive route to follow. While the extensive literature on the relationship between economic growth and development provides sufficient evidence that per capita income is inadequate as the sole indicator of living standards or development, in a developed country context that literature provides little basis on which to identify indicators which could usefully complement it. Fortunately, there is a parallel literature focused specifically on developed countries on which one can draw. Taking as starting-point the fact that conventional economic indicators were not designed to be proxies for or measures of welfare, a number of quite distinct approaches have been explored. The first concentrates on the development of broad and comprehensive national accounts, which would reflect the value of all activity – market or non-market – bearing on the welfare of individuals. (As discussed in previous chapters, parallel efforts have been made to incorporate environmental

concerns, via the "greening" of the national accounts). Many of the national accounting profession have viewed this approach with suspicion, fearing that the introduction of highly subjective and arbitrary valuations and non-transaction information would destroy the usefulness of the accounts. While some countries have put a good deal of effort into broadening the coverage of the national accounts via the production of "satellite accounts", this appears to have had relatively little impact internationally and the scope for cross-country comparisons is limited.

Another approach is to seek to adjust conventional GNP/GDP measures directly rather than broaden their coverage, with Klasen's (1994) incorporation of adjustments for the distribution of income representing a good example. He examines four different ways of constructing "distribution-weighted growth rates" for the post-war USA, and shows that the pattern they show is consistently different to the unadjusted accounts. Taking income distribution into account, he concludes that welfare increased more rapidly in the 1960s and less rapidly in the 1980s than growth in real GDP per capita would suggest. This is certainly valuable in giving a more balanced picture than mean income alone, but does not address the limitations of income itself as a proxy for welfare.

This is where the third approach comes into its own: making use of non-monetary as well as monetary information to construct "social indicators". The literature on "social indicators" was initiated during the 1960s and had its hey-day in the 1970s, with interest then abating somewhat as economic growth itself slowed. While interest was at its height the OECD undertook its Social Indicators Programme in 1970, after a Ministerial declaration which stressed that "growth is not an end in itself, but rather an instrument for creating better conditions of life". By 1980 this Programme had produced the OECD List of Social Indicators, intended to serve as a core set of indicators to measure trends in individual well-being which countries could adopt, thus facilitating harmonised comparisons of trends across countries. In the next section we discuss how this List could provide the starting-point for the development of a set of social indicators for Ireland.

5.4 OECD Social Indicators

The criteria which the OECD adopted in developing its List of Social Indicators were that the indicators should:

(a) be output-oriented or designed to describe a final social outcome, rather than inputs, throughputs or intermediate outputs;
(b) be relevant to policy, in describing social conditions which are potentially amenable to improvement through collective action or public policy;
(c) be applicable over a long period of time in a substantial number of countries;

(d) apply to conditions of individual well-being, thus excluding "indivisible public goods" such as national defence or wild-life species protection;
(e) be independent of particular institutional arrangements, so as to be reasonably comparable between countries and over time;
(f) form part of a comprehensive grid portraying all areas of social concern;
(g) correspond closely to the social concern to which they relate, yet be more than a narrow description of social phenomena;
(h) form an integrated framework of definitions, specifications, statistical guidelines and disaggregations which should be compatible with other important sets of social and demographic statistics.

The List of Social Indicators developed on the basis of these criteria is shown in Table 5.2 (taken from OECD, 1982 Chart 1, p. 13) . It contains 33 indicators, 4 relating to health, 3 to education, 10 to employment and quality of working life, 2 to free time/leisure, 4 to the distribution of income and wealth, 6 to housing and environment, and 4 to social environment and personal safety. The indicators were selected with pragmatic considerations of ease of measurement and data availability in mind, and from the OECD's point of view maximising international comparability was a central aim. The Social Indicators Programme has not in fact lead to the envisaged outcome of a compendium of Social Indicators produced by the OECD on the basis of information collected and compiled at national level. One could question the balance of the list across the various areas, as well as its comprehensiveness, and it is obviously not tailored to specifically Irish concerns. A good deal could also be learnt from the experience of the small number of countries which have devoted substantial resources to developing statistics in this area, notably the Swedish Levels of Living surveys which have been carried out regularly since the mid-1960s (see, for example, Erikson and Aberg, 1987). None the less, the OECD List represents the result of the most serious and sustained effort to systematically identify a set of indicators which has broad applicability, reasonably comprehensive coverage, and feasibility. In our view it would be sensible to take these as a core set of social indicators for Ireland on which one could subsequently build.

