Natural resource accounting

- a technique for improving planning in New Zealand?

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Chapter 1 Introduction

1.1 The purpose of this study

Since their inception, macroeconomic indicators of national well-being such as Gross Domestic Product have been strongly criticised. One set of criticisms is directed at the inadequate and misleading treatment of natural resources and environmental quality.

As a consequence, various "natural resource accounting" and "environmental accounting" methodologies have been developed around the world. In New Zealand, the Ministry for the Environment is considering whether putting environmental and natural resource data into an accounting framework will lead to better formulation of public policy. The question of whether or not to set up resource accounts is a subset of the larger issue of environmental statistics. What quantitative information do we need about the environment and in what form(s) is it most useful?

This report is a scoping study intended to help staff of the Ministry for the Environment clarify the issues in natural resource accounting and to decide on a course of action.

1.2 The underlying objective - sustainable development

Sustainable development is one of the five "umbrella" goals of the Environment Act 1986. How do we know whether particular economic developments are sustainable in an ecological and/or physical sense?

The members of the United Nations Environment Programme (UNEP) working group on environmental accounting agree that:

> "... the main data that serve as rule of conduct in the decision-making practice, viz. mutations in the level of the national income ... and the results of cost-benefit analyses ..., are incomplete and therefore *give wrong signals for arriving at a sustainable development*" (Hueting, 1987, p.55, my emphasis).

Standard macroeconomic accounting has been used largely as an indicator of economic growth. It is not an indicator of sustainability or unsustainability. We cannot dodge the potential conflict that exists between the two policy objectives of growth and sustainability (Common & Pearce, 1981, p.289).

Almost any system is sustainable given sufficient resources. So underlying an objective of sustainable development lies the question - "how real is scarcity"? Although one school of thought argues that technology will continue to outpace depletion, the proponents of resource accounting question this.

> "Technological change does not inevitably result from increasing costs or prices. Tremendous efforts can be expended on searching at great length for something not there" (Hall & Hall, 1984, p.374).

The logic of the argument can be summarised as follows.

1. The Ministry is committed to a goal of sustainable development.

2. Systems become unsustainable when inputs become scarce.

3. Economics is the discipline concerned with the allocation of scarce resources.

4. But some scarcities like the impending extinction of a commercial fish species, the depletion of natural gas or topsoil, the scarcity of clean water, do not feature in macroeconomic data.

A set of resource accounts will, of course, not guarantee sustainable development. However, such accounts hold promise for filling an information gap.

> "Tomorrow's scarcity is not reflected in today's price" (Hueting, 1980, p.24),

and:

> "... when nature's function is invisible and value-less, it can be destroyed at will" (Waring, 1988, p.203).

1.3 Why an accounting framework?

An accountant is concerned with stocks and flows of money - with inventories, with inputs and outputs, and with giving advice based on assessment of risks. A set of accounts reveals patterns and can be used to answer questions about vulnerable components of the system.

An accounting framework for recording numerical information (whether in dollars or not) has enormous strengths (Theys, 1984, p.10). It is rigorous and systematic, thus imposing a discipline on a confusing mass of data. It takes into account systems and feedback effects. It allows data to be aggregated in various ways. Data inadequacies become obvious.

What would a set of resource or environmental accounts tell us?

Ideally, such a set would display the physical base of our society, tell us what is physically possible, what are the ultimate constraints (albeit soft constraints), and thus point to impending scarcities of unpriced or underpriced environmental goods and services. Thus resource budgets and environmental

quality targets could be established. In short, such a set of accounts would provide better data for taking "full account of ... the sustainability of natural and physical resources" (Environment Act 1986).

The standard macroeconomic accounting system which is used as the major data source for national planning is the System of National Accounts of Income and Expenditure (SNA). In an ideal world, natural resource and environmental accounts would be fully monetarised and integrated into the SNA.

1.4 Resource and environmental accounting - definitions

There is a definitional problem in distinguishing between "natural resource accounting" and "environmental accounting". This distinction is not simple because the two terms are used in different ways. In some frameworks environmental accounting is seen as a subset of natural resource accounting (for example, the Norwegian system); in others, the reverse holds (for example, Weiller, 1983). Thus a set of data may be termed a resource account in one country or by one analyst, and an environmental account in another context.

There are, in fact, three different types of analysis that occur under an "accounting" label corresponding to the three functions that the environment plays in the economy. These functions are:

- an assimilator of residuals - for example, the sea as a sink for wastes

- a source of goods - for example, air

- a source of resources - for example, copper

(Common & Pearce, 1981, p.291).

These three functions give rise to three concerns:

- pollution and its control

- conservation of the natural state of the environment

- depletion of natural resources

Quantifying aspects of either of the first two in a systematic manner is frequently called "environmental accounting" whereas quantifying the third is frequently called "resource accounting". But this does not always hold.

There appears to be an emerging viewpoint that such distinctions are no longer appropriate. "Scarcity" is increasingly being seen as including scarcity of common property resources such as air and water. Hueting terms this "the new scarcity" because it is the scarcity of clean air and water which is beginning to bite in

Europe. And globally we have become concerned about the increasing scarcity of the atmosphere's ability to soak up carbon dioxide.

> "... much of the muddle comes from a traditional but artificial division between environmental and resource economics" (Hall & Hall, 1984, p.364).

Thus a distinction between "environmental" and "resource" accounting is artificial. Therefore in this study I have elected to look at all environmental accounting systems, whether or not they are labelled resource accounting.

1.5 Structure and content of report

The report begins with a look at the system of national accounts (SNA) that is used by most countries including New Zealand. A concise description of the SNA (Chapter 2) is followed by a discussion of its shortcomings (Chapter 3). It is the shortcomings of SNA that have spawned the various attempts at resource and environmental accounting.

In the next three chapters, the various attempts that have been made to develop environmental accounting systems are described - approaches taken by different countries (Chapter 4), work done by international agencies (Chapter 5), and finally, the efforts of some pioneers (Chapter 6). This is followed by a description of a variant of resource accounting, that based on energy analysis (Chapter 7).

Finally, I discuss the benefits of resource accounting (Chapter 8), identify the issues (Chapter 9) and make some recommendations for further action in New Zealand (Chapter 10).

Some sample accounts are presented in an appendix.

Chapter 2 Standard national accounting

2.1 The history of the System of National Accounts

The first estimates of the income and expenditure of a nation were done at the end of the seventeenth century for France, Holland and England. The next development grew from the work of a group of French political economists known as the Physiocrats (Department of Statistics, 1983, p.7).

In 1758 one of the Physiocrats, Francois Quesnay, produced an economic table in an attempt to show how different parts of the economy were related. The Physiocrats believed that land was the source of all wealth. It is ironic that the subject of this report, the very modern concern that national accounting does not recognise sufficiently the physical base of an economy, is an echo of the concerns of Quesnay and his associates.

Work on various concepts and estimates of national income continued through the nineteenth and into the twentieth centuries. However, the real incentive to understand flows of money in the economy came during the Depression, with the notion that understanding the relationship between macroeconomic variables was the key to controlling economic events (Hueting, 1980, p.153). National income accounting assumed a new importance in western countries during the Second World War with direct government control of economies.

