The environment and statistics

Introduction

In almost every area of social and economic policy, an important, sometimes over-riding, goal is to be "environmentally responsive" and development is no longer seen as being unequivocally desirable unless prefixed by "sustainable". These expressions are pervasive but also imprecise with different users intending different connotations or at least different emphases. The intent of this note is simply to try to distinguish the point of interaction between the environment, however defined, and a number of different areas of statistics to try to determine whether a single set of environmental statistics can respond to all needs or, if not, where the dividing lines between one subject and another may lie.

The word environment is ambiguous. For some people, this word relates to the *natural* environment, air, water, land, forests and mineral deposits, species and biodiversity. For others the unspoken adjective is the *social* environment and the main concern is with health, education and the quality of life. The interaction between the two is important, of course, but the first alone does not determine the second. Affecting both and providing an obvious influence on each is the *economic* environment. It is perhaps because it is apposite to talk of both a social and economic environment that it is often unclear whether the word "environment" is being used in a broad sense and whether it is intended in the more specific sense of the natural environment.

Measuring the natural environment

The natural environment can be regarded as made up of living organisms, divided between plants and animals and a number of inert entities compromising air, water and land. Quantification of living organisms presents few conceptual issues and is mainly of concern to biological sciences and to those people and organisations concerned with nature conservation.

Land is amenable to quantification in term of area either in total or when it is dedicated to one or another designated use. There are greater problems, though, in trying to put numeric values to the quality of land so that changes in its potential to support living organisms (including mankind) can be tracked.

Some bodies of inland and underground water can be quantified in ways similar to land. The volume of water available at a particular place and at a particular time is often of importance; the space and time dimension are usually definitive in determining whether the volume measures are useful. In pure volume terms, water becomes a major concern when there is either too much or too little of it, floods and droughts. At other times the main concern is not with the quantity of water available but its quality. In terms of quality of water, considerable effort has been devoted to documenting the functions of water as an environmental sink to absorb effluent from living organisms (again including mankind) and other by-products of human activity. Such data is usually characterised in terms of the amount of a particular compound per unit of volume.

Air has the characteristics of water as regards its use as an environmental sink and the availability of data measuring the density of particular compounds per unit of volume of air.

When we look at he interaction of different areas of statistics with environmental data, we need to consider which of these broad types of data are relevant.

	Quantity measures	Quality measures
Living organisms	Yes	
Land	Yes	Yes
Inland and underground water	Yes	Yes
Open seas		Yes
Air		Yes

Health and the environment

Clearly the state of health of a group of people depends on whether they have clean air to breathe and clean water to drink. Measures of air and water qualities are therefore the sets of natural environmental indicators of immediate relevance. The impurities in air and water of direct concern are those where epidemiological studies can show that certain precipitates have deleterious effects on health. Natural environmental indicators tend to measure the most significant residuals in terms of volume, those that have undesirable effects in other fields (agriculture, climate change) or which simply are most amenable to measurement.

The quality of water in terms of the particulates carried in it is insufficient to determine water borne disease of course. Of equal or greater concern is the access to safe drinking water. This will depend on social infrastructure such as the provision of piped water or wells which in turn is related to population distribution between urban and rural areas and within urban areas to know how many people are living in shanty towns with inadequate water and sanitation services. Such issues are quite reasonably described as “environmental” but they are not covered by natural environmental indicators. Here we are in the domain of social statistics, specifically demography and the implications of income levels and distribution. Economic indicators are also relevant for example how much is spent on health services, how many doctors are there per thousand inhabitants and so on.

Demography and the environment

Basic demographic characteristics have a profound impact on measurement of land; how much is needed for urban and rural purposes; is the carrying capacity in terms of food production adequate to meet the demands of the population. Projections of demographic trends calls in question the whole area of health statistics, for example, which provides an indirect demand for data on the natural environment but not beyond what is covered above.

Agriculture, forestry, fishing and the environment

Measuring the numbers of animals and quantities of plant-life is essential data for environmental studies. Where cultivated livestock and plants are concerned, there is no

question but that the area of agricultural statistics provides data to environmentalists and indeed to economists or those involved with determining economic data. There is a question though about who is responsible for quantifying stocks of non-cultivated assets. In the case of rain forests and natural fish stocks where the economic significance is well established, it is natural to turn to agricultural statisticians for information here also. It is less clear that they can or do provide information on non-economic species. One boundary for clarification is where agricultural statistics end and more purely biological statistics must take over.

As well as providing environmental statistics, those concerned with agriculture need other environmental data as input to their work and here there is a close analogy with the information required for human health. The effects of air, water and land quality on the health of livestock and yield of crops are obviously necessary to a study of changing patterns in these fields. Again there is a question about whether the data most immediately available are those most relevant and the time and location aspect may be critical.

Social statistics and the environment

Health statistics and demography are the most obvious domains within social statistics with a direct link to environmental data. These are discussed above. For labour statistics and income distribution, it may be possible to identify employment opportunities coming from environmental concerns or that the distribution of income is affected by the government's access to revenues from natural assets but the link is indirect and is encompassed by more general links between social and economic data.

Economic statistics and the environment

This is the area where major new developments involving the natural environment have been and are taking place. It is possible to partition the area into three distinct aspects,

those concerning data only in physical terms,

those linking physical and monetary data,

those in monetary terms only.