It is important to be clear about what a set of social indicators constructed in this way would add to the information base. It would not in any way supplant existing measures of economic activity. Rather, the aim would be to complement these measures with indicators which reflect aspects of quality of life affecting individual welfare – a micro- rather than a macro-approach, as it were – so that a more comprehensive picture of trends in well-being of the population as a whole may be derived. The OECD List of Social Indicators can be seen simply as the

Table 5.2: *OECD List of Social Indicators*

Social Concern	*Social Indicator*	*Availability of Data*
HEALTH		
Length of Life	- Life Expectancy	Good
	- Perinatal Mortality Rate	Good
Healthfulness of Life	- Short-term Disability	Poor
	- Long-term Disability	Poor
EDUCATION AND LEARNING		
Use of Educational Facilities	- Regular Education Experience	Good
	- Adult Education	Poor
Learning	- Adult Literacy	Poor
EMPLOYMENT AND QUALITY OF WORKING LIFE		
Availability of employment	- Unemployment Rate	Good
	- Involuntary Part-time Work	Fair
	- Discouraged Workers	Fair
Quality of Working Life	- Average Working Hours	Good
	- Travel Time to Work	Poor
	- Paid Annual Leave	Good
	- Atypical Work Schedule	Poor
	- Distribution of Earnings	Good for some sectors
	- Fatal Occupational Injuries	Good
	- Work Environment Nuisances	Poor
TIME AND LEISURE		
Use of Time	- Free Time	Poor
	- Free Time Activities	Poor
COMMAND OVER GOODS AND SERVICES		
Income	- Distribution of Income	Fair
	- Low Income	Fair
	- Material Deprivation	Fair
Wealth	- Distribution of Wealth	Poor
PHYSICAL ENVIRONMENT		
Housing Conditions	- Indoor Dwelling Space	Poor
	- Access to Outdoor Space	Poor
	- Basic Amenities	Good
Accessibility to Services	- Proximity to Selected Services	Fair
Environmental Nuisances	- Exposure to Air Pollutants	
	- Exposure to Noise	
SOCIAL ENVIRONMENT		
Social Attachment	- Suicide Rate	Good
PERSONAL SAFETY	- Fatal Injuries	Good
Exposure to Risk	- Serious Injuries	Fair
	- Fear for Personal Safety	Poor
Perceived Threat		Poor

starting-point, and indeed was presented by the OECD in that light. The exact specification and measurement of the indicators would require close attention, since apparently innocuous differences in definition, coverage and methodology can lead to non-comparability across countries or over time (a major preoccupation of recent cross-country studies of poverty and income inequality, for example).

5.5 Social Indicators for Ireland

Before turning to the data sources which are available in Ireland for the construction of social indicators, we can indicate some of the non-technical questions which might arise in attempting to adapt the OECD list of indicators to Irish circumstances. While many of these questions may have technical aspects, they ultimately refer as much to values and ideology as to questions of fact or scientific methodology. Such issues arise in connection with both of the two main features of social indicators – their focus on distribution rather than on aggregates or averages and their concern with non-monetary as well as monetary dimensions of welfare. Here, all we can do is point out what some of these issues are likely to be.

As far as distribution is concerned, the question is what social cleavages should be chosen as the focus of attention. What are the social categories across which distribution is to be measured? Obvious candidates include social class and region: these represent dimensions of inequality which have long been recognised in Ireland and which many aspects of public policy have been geared to address. In other countries, race might be a concern and in Northern Ireland religious denomination has been the most controversial social cleavage. Neither of these issues, however, is likely to be of similar relevance here. Concern has sometimes been expressed about generational inequality, with particular reference to the elderly and children, so that age categories are often likely to arise in connection with the distributional dimension of social indicators.