After the war the United Nations moved towards standardising national accounting methodologies; the purpose of this was international comparability. The first United Nations System of National Accounts - UNSNA - was published in 1953; a revised version was published in 1968.

The New Zealand System of National Accounts - NZSNA - follows the United Nations recommendations fairly closely. The New Zealand system was revised in 1977 and the orientation was shifted from income to production.

The UNSNA is currently under full review and there is a major effort going on to get guidelines ensuring that "proper account is taken of the use of environmental resources and changes in natural resource stocks" included in the revised guidelines due to be completed by 1991 (James, 1988).

2.2 A brief explanation of national accounting

It is not the aim of this report to explain in detail the procedures of national accounting. However, some understanding is essential.

National accounting should not be viewed as synonymous with the calculation of Gross Domestic Product (GDP) or any other macroeco-

nomic indicator. Its intent is to "reveal the patterns of economic activity in various useful ways" (Department of Statistics, 1983 p.15). Thus while the fortunes of grand totals like GDP may attract the attention of politicians, it is the details in the accounts that are of most significance.

Various macroeconomic indicators can be calculated from a national accounting system. In New Zealand the emphasis is on GDP "as a measure of the performance of the New Zealand economy" (Department of Statistics, 1983, p.6). In the past the emphasis was on Gross National Product (GNP). Both these are measures of the total production of final goods and services within a country[1].

The total economic activity of a nation can be estimated in three different ways - as income, as production, and as expenditure. Prior to 1977 the emphasis was on income - hence the term, national income accounts.

Now the approach is to sum the production of the various sectors of the economy and to match this with the expenditure accounts. The production approach is also directly related to another very useful picture of the economy, the Leontieff input-output tables or inter-industry studies, which show directly the transactions between different industries. Input-output analysis is the basis of some resource accounting methodologies.

The aspect of national accounting that is of particular importance from an environmental/natural resource perspective is that of *imputation*. Part of the production of an economy is unpriced. Women do not sell their work to their children and partner. Industries do not usually buy the assimilative capacity of air and water. These services remain outside the "production frontier" of the national accounts because they are unpriced. However, some unpriced goods and services are brought inside the production frontier by having *value imputed* to them. By far the most important imputation in the NZSNA is the imputed rental of owner-occupied houses.

National accounting has been widely criticised. In the next chapter I describe the main criticisms, particularly those relating to the environment or resource use, because it is these that have spawned the efforts to set up systems of environment and resource accounting.

Chapter 3 Criticisms of national accounting

3.1 Introduction

Since the war national accounting has moved into an apparently secure position as the basis for economic planning in the western world. On the whole, it remains unquestioned by the media, politicians and many of its users. Yet it has been criticised throughout its development. The professionals who work on national accounts are aware of its shortcomings.

Some see national accounting occupying its privileged position by default; that is, we use it although it is extremely flawed because we have nothing better. Repetto argues that national accounting is protected by its own inadequacy.

> "... wholesale reform is a task of large proportions, and improvement limited to just one aspect is hard to justify when so many other problems would still remain" (Repetto, 1988, p.3).

Criticisms occur on two levels. Firstly, there is criticism of national accounting as an indicator of welfare. Secondly, there are many criticisms of how it is done, that is, of omissions and misrepresentations. Criticisms from those concerned with environmental issues feature on both these levels.

It is easy to find all sorts of faults with national accounting; it is far more difficult to rectify them or find a substitute.

3.2 The welfare criticism

An increase in real GDP is popularly interpreted as economic growth. Economic growth is taken as being "a good thing" and correlated with progress, welfare, happiness and so on. The pioneers of national accounting never claimed that this correlation existed.

The "Social Indicators movement" arose in the seventies with the aim of developing systems of *social* accounts. In social accounts economic indicators would be just one subset of many social indicators. Variables like life expectancy and job satisfaction would feature as noneconomic social indicators (Heilbroner & Thurow, 1984, pp.107-108).

Apparently the Social Indicators movement has suffered a major setback in the United States under the Reagan administration; if one is confident that "what is good for business is good for America", then new indicators and data are not needed (Leipert, 1987, p.359).

Another aspect of the welfare criticism is the question of equity; national accounting provides no information on the *distribution* of

goods and services among social groups.

If GDP does not capture social welfare, does it capture economic welfare? A major attempt to modify national accounting to better reflect economic welfare was the Nordhaus & Tobin proposal for a new indicator, known both as the Measure of Economic Welfare (MEW) and Net Economic Welfare (NEW) (Nordhaus & Tobin, 1973). Their intent was to correct some of the anomalies outlined below. However, in spite of a great deal of discussion and debate at an international level, their proposal was not adopted because there were problems of valuation and rather too much "subjectivity" (Bartelmus, 1986, pp.348-349; Peskin, 1981, pp.514-515).

3.3 A conflict between our aims and our means

Drechsler sees the fundamental problem in national accounting as a conflict between our *aims* and our *means* (Drechsler, 1976). Our *aim* is the welfare of society and economic welfare has a great deal to do with this. But we cannot measure this satisfactorily. Our *means* of measurement are not up to the task.

Our basic means of measurement are market values. But even conventional national accounting goes beyond this by imputing value to some unpriced transactions. To get closer to our aim of measuring welfare, we may impute monetary value to more and more activities. But as we get closer to our aims by doing this, our means become on shakier and shakier ground because our measurements become more and more uncertain.

> "Thus, what we are looking for is, in a general sense, a compromise, an optimal point, where we get reasonably close to measuring the contribution of economic activities to welfare, but where our yardstick is still sufficiently sound and the measurement sufficiently objective" (Drechsler, 1976, p.241).

Hence Nordhaus & Tobin's MEW foundered under the criticism that we do not have adequate means to assess MEW; there are too many imputations, too many uncertainties, and too much distance from real financial transactions.

3.4 Imputations are incomplete

Many criticisms of national accounting stem from the incompleteness of imputations. The value of some non-marketed goods and services are imputed. Others are not.

Marilyn Waring is not the first to point out that if a man marries his housekeeper, GDP falls. In her words, most of the production from women's work is simply not counted and therefore, invisible.

In the context of this report we are concerned with invisible environmental goods and services - invisible because they are

unpriced (or underpriced). GDP is an "empty-world accounting concept" hatched in a time of environmental and resource plenty not scarcity, when there was plenty of coal to burn and plenty of clean air to absorb emissions (Daly, 1988, p.49).

We live now in a:

> "... complex, delicate, and possibly unstable life-support system, the outputs of which do not always directly and obviously appear as inputs to production and consumption, but which outputs are essential for the continued existence of those activities" (Common & Pearce, 1981, p.291).

3.5 The output anomaly and the input asymmetry

When a power company puts scrubbers on its smoke stacks or government institutes a "polluter pays" tax, some environmental goods and services are priced. However, although the "environment" is not completely invisible in national accounting, its treatment is distorted. There are two major problems; Drechsler terms them the "output anomaly" and the "input asymmetry" (Drechsler, 1976).

The first problem, the "output anomaly", is that when we harm the environment, national income is unaffected. (It may be affected indirectly but this does not reflect the degree of harm.) However, if we repair this harm, the cost of this restoration is recorded and national income rises. It follows that it is better, economically speaking, to cause harm and then to repair it than to avoid the harm in the first place. To solve the output anomaly, harm caused to the environment should be treated as negative output.