Physical data only

For physical data, the usual approach is industry by industry, concentrating on the production process. One step is to identify inputs from the natural environment (timber, fish, agricultural products, mineral and non-mineral deposits). The industries of prime concern are agriculture, forestry, fishing, mining and quarrying, construction, energy generation, wood products and paper. The volume of inputs is of interest in itself and also the conversion factors whereby a unit of "natural" resource is converted to another of use subsequently in production or for consumption, for example the conversion of crude petroleum to refined spirit or the conversion of coal to electricity. Technical production processes are central to this approach.

As well as inputs from nature into physical processes there is concern with outputs to nature,

in particular the use of land, air and water as environmental sinks. Again interest centres on the technological process whereby, say, the burning of fossil fuel generates particulates expelled to the air or eutrophication from livestock raising. Some studies link the output of residuals to the end product of the production process; some link them to particular inputs. These data sets are the basis for projecting future levels of pollution under given assumptions.

A further development of the physical only approach of some current interest is the derivation of physical input-output tables where all inputs and outputs are measured in a common unit, normally weight, as a means of approximating the "environmental footprint" of human activities. This is attracting a wide attention, not all of it uncritical.

Physical/monetary data

One problem with the physical only approach is the lack of additivity when different units are appropriate for different commodities. In this approach, an input output table in conventional money terms is linked to outputs of residuals in physical terms. This is the basic material of modelling exercises designed to simulate costs that would be incurred if certain preventive measures were taken to inhibit pollution or to undertake further clean-up activities. Like the physical only approach described above, it is mainly linked to an industrial dimension and the inherent technological processes. Some aspects of the expenditure dimension of the economy may be invoked by imputing production-type activities for certain types of expenditure within a satellite account but this is still essentially a production driven approach.

Monetary only data

A more restrictive but more complex form of environmental accounting concerns only monetary data. The usual starting point is also an input-output table in money terms, within the context of a full set of SNA accounts. This allows analysis involving income and expenditure as well as production. Inputs from the natural environment incorporated into economic activities can, at least in principle, be identified in money terms. Expenditures to inhibit pollution or to clean it up can be identified as environmental protection expenditure and given special treatment, again within a satellite account. Taxes and subsidies linked to environmentally harmful (or benign) substances can also be identified and their effects studied by simulation.

More elaborate modelling allows for the use of valuation systems sometimes advocated by environmentalists but which differ from that used in the SNA. If desired, measures of economic activity different from the conventional SNA income, expenditure and production measures of GDP can be derived.

Other environmental issues

Apart from the impact of the natural environment of recognised statistical domains, there are two areas of major concern where statisticians need to be able to respond effectively. The first of these concerns climate change where identification of the substances most damaging to the atmosphere and a suitable modelling basis are required to simulate alternative scenarios.

The second issue is the development of indicators of sustainable development. Many initiatives are under way in this area, not least the set put forward by the UNCSD. The underlying objective is to demonstrate concern at the same time for the natural environment and for the social and economic aspects of development. So far most of the suggested sets of indicators associate indicators drawing on these three subject areas rather than provide an integrated framework with individual indicators simultaneously reflecting the state of each dimension. This is hardly surprising since attempts to provide a robust integration of economic and social dimensions of development have so far met with only limited success despite the priority and resources given to the exercise over many years.

Conclusion

This note has a very limited objective; simply to try to spell out where and how data from the natural environment does or might impact other statistical domains and point out where commonly perceived pressure for "environmentally-sensitive" data may in fact require resource to social and economic data rather than data from the natural environment. The table attached provides a summary of the points made and a possible starting point for further discussion.

Domain	Natural environment data generated	Natural environment data used	Comments
Agriculture	Numbers and types of livestock; population growth; offtake/death rate; Areas under cultivation by type of crop; growth rates; harvest information	Land use and land quality data Information on use of pesticides and fertilizers	Where is the boundary for what species are covered by agriculture?
	Use of pesticides and fertilizers		
Construction	Use of sand, gravel		Construction has a major effect on land use, not just urban to rural but effect on ground water of gravel pits, dams, earthmoving and “landscaping”. Is this causation monitored?
Demography	Population; life expectancies; mortality rates; immigration data	Land use data	Information on human population etc. usually seen as social data rather than natural environmental data
Education			Indirect use via health, demography and economic statistics
Energy generation	Use of fossil fuels, (direct and indirect); water		
	Generation of pollutants		
Fishing	Stocks of fish by type in farms and inland waters; growth and offtake rates	Ground water resources; water quality	How much information available on deep sea stocks?
Forestry	Area under forests by type of tree; natural growth rates; logging and offtake rates	Land use and land quality data	How far are natural forests covered?
	Use of pesticides and fertilizers	Information on use of pesticides and fertilizers	Possibly no information on habitat provided to other species by forests or amenity value to people
Geography, geology, cartography	Land use data		Are there standard classifications of use to all other domains?
	Availability of sub-soil deposits		

Health		Air and water quality information	Are the precipitates identified in air and water pollution those most relevant for the study of human health? How useful are annual average figures? Can health statisticians specify time and place for more specific data?
Income distribution			Indirect
Industrial statistics	Use of environmental resources (sub-soil deposits, timber, fish, livestock, plants, water; sand, clay etc.); Output of residuals to air and water Solid waste generated Environmental protection expenditure		
Labour			Indirect use via health, demography and economic statistics
Transport	Use of fossil fuels Generation of air pollutants		