In many countries, including Ireland, gender has been increasingly recognised in recent years as a key dimension of inequality. In its most recent World Development Report, for example, the UNDP declares that gender inequality is one of the main obstacles to human development (UNDP, 1995). In keeping with that view, the 1995 Report presents two new composite indicators of development which take account of gender – the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM).[61] If a gender perspective were to be

[61] The GDI is simply the HDI (described earlier) discounted, or adjusted downwards, for gender inequality in each of the constituent items in the index. It produces quite a different ranking of countries on the development scale than the HDI. The GEM is a measure of gender equality in control over resources, political participation and decision-making. It is comprised of three items: women's per capita earned income

applied to the OECD list of indicators, the minimum requirement would be to present gender differences on each indicator in the list. Beyond that, it might require further indicators to cope with issues peculiar to gender inequality. Under the heading of "employment and quality of working life", for example, it might be argued that measures of the female labour force participation rate and of gender segregation in occupations should be included since these reflect key aspects of gender inequality. In the case of "personal safety", experiences of sexual violence or domestic violence might be as relevant as serious physical injuries in measuring well-being. These examples indicate that the choice of social categories over which distribution is to be measured can be important, not only for the way those indicators are analysed and presented but also for the selection of indicators.

Moving beyond questions about distributional categories to questions about the factors which determine quality of life, we are confronted with an even broader range of possibilities. The OECD list, for example, includes no reference to family patterns, even though family life is often thought of as central to quality of life. Should the marriage rate, the rate of marital breakdown, the incidence of lone parenthood or the abortion rate be considered as indicators of quality of life? Neither is there any reference to crime – though here again there would be difficult questions about which types of crime might be considered most relevant, along with some formidable difficulties of measurement. Social integration is referred to in the OECD list under the heading of "social attachment", but only one indicator – suicide – is included under this heading. Other forms of self-destructive behaviour, such as drug addiction and alcoholism, might equally qualify under the same heading, as might other indicators such as organisational membership and sense of national or group identity.

Certain practical constraints might eliminate some of these possibilities. For example, most forms of illegal or socially disapproved behaviour are difficult to measure, so that no matter how relevant they might be to quality of life, they cannot be included in social indicators. In other cases, it might be difficult to reconcile differences between apparently similar or related indicators. In Ireland, for example, the incidence of homicide (often taken as a crude indicator of social integration) remained almost unchanged for the 30 years between the early 1960s and the early 1990s. In general, we had a murder about once every twelve days or so over that entire period though recently we have signs of an increase (O'Mahony, 1993, p. 38). The incidence of suicide, however, has increased about five-fold over the same period. We now have about one suicide per day on

(control over economic resources), women's and men's percentage shares of administrative, managerial, professional and technical positions (economic power and decision-making opportunities), percentage of parliamentary seats held by women and men (political participation and decision-making power).

average, compared to little more than one a week in the early 1960s. While some of that increase is due to a higher level of reporting of suicide, much of it reflects a genuine increase in suicidal deaths (some of the relevant literature is cited in Bowers, 1994). Thus homicide and suicide tell quite different stories about the trend in social integration in Ireland, and it would be quite difficult to decide which story is nearer the truth.

However, while such practical constraints are there, for many indicators the choice of what to include and what to exclude is more arbitrary. It depends on social priorities and cultural preferences rather than objective or practical criteria. In those cases, what is required is a process of debate and negotiation between representatives of various points of view in order to arrive at a decision on what the final list should aim to measure.

5.5.1 Data requirements

Much of the information required to construct the OECD list of social indicators for Ireland at aggregate level is already available, from a variety of sources. For example,

1. statistics on life expectancy are regularly produced by the CSO,
2. perinatal mortality data are collected by the Department of Health and published annually,
3. years of education and education level attained are measured in the annual Labour Force Survey (LFS) as well as the Census of Population,
4. information on unemployment, involuntary part-time work and discouraged workers, and working hours are obtained in the LFS,
5. statistics on the distribution of earnings in specific sectors are collected and published by the CSO,
6. data on the distribution of income is available from the Household Budget Survey,
7. information relating to housing space and amenities is collected in the Census of Population and published by the CSO, and
8. fatal injuries and suicides are among the causes of death distinguished in the vital statistics produced by the CSO.