Other writers express this problem in different ways.

Leipert labels expenditure on environmental repair and protection as one class of "defensive expenditures" and is interested in treating all of society's defensive expenditures as negative production (Leipert, 1987).

Daly sees GDP as an irrational sum of costs and benefits (Daly, 1988). Paying to repair environmental damage is a cost to us; it adds nothing to the benefit of net production.

The second problem, the "input asymmetry", is the inconsistent way in which money spent on environmental protection is treated in national accounting.

Gross Domestic Product is intended to be the value of the *ultimate* production of the economy, so only the values of all *final* goods and services are summed. Embodied in the final product is the value of all the *intermediate* products that contributed to its making. Thus double-counting is avoided.

However, this leads to an asymmetry in the treatment of expenditure on pollution. If households or government spend money on environmental protection, it is viewed as final consumption and national income is unaffected. However, if businesses spend money on pollution abatement, then this may result in a decrease in national income.

> "... business expenditures for the operation and maintenance of pollution control equipment will tend to show up as a reduction in GNP. In effect, these expenditures divert labor and material away from items counted in the GNP and toward the production of a cleaner environment, which is not counted in GNP" (Peskin, 1981, p.513).

3.6 Stocks matter too - the lack of balance sheets

Another major problem is that national accounting focuses on flows and does not give adequate attention to stocks. (There is no conceptual reason why this should be so.)

Financial accounts consist of two parts - an income statement (flows) and a balance sheet (stocks). An accountant could not assess a firm's long term viability without both. Balance sheets have been largely ignored in national accounting practice (Repetto, 1988, p.5)[2].

To some extent stocks are included in standard national accounting; the depreciation of capital is one imputed transaction.[3] The values of assets are amortised over their useful life.

But this is done only to human-made assets, not to natural assets. This, in Repetto's words, is a "dangerous asymmetry".

> "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, but measured income would rise steadily as these assets disappeared" (Repetto, 1988, p.2).

Chapter 4 National resource accounting initiatives

4.1 Introduction

A variety of different moves towards resource accounting have been made around the world. Some approaches have been adopted officially by governments and by international organisations; others are being pioneered by various researchers. In this chapter, I describe the resource accounting frameworks and approaches taken by various countries.

The approaches fall roughly into two categories.

1. Stocks and flows of resources and environmental services are expressed in physical units.

2. Stocks and flows of resources and/or environmental services are expressed in monetary units. Some try to "improve" GDP whereas others seek to develop satellite accounts that can be put alongside standard national accounts. Sometimes environmental expenditure is simply isolated.

Evaluating these very different approaches is only partly a matter of assessing the "correctness" of theory and concepts. The choice of methodology reflects the planning concern, the access to "reasonable" data and so on.

The material I have obtained on different approaches is incomplete; much of it is unpublished. Thus the following information will be uneven; for instance, I have found a great deal of information about Norway's "resource accounts", but virtually nothing about Japan's "green accounts".

4.2 Norway

The Norwegian system of resource accounts (SRA), initiated in 1971/72, seems to be the most advanced and comprehensive, probably because it is the least ambitious (Longva, 1981; Anon., 1983; Friend, 1983; Garnasjordet & Saebo, 1986; Alfsen, *et al.*, 1987, Lone, 1988). There is no attempt to value resources in monetary units although the SRA has been designed to be "fully compatible" with the SNA.

The Norwegian system has had a somewhat chequered career with some successes (particularly in the energy field) and some failures (Lone, 1988). Over the years it seems to have become more partial (less holistic) and pragmatic (Friend, 1983, p.5).

The Norwegian resource accounts are divided into two categories - *material* accounts and *environmental* accounts. This is regarded as a "management-oriented" classification (Anon., 1983, p.448).

Material resources are distinguished from *environmental* resources in that they are consumed by the production process (the quantity changes), whereas environmental resources are changed by the production process (the quality changes).

Material resources

minerals e.g. hydrocarbons	- non-renewable
biological e.g. fish	- conditionally renewable
inflowing e.g. solar radiation	- renewable

Environmental resources

e.g. water, soil	- conditionally renewable

(Longva, 1981, p.8)

Each category is further subdivided into stock and flow accounts. Thus there are:
- material stock accounts;
- material flow accounts;
- environmental stock accounts;
- environmental flow accounts.

1. Material stock accounts comprise biological stock accounts and mineral reserve accounts.

2. Material flow accounts trace the flow of energy and materials from their natural state to different sectors of the economy. They are thus modified input-output tables. Monetarising the material flow accounts would allow their incorporation into national accounts.

3. Environmental stock accounts are termed "state accounts". Assessment is made of the state of the environment at different points in time. Recording data in environmental state and flow accounts is one way of presenting information gained from environmental monitoring.

4. Environmental flow accounts are termed "emission accounts". These deal with the emission of waste products into air, water and soil.

Some Norwegian resource accounts are given in the appendix (Tables 1 to 4).

4.3 France

France is another country in which an extensive system of resource accounting has been established (Friend, 1983; Theys, 1984; Weber, 1983; Corniere, 1986). As in Norway, the French resource accounts are intended to be a supplement to, rather than a fully integrated component of, the national accounts.

The French resource accounts are known as the "natural patrimony accounts". "Patrimony" suggests endowment, estate, heritage - giving an interesting clue as to the ethical stance motivating the establishment of these accounts. The goods and services provided by the environment have been endowed to the present generation who are obligated to hold them in trust for those yet to come.

Unlike the Norwegian approach the French approach is both physical and economic. The attempt to express at least some data in monetary units is seen as critical for decision making because without a common language being spoken by economists, environmental managers and scientists, environmental concerns will remain on the periphery (Theys, 1984, p.8). However:

> "The idea of incorporating all of nature in a "super" economic balance sheet has been abandoned" (Theys, 1984, p.8).

The main objective is:

> "... to demonstrate not a net profit or loss with respect to man's exploitation of nature, but conflicts between the economic, ecological and social functions of natural resources" (Theys, 1984, p.9).

At the beginning of 1984, natural patrimony accounts had apparently been prepared for water, forestry, soil and wildlife (Theys, 1984, p.13).

Environmental data is seen as existing on six levels.

Environmental data, which has been collected for various purposes but is not organised into a comprehensive framework, is seen as belonging on Level I. At the top end of the scale, Level VI, belong attempts at improving GDP as an indicator of national welfare.

It is not until Level IV that natural patrimony accounts appear.

Also on Level IV appear "satellite accounts". Satellite accounts contain monetary data presented in a framework that is compatible with national accounting. However, they are not integrated although that potential exists.

The French *environmental* satellite accounting:

> "... is designed to assess national environmental expenditure, its funding, and its beneficiaries" (Theys, 1984, p.4).

In 1983, Friend expressed concern about the complexity of the French system.

> "The potential weakness of the approach is the fragmentation of the data within a complex set of overlapping categories" (Friend, 1983, p.11).

4.4 Canada

Canada's approach is, like France's, a dual physical/economic approach (Repetto, 1988, p.7).