However, the Census of Population is only carried out every five years, the Household Budget Survey at national level has been only every seven years, and CSO surveys of earnings have been intermittent. Much more frequent and timely sources would have to be developed in those cases. In other cases official data relating to the topic are available from administrative statistics but survey-based information would probably be required to permit meaningful comparisons with other countries or over time – for example on disability. For some of the other indicators in the OECD List, no official source of data currently exists – notably

use of time, distribution of wealth, environmental nuisances, and fears for personal safety.

In addition to these major gaps in information, in considering data needs it is also essential to note the OECD emphasis on the importance not only of obtaining consistent and reliable information on the various indicators for the population, but also of measuring their distribution across different population groups – for example, age, sex, income or socio-economic groups. Such disaggregation is an intrinsic part of any social indicators development programme, since the aim is to capture trends in individual rather than average welfare. Given this objective, the OECD stresses the desirability of collecting the required information through multi-purpose surveys of the population. The CSO is currently considering the possibility of a quarterly household survey to obtain, *inter alia,* more frequent information on labour force participation. Such a survey could provide an ideal vehicle for the collection of information which would permit the construction of social indicators for the population and their disaggregation by various sub-groups: this would require one of the quarterly surveys in each year to devote substantial questionnaire space towards this objective.

If an annual survey of that kind were being carried out, consideration must also be given to adding indicators to the OECD's core set. Among the many potential candidates, we would at this stage highlight the value of regular information on the prevalence of specific types of material deprivation. (Confusingly, the OECD List in referring to an indicator of "material deprivation" actually means the numbers falling below relative income poverty lines). Such deprivation indicators can be seen as a sub-species of social indicators, and have been researched in the Irish context using the survey of Income Distribution, Poverty and Usage of State Services carried out by the ESRI in 1987, detailed in Callan, Nolan and Whelan (1993) and Nolan and Whelan (1996).

5.6 Recommendations

This chapter has set out the rationale for devoting attention and resources to the collection and reporting of information on social indicators and pointed to some of the difficulties involved in that task. The essential justification is that conventional measures of economic activity are not designed to serve as measures of welfare and may mislead if used for that purpose. It is therefore necessary to take into account a broader set of information in assessing the evolution of well-being or making comparisons across countries. While some efforts have been made to do so within an expanded national accounts framework, more attention has been paid to the development of social indicators which can be used together with conventional measures of economic activity to more adequately reflect quality of life.

The problem one then faces is how to select appropriate social indicators from the extremely wide range of possibilities. In seeking to reflect a widely shared definition of welfare the choices made will be influenced by the traditions, cultural background and social context of the society in question, and may therefore differ across societies. From that perspective, it is not the role of "experts" to determine the most suitable indicators for a particular country: rather, a process of wide-ranging debate about societal preferences and priorities would be required. This process must start from somewhere, however, and our recommended point of departure for such an exercise for Ireland is the List of Social Indicators developed by the OECD. This set contains 33 indicators, relating to health, education, employment and quality of working life, free time and leisure, the distribution of income and wealth, housing and the physical environment, and social attachment and personal safety. It was proposed by the OECD precisely as a starting-point, and designed with comprehensiveness, feasibility and the promotion of cross-country comparability in mind. To proceed beyond that initial point would require further debate about underlying values as well as about technical questions of measurement, including definition and data availability.

The data required to produce the OECD set of social indicators was examined, and its availability for Ireland assessed.. Some of the information required is already available, but major gaps were identified. In particular, more regular data is needed on the distribution of income and on the physical housing conditions and surroundings in which people live, and little or no official information is produced on disability, time use, social attachment and perceived personal security. Our second key recommendation is that resources be devoted to filling these gaps in a structured way. One framework within which this could be done is through the development of a quarterly household survey from the current annual Labour Force Survey, currently being considered by the CSO. Such a large-scale survey would provide an ideal vehicle for the collection of a coherent and consistent set of social indicators and allow the analysis of the way they vary across sub-groups of interest, such as income groups or social classes. Only if these data requirements are met and the production of social indicators is incorporated into the official statistical system can they become a regular part of policy making and political debate in Ireland.

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Appendix I

ENVIRONMENTAL INDICATORS UNDER CONSIDERATION (AND TARGET THEMES)

(a) By The United Nations Environment Programme

Issues	*Pressure*	*State*	*Response*
Climate Change	(GHG) emissions	Concentrations	Energy intensity; env. measures
Ozone Depletion	(Halocarbon) emissions; production	(Chlorine)concentrations; O_3 column	Protocol sign.: CFC recovery; Fund contrib'n
Eutrophication	(N, P water, soil) emissions	(N, P, BOD) concentrations	Treatm. connect.; investments/costs
Acidification	(SO_x, NO_x, NH_3) emissions	Deposition; concentrations	Investments; sign. agreements
Toxic Contamination	(POC, heavy metal) emissions	(POC, heavy metal) concentrations	Recovery hazardous waste; investments/costs
Urban Env. Quality	(VOC, NO_x, SO_x) emissions	(VOC, NO_x, SO_x) concentrations	Expenditure; transp. policy
Biodiversity	Land conversion; land fragmentation	Species abundance comp. to virgin area	Protected areas
Waste	Waste generation mun'pal, ind. agric.	Soil/groundwater quality	Collection rate; recycling investments/cost
Water Resources	Demand/use intensity resid./ind./agric.	Demand/supply ratio; quality	Expenditures; water pricing; savings policy
Forest Resources	Use intensity	Area degr. forest; use/sustain. growth ratio	Protected area forest, sustain. logging
Fish Resources	Fish catches	Sustainable stocks	Quotas
Soil Degradation	Land use changes	Top soil loss	Rehabilitation/protection
Oceans/Coastal Zones	Emissions; oil spills; depositions	Water quality	Coastal Zone management; ocean protection
Environmental Index	Pressure index	State index	Response index

Source: OECD and UNEP.

(b) By The World Bank

Issues	*Pressure*	*State*	*Response*
I. Source Indicators			
1. Agriculture	Value Added/Gross Output	Cropland as % of wealth	Rural/Urban Terms of Trade
(a) Land Quality	Human-Induced Soil Degrad.	Climatic Classes & Soil constraints	.....
(b) Other	.....	.....	.....
2. Forest	Land Use Changes, Inputs for EDP	Area, volumes, distribution; value of forest	In/Output ratio, main users; recyc. rates
3. Marine Resources	Contaminants, Demand for Fish as Food	Stock of Marine Species	% Coverage of Int'l Protocols/Conv.
4. Water	Intensity of Use	Accessibility to Pop. (weighted % of total)	Water efficiency measures
5. Subsoil Assets	Extraction Rate(s)	Subsoil assets % wealth	Material balances/NNP
(a) Fossil Fuels	Extraction Rate(s)	Proven Reserves	Reverse Energy Subsidies
(b) Metals & Minerals	Extraction Rate(s)	Proven Reserves	In/Output ratio, main users; recyc. rates
II. Sink or Pollution Indicators			
1. Climate Change	.....	.....	.....
(a) Greenhouse Gases	Emissions of CO_2	Atmosph. Concentr. of Greenhouse Gases	Energy Efficiency of NNP
(b) Stratospheric Ozone	Apparent Consumption of CFCs	Atmosph. Concentr. of CFCs	% Coverage of Int'l Protocols/Conv.
2. Acidification	Emissions of SO_x, NO_x	Concentr. of pH, SO_x, NO_x in precipitation	Expenditures on Pollution Abatement
3. Eutrophication	Use of Phosphates(P), Nitrates(N)	Biological Oxygen Demand, P, N in rivers	% Pop. w/waste treatment
4. Toxification	Generation of hazardous waste/load	Concentr. of lead, cadmium, etc. in rivers	% Petrol unleaded
III. Life Support Indicators			
1. Biodiversity	Land Use Changes	Habitat/NR	Protected Areas as % Threatened
2. Oceans	Threatened, Extinct species % total	.....	.....
3. Special Lands (e.g., wetland)	.....	.....	.....
IV. Human Impact Indicators			
1. Health	Burden of Disease (DALYs/persons)	Life Expectancy at birth	% NNP spent on Health, vaccination
(a) Water Quality	.....	Dissolved Oxygen, faecal coliform	Access to safe water
(b) Air Quality	Energy Demand	Concentr. of particulates, SO_2, etc.	.....
(c) Occupat'l Exposures, etc.	.....	.....	.....
2. Food Security & Quality	.....	.....	.....
3. Housing/Urban	Population Density (persons/km^2)	.....	% NPP spent on Housing
4. Waste	Generation of industrial, municipal waste	Accumulation to date	Exp. on collect. & treatment, recyc. rates
5. Natural Disaster	.....	.....	.....