In Canada, environmental statistics have been coordinated into a framework known as the "Stress-Response Statistical System" (Rapport & Friend, 1979). It is:

> "... an overall method of assessing the state of ecosystems and their trends in the function of human activities. It is coordinated with economic and social statistics" (Weber, 1983, p.426).

4.5 USA

In the United States the Bureau of Economic Analysis has prepared satellite accounts known as PAC expenditures (Cremeans, 1977).

PAC stands for "pollution abatement and control". Pollution abatement is "direct action to reduce the emission of pollutants". Pollution control is "indirect action" and has two components - regulation and monitoring, and research and development (Cremeans, 1977, p.115).

The intent in 1977 was that the benefits of PAC expenditure should also be quantified in dollars.

The PAC estimates are designed to be comparable with the national accounts. This work is very cautious; there are no imputations involved. In spite of the relatively modest goal, there are still huge data problems (Cremeans, 1977, pp.100-101).

The aim of this work appears to be to keep a check on pollution expenditure to ensure that it does not exceed the corresponding benefits. The PAC expenditures could certainly be called "environmental accounts" but the objective is "value for money" rather than sustainable development.

4.6 Japan

Japan's approach is apparently similar to that of the United States with the preparation of satellite accounts known as the "green accounts", monetarising environmental services and damages in a framework compatible with national accounting (Repetto, 1988, p.7).

There has been at least one move to integrate the green accounts with the national accounts (Peskin, 1981). In 1974, the Economic Council of Japan attempted a fairly thorough modification of national accounts to produce a Net National Welfare (NNW) along the lines of Nordhaus and Tobin's Net Economic Welfare (NEW). The imputations include two environmental subtractions from GDP - one concerned with the costs of pollution control, and the other with the costs of remaining uncontrolled pollution. (The latter is the estimated cost of reducing pollution to 1955 levels.)

Peskin does not consider this a valid approach since:

> "... the Japanese NNW may increase, show no change, or even decrease when environmental quality improves" (Peskin, 1981, pp.515-516).

4.7 Australia

In Australia the Australian Environment Council and the Victorian Ministry for Planning and Environment have initiated work on resource accounting. In 1986 they commissioned Dr Robert Repetto from the World Resources Institute in Washington DC to prepare a discussion paper. After a number of public seminars and intra-governmental workshops held around the country, a sequence of case studies has been started in Victoria.

The first stage comprises studies on timber, petroleum and brown coal, and the second stage, studies on fisheries, water and soil. The intent is not to be comprehensive but to give high priority to sectors where resource accounts will be useful for management.

Chapter 5 International efforts

5.1 Introduction

The United Nations, the World Bank, the OECD and the European Community have and are continuing to put effort into resource and environmental accounting. In this chapter I describe briefly some of these cooperative efforts. It is important to keep in mind that official recommendations from the United Nations may be of the "lowest common denominator" type because countries with poor data collecting facilities must have a chance at implementing them (Leipert, 1987, p.358).

5.2 The United Nations - three different approaches

Most countries base their systems of national accounting on the United Nations System of National Accounts (UNSNA) which has been set up as the standard method. International consistency is seen as extremely important; eligibility for aid and national credit ratings, for instance, are based on real GDP/capita. A new revision of UNSNA is apparently due out in 1990, but according to Leipert there is:

> "... virtually no contact between the parties involved in the scientific discussion regarding a revision of national accounts ... and the creation of statistics on the environment and natural resources" (Leipert, 1987, p.358).

The United Nations Statistical Commission has been involved in the revision of UNSNA whereas the United Nations Environment Programme (UNEP) along with the World Bank has been active in the area of environmental statistics. An outcome of this seems to be two United Nations positions on resource accounting.

In 1983, UNEP formed a working group on environmental accounting and have subsequently organised four workshops on the topic. At least one of these workshops focused on modifying GNP to "sustainable" GNP.[4] Modifications would comprise both subtractions from and additions to the standard GNP. Subtractions would be the "user costs" of natural resources and "defensive environmental expenditures". Additions would be "discoveries" and other increases of natural resources and "net environmental benefits" (Bartelmus, 1987, p.349). These recommendations are in the tradition of Nordhaus and Tobin and flow from the work of Hueting, Leipert, Repetto and others. The World Bank is currently developing a formal set of guidelines that would enable such modifications to done consistently.

On the other hand the United Nations Statistical Office has shied away from environmental modifications to GNP. It is "regarded as too large and complicated an exercise" (Leipert, 1987, p.358). However, support has been given for such modifications to appear in UNSNA, but in the balance sheet and reconciliation accounts

rather than in current flow accounts (Landefeld & Hines, 1985; U.N. 1977 and 1979).

Repetto explains what reconciliation accounts are and goes on to say that inclusion of environmental concerns in UNSNA in this format would ensure their continued invisibility.

> "In essence, reconciliation accounts provide a means of recording changes in the value of net assets between successive measurement dates without having to show any effect on the income of the intervening period. Since attention has traditionally been directed at national income data rather than integrated national accounts (that is combined income statements and balance sheets), recording these adjustments in reconciliation accounts is likely to *minimise their consideration* in national policy analysis" (Repetto, 1988, p.6, my emphasis).

There is yet a third United Nations initiative on resource accounting; this one is under the auspices of UNESCO. In 1980, UNESCO began to explore ways of bringing interactions between population, natural resources and environment into long term planning (King, 1987). The methodology adopted was a form of resource accounting, that developed in Scotland under the leadership of Malcolm Slesser. It is described in Section 7.2 in this report.

5.3 The OECD - pilot studies

The OECD countries have also decided to take a joint initiative in the matter of natural resource and environment information. In a crowded Europe, the interdependence between economic development and the quality of the environment is becoming clear. There is an expressed desire to develop environmental policy instruments that treat the disease rather than just the symptoms. For this "the policy community in the OECD member countries" needs information (OECD, 1986, p.13).

Currently the OECD Group on the State of the Environment is reviewing the state of the art concerning natural resource accounts and is undertaking two pilot studies. Not surprisingly, the two European pioneering countries, Norway and France, are providing a lead.

The first pilot study is on forest resources. Norway is the pilot country and Canada, Italy, Finland, France and Sweden are also taking part. The emphasis is on physical input-output in the forest industries (OECD, 1988a).

The second pilot study is on inland waters. France is the pilot country and Finland, Italy and Portugal are also taking part. Five types of accounts are being considered - water cycle accounting (quantity), water quality accounting, aquatic ecosystem

accounting, water utilisation accounting, water economics (OECD, 1988b).

5.4 The European Community

As part of a research programme of the European Community, natural resource accounts (for renewable resources) are being developed for Europe (Gilbert & James, 1987). This work is being done by the Institute for Environmental Studies at the Free University, Amsterdam.

The framework for these accounts is currently being applied to drylands management in Botswana and has already been modified as a result of this experience. In this framework stocks and flows within the economy are linked with stocks and flows in the environment and natural resource systems.

In contrast with the resource accounts of France and Norway which are data-oriented, these accounts are to be *issue-oriented*.

> "... the intention is to design a shell or framework, and then fill it according to issues and perceived management needs" (Gilbert & James, 1987).

Chapter 6 Pioneers and radicals

6.1 Introduction

Around the world a number of researchers are attempting to develop new approaches and frameworks for resource and environmental accounting. In this chapter, I describe some of this work under the names of those who have led the work. The list is obviously not complete and the order is of no significance.

6.2 Repetto

Dr Robert Repetto of the World Resources Institute in Washington DC has been an influential advocate of the incorporation of resource accounts into standard national accounting.

Repetto's emphasis is on resource depletion rather than on environmental degradation. He sees a "dangerous asymmetry" in the fact that the depreciation of human-made assets is present in national accounts whereas the depreciation (or depletion) of natural resources is ignored. (See Section 3.6.)

> "Underlying the asymmetry is the implicit and inappropriate assumption that natural resources are so abundant that they have no marginal value" (Repetto, 1988b, p.2).

Repetto contends that it is possible to "recognize additions to, deletions from (including production) and changes in value of natural resource stock" in dollars (Repetto, 1988, p.17). This data can be used to adjust GDP. Repetto does not see a conflict between the "physical" approach and the "monetary" approach. Expressing data in physical units is a necessary prerequisite to expression in dollars. He seems to be a believer in going as far as possible until the data becomes ridiculously uncertain.

Repetto has developed timber and petroleum accounts for Indonesia (Repetto, 1988a). One of these appears as Table 5 in the appendix.

6.3 Hueting

A great deal of research into environmental accounting is going on in the Netherlands under the leadership of Dr Roefie Hueting at the Central Bureau of Statistics.

Hueting is an advocate of monetarisation but sees it as a solution only in exceptional cases. The attempt is useful, he contends, but for most scarce environmental goods and services, it is not possible to estimate appropriate shadow prices.

> "... it is most useful, as far as possible, to include the environment in market terms in CBA's, the SNA and models. ... But the great danger here is that politicians and the public come to interpret the relatively very small part of scarce environmental goods that can be valued in terms of money as the only part of the environment that is of importance in decisionmaking. This is the well-known *pars pro toto* hazard; a part is regarded as the whole" (Hueting, 1987, p.57).

The emphasis of the work of Hueting and his associates has been on quantifying and monetarising the losses of environmental functions. They have focused on water, air and soil.

Hueting appears to have some data that could be used for modifying the national accounts of his country but is reluctant to do this. His intent seems to be to isolate expenditure on the environment, thus making possible:

> "... a heightened awareness of the interrelationships between production and environmental destruction - although admittedly only to the extent that environmental stress and damage have already produced economic reactions" (Leipert, 1987, p.367).

6.4 Leipert

Hueting's work is very similar to a project under way at the International Institute for Environment and Society in Berlin. Here Christian Leipert and his associates are attempting to deal with the output anomaly discussed in Section 3.5.

Expenditure on preventing or repairing environmental damage may appear as increased productivity of an economy whereas it is one class of "defensive expenditures". Defensive expenditures:

> "... in welfare and from a longer-term perspective, do not form part of net production but rather represent additional costs of economic and ecological reproduction occasioned by growth and concentration" (Leipert, 1987, p.367).

Leipert's aim is to answer the question:

> "... is ... net production still rising in real terms, or does it merely appear to be because of an obsolete accounting system?" (Leipert, 1987, p.367).

One of Leipert's environmental accounts appears as Table 6 in the appendix.

6.5 Peskin

Henry Peskin of Resources for the Future in Washington DC believes that environmental accounting should be incorporated into the existing system of national accounts, and that anything more radical would be doomed to obscurity.

Peskin's aim is to impute values of environmental services and introduce them into the national accounts (of the USA). For example, there are two aspects of air pollution that Peskin attempts to monetarise - the value of air as a disposal mechanism and the value of the associated damages from air pollution (Peskin, 1975, p.195).

Peskin discusses four different ways of "improving" GDP; all have advantages and disadvantages; no one way is always the best. It depends on the questions the user of the data is asking (Peskin, 1976; Peskin & Peskin, 1978).

His approach is vulnerable to Hueting's criticism that "a part is regarded as the whole"; that is, only easily monetarised costs and benefits, which may well be less important in ecological terms, will be visible (Leipert, 1987, p.366).

Thus the conflict between aims and means of which Drechsler writes (Drechsler, 1976) lies at the heart of Peskin's work. (See Section 3.3.) Peskin himself is at pains to explain that non-marketed values have different price weights depending on the method of calculation (Peskin & Peskin, 1978, p.72).

6.6 Daly

The "steady state economist", Herman Daly, has for some years been a fearless and articulate critic of the "economic growth paradigm". He has now proposed a radically different system of economic accounting. Although he seems to be on strong ground conceptually, his proposals are unacceptable to the mainstream. Apparently, the Economic Division of the World Bank has rejected his proposals:

> "... because of the excessive distance from established GNP accounting and the lack of evidence of the concrete application ..." (Leipert, 1987, p.371).

Daly's argument begins with the contention that economic development as understood and measured is neither sustainable nor generalisable (Daly, 1988). (By the latter, he means that it is impossible for everyone in the world to have the same real GDP/capita as the developed countries.) Even the technological optimists still:

> "... face the problem of keeping physical flows within ecological limits" (Daly, 1988, p.44).

Gross National Product, he says, is a conflation of unlike entities, a summation of apples and oranges. Kuwait, for example, has a very high GNP/capita which is equated with a high income, yet it is based on the consumption of capital. GNP is an "empty world" accounting concept developed in a world of plenty.

Hence we are seeking to maximise something that does not merit maximisation. Daly compares microeconomics with macroeconomics as follows. In microeconomics, the intent is to compare costs with benefits and so optimise the activity. But in macroeconomics there is no optimum; costs and benefits are summed and more is always better than less (Daly, 1988, pp.51-52).

Daly advocates the replacement of one account, GDP, with three - a *benefit* account, a *cost* account and a *capital* account. Instead of maximising throughput, optimal behaviour would comprise:

- satisficing the accumulation of stocks and funds;
- maximising service given the sufficient accumulation; &
- minimising throughput given the sufficient accumulation (Daly, 1988, p.53).

Daly is clearly building on the work of Kenneth Boulding who, as long ago as 1969, argued that Gross National Product would be better named Gross National Cost, and that it should be minimised, not maximised.

Chapter 7 The energy approach

7.1 Introduction

A very different form of resource accounting has evolved out of the field of energy analysis. The approach is thermodynamic; the "world" is described in terms of an energy numeraire, the joule. Because everything is expressed in one physical unit, data can be aggregated, unlike resource accounts with data expressed in a variety of physical units. The basic notion is that energy is the one resource that is an input to all activity, and is therefore appropriate as a numeraire. It is also argued that the joule is a more robust numeraire than the dollar for long term planning, because it is not subject to inflation and price noise.

The concept of analysing a process or an economy in energy terms is not new; as long ago as 1926 the chemist Frederick Soddy argued that energy was the fundamental resource for economic well-being (King, 1987, p.13).