Sources: The World Bank. Hammond *et al.*, 1995.

(c) Target Themes In The Programme: Towards Sustainability (CEC 1992)

1 Climate change, including ozone depletion.

2 Acidification and air quality.

3 Protection of nature and bio-diversity.

4 Management of water resources.

5 The urban environment, including noise.

6 Coastal zones.

7 Waste management.

8 Management of risk and accidents, including hazardous and toxic substances.

9 Nuclear safety and radiation protection.

10 Civil protection and environmental emergencies.

The distinguishing features of this list are themes 6 (coastal zones, which other agencies would include under marine/estuarial/erosion/habitats etc.), 8, 9 and 10. Apart from toxic substances which are dealt with by other agencies under such heading as toxic contamination, the last three themes encompass human response to potential accidents and emergencies, a theme less extensively or not covered by the other agencies.

Appendix II

CALCULATION OF THE USER COST APPROACH TO DEPLETION

The description here is taken from Bryant and Cook.[62] Assuming annual constant receipts R over remaining finite lifetime n, a portion of these receipts could be invested at a real return r to yield a continuous income stream, X, indefinitely. The remainder, R - X, (also a finite series) is in fact the amount to be invested each year to yield the perpetual stream X, such that the present value of the finite series, R, equals the present value of the perpetual income, X.

The present value of the finite series, R is:

$$\sum_{i=0}^{n} \frac{R}{(1+r)^i} = R\frac{\left[1 - \frac{1}{(1+r)^{n+1}}\right]}{1 - \frac{1}{1+r}}$$

The present value of the infinite series X is:

$$\sum_{i=0}^{\infty} \frac{X}{(1+r)^i} = \frac{X}{1 - \frac{1}{1+r}}$$

Setting the above two equations equal and multiplying by the denominator gives:

$$X = R\left[1 - \frac{1}{(1+r)^{n+1}}\right]$$

Hence, the proportion of the operating surplus which can be considered as income is:

$$\frac{X}{R} = 1 - \frac{1}{(1+r)^{n+1}}$$

The complement of this is the proportion of the operating surplus which is considered as the user cost, to be invested, and is expressed as:

$$1 - \frac{X}{R} = \frac{1}{(1+r)^{n+1}}$$

[62] With the missing "one minus" inserted at the start of the square bracket in the first equation.