A different philosophy of decision making underlies "energy" resource accounts. (See Section 9.4.) The dominant macroeconomic approach is seen as putting numbers on everything and forcing everything into the same model; the decision then "falls" out the other end wrapped in an aura of objectivity. The new approach proposed by energy analysts and others is that in order to solve complex problems, we need to line up different models and openly exercise subjective judgement as to which model is most appropriate in a given situation. We need "a battery of macroscopic minimodels". Under this approach, national accounts in dollars would be one "minimodel"; national accounts in joules would be another.[5]

Methodologies for applying energy analysis to long term national planning have been developed; two examples are the ECCO model in Scotland and the Leontieff energy tables in the United States and in New Zealand. A short description of each follows.

7.2 A model for assessing carrying capacity

Researchers at the Energy Studies Unit of the University of Strathclyde and the Centre for Human Ecology of the University of Edinburgh have developed an "energy" system of resource accounting for the purpose of assessing carrying capacity (King, 1987; Slesser & King, 1988).

The development of "Enhancement of Carrying Capacity Options" (ECCO) was conceived under a major UNESCO programme aimed at integrating population, resource and environment concerns into long term planning. (See Section 5.2.) ECCO has been applied in several countries - Kenya, Mauritius, Thailand, China and Zimbabwe.

King describes the rationale behind the choice of an energy numeraire.

> "Physical resources other than energy may become dissipated and hard to recover but they are never actually consumed, being rather relocated, reshaped or transformed into other chemical species. Energy, on the other hand, once it has been used in making a resource useful to the economy is irretrievably gone. Thus, unlike money which takes no physical part in an economic process, remains unchanged after serving in a transaction, is used many times over and can be withdrawn at will, energy is a direct and robust measure of the effort required to carry out such a process, escaping problems of double counting and unstable relationships over time" (King, 1987, pp.17-18).

ECCO links resource accounting with systems dynamics modelling; it is used in dynamic simulation and scenario-type activities. Accordingly, it "does not optimise around any single criterion"; different criteria for judging success can be chosen according to policy goals. For instance, one parameter for judging the success of a proposed set of policies is Material Standard of Living (MSOL). If individuals are able to spend more on non-essentials, MSOL rises (King, 1987, p.24).

Most of the applications of ECCO have been to less developed countries; the application to Britain probably has more relevance to New Zealand. The main purpose of the British study was to validate ECCO; this was done by beginning with 1974 data, running the model forward 10 years and comparing the output with 1984 data (Slesser, 1988). A successful outcome has been claimed.

> "On the most sensitive indicator, capital stock in manufacturing, the calculation of Theil's inequality index was 0.045, ten times better than UK Treasury GNP forecasts" (King, 1987, p.33).

7.3 Energy input-output tables in New Zealand

Another approach to resource accounting involves using the concepts and framework of the inter-industry tables, also known as the input-output tables. Input-output analysis is based on a recognition that production and consumption can be usefully understood by tracing exchanges of goods and services between different sectors of the economy. These exchanges are presented in the form of a matrix where one can read, for instance, the dollars moving from the meat processing sector to the livestock production sector. (See Section 2.2.)

In 1963, Hannon and Herendeen at the Center for Advanced Computation in Illinois took the United States input-output table and switched the numeraire from dollars to joules, thus displaying the

energy consequences of transactions in the economy.[6]

In New Zealand, work on energy input-output tables has been going on since 1979 at the University of Canterbury (Hendtlass *et al.*, 1988). John Peet, James Baines, and others have produced energy analyses of the 1971-72 and 1976-77 inter-industry tables.

The energy input-output tables have been used for long term strategic planning exercises in New Zealand. While not amenable to simulation, input-output energy accounting provides a much greater level of detail than ECCO (a 160-sector analysis against ECCO's 12-sector analysis.)

John Peet sees the primary value of this work as educational. It identifies some of the (soft) physical constraints on the economy, thus telling decision makers something about the feasibility of various long term planning options.

Unfortunately, logic and good argument alone do not determine the acceptability of a methodology. The language of joules suffers from the same problem as Esperanto; they may both be excellent concepts and practicable, but that does not necessarily mean anyone wants to use them.

Chapter 8 The benefits of resource accounts

8.1 Introduction

In Chapter 1, the rationale for resource accounting was discussed in general terms. The basic concern is that the environment is invisible to decision makers; resource and environment accounts are seen as a potential means for rectifying this. There is agreement that the scarcity of natural resources and of environmental services can become visible through numerical data. What this data should be, the units in which it is expressed, and the framework in which it is set, are all open to debate.

Given that the general purpose of resource accounting is to make the environment visible, how can this happen in practice? What questions can resource accounts help to answer? What issues can resource accounts help to resolve? Establishing resource accounts may seem like a good thing to do but it is not without cost.

The best way of assessing the benefits of resource accounting would be to look at the use that is made of existing resource accounts. But this is not readily available information. Most statements on the usefulness of resource accounts are speculative, along the lines of "these accounts will be useful for answering questions such as ...". There may be nothing "wrong" (conceptually or empirically) with unused resource accounts but they will not be used until their validity is accepted. Their existence may be a necessary prerequisite for their acceptability.

Accordingly, in order to consider the practical usefulness of resource accounts, statements from the proponents of various systems, whether speculative or not, were sought. Some of this information already appears in Chapter 4.

There is one further point. The potential uses of a set of resource accounts depend on the methodology chosen; the choice of methodology depends on the planning concern.

8.2 Answering particular questions

As for standard national accounts, the *detail* of resource accounts is seen as being useful for answering specific questions. The information is there in an integrated form and questions can be answered relatively quickly with some accuracy.

One typical list of such questions follows. This list is from OECD, 1988a; "efficiently" refers to physical measures of efficiency, not economic.

With regard to a natural resource:

How much is left?

How much is harvested and how efficiently?

How much is imported and/or exported?

How much is processed (domestically) and how efficiently?

How much is used and for which end-purposes and how efficiently?

Where does it all end up?

How much is reused/recycled?

How much is waste or pollution?

How much will be available in the future?

How much will be demanded in the future?

Similar questions regarding environmental services could presumably also be asked and answered. "State of the environment" reports could contain time series drawn directly from environmental accounts.

8.3 Resource budgets and environmental quality targets

A second use of resource accounting is concerned with the setting of goals, an interventionist practice that seems inevitable if scarcity is really increasing. There is nothing new about the notion of resource budgets in New Zealand; Total Allowable Catches and Minimum Instream Flows are fish and water budgets.

Norway seems to see the setting of resource budgets as the primary outcome from resource accounts. In 1986, resource budgets were planned in the fields of land use, energy, fish and forestry.

> "The resource budgets will be presented in terms of physical units supplied with economic considerations. The budgets will reflect expected economic developments and policy principles on natural resource management and planning being approved by government" (Garnasjordet & Saebo, 1986, p.39).

The "environmental version" of a resource budget is an environmental quality target. Consider, for example, sulphur dioxide emissions. An environmental emissions account, after the Norwegian model, would show how these emissions vary over time. This might result in a target being set of a maximum of so many tonnes of the pollutant per year by say, 1995. The environmental emissions account should also show what sectors of the economy are emitting the sulphur dioxide, and therefore, indicate which actions might be effective.

8.4 Exploring the outcomes of policies

The third use of resource accounts is to explore the effects of particular combinations of policies, that is, scenario building.

This has been the primary application of ECCO. For instance, in an application to Mauritius, the effects of such policies as reduction in population growth, the intensification of sugar production to release land for food, and the creation of biomass plantations were modelled (King, 1987, p.33).