Appendix III

ORIGIN AND DESTINATION OF EMISSIONS AND NATURAL RESOURCES IN THE NETHERLANDS, 1991

	CO2 11a	N2O 11b	CH4 11c	CFCs and halons 11d	NOx 11e	SO2 11f	NH3 11g	P 11h	N 11i	Waste 11j	Natural gas 11k	Crude oil 11l
	mln kg			1000 kg	mln kg						pj	tj
ORIGIN												
FINAL CONSUMPTION EXPENDITURE (2)	36372	2	4	856	156	5	-	15	115	8663	-	-
Own transport	14672	2	-	-	135	4	-	-	39	120	-	-
Other	21700	-	4	856	21	1	-	15	76	8543	-	-
OUTPUT (3)	128040	59	724	4378	397	191	220	185	1257	19742	-	-
Agriculture, hunting, forestry, fishing	10280	33	534	-	36	2	218	131	1117	1180	-	-
Mining and quarrying												
Crude petroleum and natural gas production	1586	-	78	-	5	2	-	-	2	1368	-	-
Other mining and quarrying	357	-	-	-	-	1	-	-	-	-	-	-
Manufacturing												
Food, beverage and tobacco industry	4173	-	1	8	12	2	-	1	4	2225	-	-
Textile, wearing apparel and leather industry	357	-	-	180	1	-	-	-	-	61	-	-
Wood, furniture and building materials industry	83	-	-	478	1	-	-	-	-	218	-	-
Paper, paper products, printing and publishing industry	1828	-	-	6	4	-	-	-	1	381	-	-
Petroleum industry	11843	-	-	-	22	78	-	-	9	56	-	-
Chemical industry	20307	17	3	1828	41	22	4	14	25	3099	-	-
Rubber and artificial materials processing industry	1487	-	-	720	3	-	-	-	1	41	-	-
Manufacture of building materials, earthenware and glass products	2335	-	-	50	14	5	1	-	5	378	-	-
Manufacture of basic metals	8097	-	-	15	12	14	-	-	4	308	-	-
Manufacture of metal products and machinery	1180	-	-	742	3	-	-	-	1	160	-	-
Industrial manufacturing n.e.c.	992	-	-	472	2	-	-	9	16	123	-	-
Public utilities												
Electricity	38781	-	-	-	68	35	-	-	21	149	-	-
Other public utilities	75	-	96	-	1	-	-	-	-	485	-	-
Construction	2501	-	8	-	26	3	-	-	8	3574	-	-
Transport and storage	9234	2	-	8	78	22	-	-	23	2270	-	-
Environmental cleansing and sanitary services	3641	8	4	-	8	3	-	-	2	880	-	-
Other services	11115	1	-	93	63	4	-	-	18	2968	-	-
CAPITAL (8)											1836	138
REST OF THE WORLD, CURRENT (9)					93	98	27	20	415			
Total = column total 11	184412	61	728	5031	846	295	247	190	1787	28405	1836	138
DESTINATION												
OUTPUT (3)												
Crude petroleum and natural gas production											2595	136
Environmental cleansing and sanitary services										2645		
REST OF THE WORLD, CURRENT (9)					488	158	113	24	581			
MONDIAL ENVIRONMENTAL THEMES (12)	184412	61	728	5031								
NATIONAL ENVIRONMENTAL THEMES (13)					158	136	134	166	1206	23760	-759	
Total = row total 11	184412	61	728	5031	846	295	247	190	1787	28405	1836	138

Source: de Haan and Keuning (1995), Table a6, National Accounting Matrix including Environmental Accounts (NAMEA).

Appendix IV

LIST OF TABLES FROM IRISH ENVIRONMENTAL STATISTICS (1993)

PART 1: STATE OF THE ENVIRONMENT

Table No.

Air Quality

Water Resources and Water Quality

Figure No.

Table No.

102 Environmental Impact Statements submitted under Directive 85/337/EEC 1988 to 1991

Legislation

General	National Legislation/EC Legislation
Air	National Legislation/EC Legislation
Water	National Legislation/EC Legislation
National Heritage	National Legislation/EC Legislation
Noise	National Legislation/EC Legislation
Waste	National Legislation/EC Legislation
Housing	National Legislation
Chemical Substances	National Legislation/EC Legislation

PART 4: GENERAL DATA

Population

103 Population of Each County, 1971, 1981, 1986 and 1991

Climate

104 Annual Average Wind Speed at Irish Meteorological Stations, 1975, and 1980 to 1990

105 Annual Total Rainfall at Irish Meteorological Stations, 1975, and 1980 to 1990

106 Annual Average Temperature at Irish Meteorological Stations, 1975, and 1980 to 1990

Source: Environmental Research Unit of the Department of the Environment.

Appendix V

REFINEMENT OF OECD INDICATORS, PROPOSED BY EPA

OECD[63]	*Further EPA Suggestions for Ireland*
	Eutrophication
Pressures:	
N and P to water and soil from fertiliser and livestock	N and P use in vulnerable areas and from point sources
State:	
BOD, N and P in inland and marine waters	Trends, winter trends in marine waters. Slight-moderate river pollution, incidence of excessive macro- and planktonic algal matter in tidal waters
Response:	
% population connected to treatment, user charges, % of phosphate-free detergent	Extent of farm management of fertiliser and slurry, extent of nutrient removal from sewage in sensitive areas
	Urban Environment
Pressures:	
Emissions SO_x, NO_x, VOCs, Urban and national traffic density, degree of urbanisation	Growth of urban population, energy consumption and vehicle numbers: smoke, leaded petrol sales, waste arising, litter.
State:	
Population exposure to air pollution and noise, ambient water conditions in the urban areas.	Concentrations of smoke, SO_2, NO_x, lead and ground level ozone. Significance of VOCs PM_{10}, trend in certain journey times, numbers and areas of derelict sites, and wholly or partially vacant buildings.
Response:	
Green spaces, economic, fiscal, regulatory instruments. Expenditures	Renewal schemes, smoke control, scale of recycling, initiatives, public transport upgrades, cycle facilities, pedestrianisation, infrastructure, decentralisation.