The New Zealand energy input-output tables have been used to answer such questions as:
"Which sectors of the economy would be most vulnerable to disruption in oil imports?"

One application of these tables was an examination of the employment implications of "Think Big" (Baines & Peet, 1981).

Chapter 9 Issues

9.1 Introduction

Clearly the emerging field of resource/environmental accounting is a maelstrom of theories, data and values. There is no consensus on the best way to go about it. What is "best" depends on the questions one is asking (or would like to see asked).

Before selecting an accounting methodology with which to experiment it is essential to consider a number of issues. These issues cannot be finally resolved one way or the other, but choices do have to be made. Some of the choices are of the "swings and roundabouts" type; if you choose a "swings" methodology, you cannot expect it to have the strengths of a "roundabouts" methodology.

In this chapter, I have identified four issues to be considered in deciding whether or not to establish resource accounts, and if so, which methodology to adopt. Most of these issues have already been presented in this report in discussion on the strengths and weaknesses of various approaches.

9.2 Physical or monetary units?

The choice of units - heterogeneous physical units, or dollars, or a physical numeraire like the joule - is a major issue.

There is not necessarily a conflict - physical units are a prerequisite for monetary units. The decision of whether or not to attempt monetarisation can be deferred. Monetarisation need not be total. (This does not apply to the energy numeraire approach; two numeraires cannot both be put into the same model.)

The basic argument for expressing resource accounts in dollars is that this is the only way for them to be noticed; externalities must be internalised.

A second argument for monetarisation (in fact, an argument for a numeraire whether dollars or joules) is the problem of aggregation.

> "Aggregating reserves of a mineral in physical units (tonnes) obscures vast differences in the value of different deposits, due to grade and recovery cost. On the other hand, maintaining physical accounts in disaggregated detail results in a mountain of statistics that are not easily summarised or used" (Repetto, 1988, p.7).

The basic argument against monetarisation is "the *pars pro toto* hazard" (Hueting, 1987, p.57). (See Section 6.2.) The act of monetarisation immediately introduces a bias toward easily

monetarised entities. (The same criticism presumably applies to the use of an energy numeraire; some things are more easily "energised" than others.)

A further argument against monetarisation is that there is a whole extra layer of uncertainty built into the data. Valuations are constantly changing. Further:

> "... a nonmarketed activity does not possess a single value or price weight" (Peskin & Peskin, 1978, p.72).

In the United States, the Department of Commerce has elected to keep estimates of the value of non-renewable resources out of the NIPA's (National Income & Product Accounts) because such estimates are so "volatile". Three different methods of valuation exist - the present value method, the land price method, and the net price method. All give different answers and all are "correct" (Landefeld & Hines, 1985).

The same problem exists in the energy numeraire models. All joules are not the same and apples get added to oranges.[7]

A further argument against monetarisation is that it is "undemocratic". Environmental and resource data expressed in dollars is largely impervious to public criticism. Were New Zealand to prepare a set of resource accounts in dollars, the only people in the country able to fully understand them would be a tiny group of professionals. We would slip further into expertocracy and the popular notions of transparency and accountability would be absent. (This argument is rather weak as any attempt to deal with complexity could be condemned as "undemocratic".)

9.3 Modification of national accounts?

The second issue follows on from the first. If resource accounts are expressed in dollars, then should the national accounts be modified?

The major argument for modification of the national accounts is the same as that for monetarisation, but in a stronger form. It is that the scarcity of natural resources and environmental services simply will not be taken into account until it is fully integrated into mainstream information bases.

Again the resolution of this issue can be deferred. Resource accounts can be made *compatible* with national accounts without being fully *integrated*. Norway has proceeded in this direction; in the Norwegian SRA (System of Resource Accounts), the economy is broken down into the same sectors as the SNA (System of National Accounts). The New Zealand energy input-output tables mirror the dollar input-output tables.

Opposition to modification of national accounts has come from both ends of the spectrum.

The professionals responsible for revising national accounts - the UN Statistical Office - have recommended that resource accounts be kept separate in satellite accounts. If a few countries go ahead and modify GDP in isolation, then international comparability is lost and time series suffer a discontinuity. The data is simply considered too shaky. Waring quotes "an unnamed New Zealand Treasury official":

> "The inclusion of too much non-marketed activity, based on questionable imputations, greatly reduces the usefulness of national accounts as a tool for economic analysis" (Waring, 1988, p.67).

Repetto argues that if resource accounts are relegated to satellite accounts, then they will receive only minimum consideration - being doomed to orbit forever on the periphery. (See Section 5.2.)

At the other end of the spectrum, Daly argues against the integration of resource and environmental data into national accounts because there is so much wrong with the current system. (See Section 6.5).

> "Are we trying to fine-tune a system that is getting more and more grossly out of focus?" (Kneese *et al.*, 1970, p.119)

A partial answer to that may be provided by a recent newspaper report under the headline, *U. K. statistics go awry*.

> "Britain's real gross domestic product grew by four and a quarter per cent in the year to the third quarter; or by two and three quarters per cent; or it contracted by one per cent. Take your pick, for the Central Statistical Office has disowned its measurement of national output" (Christchurch Press, 16 January, 1989).

9.4 The underlying philosophical issue

Another issue is the philosophical question already discussed in Section 7.1 which underlies the two issues discussed above.

Do we try to make the environment visible by forcing it into the dominant macroeconomic model, or do we settle for living with a duality that Waring likens to the wavicle of quantum physics; a wavicle is both a particle and a wave depending on the aspect of interest (Waring, 1988, p.241).

Richard Norgaard, a resource economist from Berkeley, is an articulate advocate of the second approach with his "plea for pluralism".

> "Logic ... indicates that multiple methodologies, conceptual pluralism, provides the key to a safer and pragmatic strategy for linking environmental and economic accounting. Sustainability is too important, too multi-dimensional, and too poorly understood for societies to rely on one methodology" (Norgaard, 1989, p.185).

Leipert believes that Norgaard has constructed "a dichotomy that does not reflect the actual state of current research" because "economics is not a monolithic discipline" and the growing body of work in "ecological economics" holds promise (Leipert, 1987, pp.367-369).

> "There are more than two general schools of thought: this would be true only if there existed such a thing as *the* economic method or *the* economic perspective. Many non-economists, both scientists and concerned citizens, have the impression that such is the case. The belief is widespread in the ecology movement, where economics is often the target of generalized criticism" (Leipert, 1987, p.368).

9.5 Is resource accounting worth it?

Finally, a system of resource accounting will cost money and skills. Is it worth it?

The benefits of resource accounting are indicated in general terms in the previous chapter. In weighing up these benefits against possible costs there are several things to keep in mind.

Firstly, there is a danger of data gathering for the sake of the data gatherers. Whether it is consciously acknowledged or not, it can be appealing to argue for collecting data and ordering it into a framework if one's job security, status or empire benefits.

On the other hand, it is true that if decision makers do not have information about resource depletion and environmental degradation, then they cannot be expected to take it into account.

Secondly, there is a danger of collecting a mountain of data that might never be used. Numbers are important but why not collect them, as the need arises, to answer specific questions?