[63] OECD (1994), *Environmental Indicators, OECD Core Set.*

	Waste
Pressure: Municipal, industrial, nuclear, hazardous	Agricultural and commercial waste, and sewage sludge
Response: Waste minimisation, recycling rate, economic and fiscal instruments, expenditures	Adoption of clean technologies, recycling incentives, provision of new waste management, treatment and disposal facilities, improved controls on litter and unauthorised dumping, improved management practices, waste avoidance and minimisation
	Agriculture[64]
Pressure:	Phosphorous loss to water from various soil types. Loss of the gases ammonia and NO_x. Herbicide, pesticide use and extent of monoculture
State:	Change in river length in unpolluted category. Extent of hill and arable land erosion. Organochlorine pesticide residues, PCBs and heavy metals concentration in soils.

The possibility of sectoral indicators for tourism and for transport is also considered.

[64] These could be included with eutrophication, climate change, acidification, biodiversity/landscape, and soil degradation.

GLOSSARY OF TERMS

5EAP	5th environmental action programme, *TOWARDS SUSTAINABILITY*, Commission of the European Communities (1992).
CEC	Commission of the European Communities.
CSO	Central Statistics Office, Dublin and Cork.
EDP	Environmentally adjusted Domestic Product or Eco Domestic Product, a measure of national income adjusted to take account of environmental considerations.
EPA	Environmental Protection Agency, established in 1993.
ERU	Environment Research Unit was a section within the Department of the Environment.
ESEA	See Box 2 in the text.
ESI	See Box 2 in the text.
ESRI	The Economic and Social Research Institute, Dublin.
EUROSTAT	The Statistical Office of the European Communities.
EUTROPHICATION	Occurs when nutrient release (e.g., phosphate and nitrate) to water leads to excessive growth of algae and to the subsequent depletion of dissolved oxygen, affecting aquatic life.
GDP	Gross Domestic Product, a measure of national income, see footnote 20 in Chapter 2.

GNP	Gross National Product, a measure of national income which is net of factor flows such as profit outflows, see footnote 20 in Chapter 2.
GREENHOUSE GASES	The main gases considered responsible for a major part of the greenhouse effect and global warming are carbon dioxide (e.g., from combustion of fossil fuels and industrial processes such as cement production), methane (e.g., from use of natural gas and ruminant livestock), chlorofluorocarbons (e.g., propellants in aerosols and coolants in refrigerators) and nitrous oxide (e.g., from combustion of fossil fuels and use of nitrogenous fertilisers).
IIRS	Institute for Industrial Research and Standards, renamed EOLAS and then Forbairt.
INSEE	Institut National de Statistique et de l'Economie, the statistics and economic forecasting office in France.
NAMEA	Netherlands Accounting Method for Economic Analysis.
NEPP	The National Environmental Plan in the Netherlands.
NDP	Net Domestic Product, a measure of national income which is net of depreciation, see footnote 20 in Chapter 2.
NNP	Net National Product or National Income is net of depreciation and of factor flows such as profit expatriation, see footnote 20 in Chapter 2.
OECD	Organisation for Economic Co-operation and Development, Paris. It has published such works as *The Polluter Pays Principle* (1975), *Pricing of Water Services* (1987) and *Environmental Indicators, OECD Core Set* (1994).
OZONE LAYER DEPLETION	The release of man-made substances (e.g., chlorofluorocarbons or CFCs) containing chlorine endangers the stratospheric ozone layer, which provides a shield against harmful solar ultraviolet radiation, causing concern for the marine food chain in particular.

SAM	Social Accounting Matrix, see UN (1993).
SEEA	*Integrated Environmental and Economic Accounting*, UN (1993).
SNA	*A System of National Accounts*. The 1968 version was produced by the UN. The 1993 version was produced by the UN with other international agencies and includes suggestions on incorporating environmental considerations in satellite accounts.
UN	United Nations, New York, produced *A System of National Accounts* in 1968 and in 1993.

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