There are various responses to this. In arguing that a macro perspective is essential, Leipert describes too narrow problem definition as giving "a worm's eye view of the status quo" (Leipert, 1987, p.361).

The data itself, for example, time series of polluting emissions, may well suggest some of the specific questions.

Thirdly, it may be worth wondering about the advantages and disadvantages of a *large uniform* accounting framework. In manipulating the data to fit the framework, will the interesting detail be lost? Everything is connected to everything else, but not all the connections are important.

Chapter 10 Recommendations

10.1 Introduction

The Ministry for the Environment has for some time now been considering the question of whether resource/environmental accounting would provide useful information in New Zealand. I have concluded that the area is definitely worth further investigation. In this chapter I make some specific recommendations for further action.

Certainly further discussion and scoping exercises are needed. If "resource accounting" was simply a single well-established methodology, then a five-week investigation (as this had to be) might be sufficient. But it is not. It would be presumptuous of me to make firm, detailed recommendations after an investigation of this length. Nevertheless the recommendations that follow are, I believe, reasonable, and not expensive exercises compared with the potential benefits.

10.2 Locate and audit existing resource accounts

There is already an enormous amount of natural resource and environment data in this country. There are almost certainly collections of data that could be rearranged into resource accounts in physical units. There is a task to do in locating and describing this information, and auditing it in a "value for money" sense. Who uses it and for what purpose? Is there data we don't know we have? Is there data we ought to be collecting? Are there data collection exercises going on that have become self-perpetuating?

The public's "right to know" is a further reason for locating this data. Environmental watchdogs fear that one of the costs of corporatisation is lack of public access to information. For instance, the New Zealand Energy Plan is no more. For all its shortcomings, it did provide data that was used to inform public scrutiny of the New Zealand Electricity Department and other energy suppliers. Further, privately supplied data may be "massaged" where its suppliers cannot be held publicly accountable.

One body of data that New Zealand already has is a set of resource accounts in energy units that are compatible with the system of national accounts. (See Section 7.3.) The inter-industry tables are published every five years; the last two sets have been converted to an energy version and plans exist to continue this with the 1981-82 tables (Pers. comm., J. Baines, 1989).

It would make sense for Ministry staff to look at the use that has already been made of these tables and to spend some time discussing potential uses with the researchers who have worked on this project for several years.

This recommendation is a general one for the whole field of environmental statistics, including environmental monitoring data.

10.3 Keep a watching brief on overseas developments

Activity in the area of natural resource accounting is particularly intense at the moment because of the review of UNSNA.

Obtaining and reading material, corresponding with overseas researchers, and then communicating the essence of new ideas to appropriate people in New Zealand is clearly an important task. It would be rash to decide on an appropriate methodology for New Zealand when there is so much international debate going on.

10.4 Learn from Norway in particular

Norway and New Zealand are similar countries in at least some relevant aspects. Both countries are small (Norway has four million people), with economies largely dependent on renewable natural resources like fish and forests, and on tourism. This last is important because the image of a clean environment has economic value.

Norway has put more effort into a system of resource accounting than any other country and some hardheaded evaluations of its usefulness have been and are being made. It makes sense for New Zealand to "jump up" Norway's learning curve.

Norway is already providing leadership to western countries in this field as the pilot country in the OECD forestry study. (See Section 5.3.)

It is important for New Zealand to take cues from other western countries with complex economies. Some resource accounting approaches seem to have been developed for the policy needs of Third World countries. This is encouraging since the environment has little protection where economic choices are restricted. But Third World models may not be appropriate for New Zealand.

The Norwegian resource accounting system is in physical units but monetarisation is not precluded. Neither is integration into the national accounts precluded since their SRA (System of Resource Accounts) and SNA (System of National Accounts) are compatible.

A thorough understanding of Norway's SRA would be a very useful step in considering alternatives for natural resource accounting in New Zealand. The preparation of some pilot resource accounts after the Norwegian model may help this.

> "... less effort should be spent in debate and more on experimentation, learning through doing, and sharing of experiences" (Norgaard, 1989, p.185).

Notes

1. What is the difference between GDP and GNP? GDP measures all the income generated from the production of goods and services in a country. GNP measures all the income generated from production that is received by residents of that country. Thus income flowing from, say, an aluminium smelter in New Zealand to overseas shareholders will feature in GDP but not in GNP.

2. New Zealand does not yet produce comprehensive national balance sheets. However, the Department of Statistics does record the total value of exotic timber, of livestock, and of all those things called stocks by firms - plant machinery, parts, tools etc.

3. Gross domestic product - depreciation = Net domestic product.

4. At times in this report it may appear that GDP and GNP are used interchangeably. In some countries including New Zealand, discussion focuses on GDP but in much of the international literature, GNP is used.

5. This paragraph is the result of a discussion with Dr John Peet and Professor Arthur Williamson at the University of Canterbury, January, 1989. Such an approach is also advocated by Richard Norgaard (see Norgaard, 1985) and Mark Sagoff, among others.

6. The input-output matrix has the potential to serve as a vehicle for other forms of resource accounting. For example, in 1970, Leontieff suggested adapting the input-output tables to account for pollution (Leontieff, 1970). His method involves adding an extra row "pollution" and an extra column "anti-pollution". All data must be in monetary terms. A Leontieff-type pollution model has been developed and used in the Netherlands (Hueting, 1980, p.79).

7. Energy of different types is often summed together in thermal equivalent units like tonnes of coal equivalent. It is easy to express a kWh of electricity in this unit if its origin is a thermal power station. But there is no satisfactory way to express hydroelectricity in thermal units.

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Appendix

Some sample resource and environmental accounts

Table 1: A Norwegian resource account.
The forest balance.

Millions m^3. 1985

	Total volume 1 Jan.	Harvest	Losses	Growth	Total volume 31 Dec.
Total	616.9	-11.0	-2.3	20.6	624.3
Spruce	282.1	-7.4	-1.2	9.5	283.0
Pine	197.3	-2.1	-0.5	5.4	200.1
Hardwood	137.6	-1.5	-0.6	5.6	141.1

Source: Alfsen *et al.*, 1987, p.21

Table 2: A Norwegian resource account.
Reserve estimates of iron, titanium, copper, zinc and lead.

Million tons pure metal. 1980, 1982, 1984.

		Reserves 1 Jan.	Extraction	Revaluation	Reserves 31 Dec.
Iron	1980	157.3	-2.4	-3.3	151.6
	1982	78.0	-2.1	-0.9	75.0
	1984	72.7	-2.4	-35.6	34.7
Titanium	1980	20.0	-0.4	-0.4	19.2
	1982	18.5	-0.2	-0.1	18.2
	1984	17.9	-0.3	-0.0	17.6
Copper	1980	0.50	-0.03	-0.08	0.39
	1982	0.28	-0.03	-0.00	0.25
	1984	0.23	-0.02	-0.03	0.18
Zinc	1980	0.54	-0.03	-0.06	0.45
	1982	0.33	-0.03	-0.00	0.30
	1984	0.27	-0.03	-0.09	0.15
Lead	1980	0.046	-0.002	-0.016	0.028
	1982	0.025	-0.004	-0.001	0.022
	1984	0.018	-0.004	-0.005	0.009

Source: Alfsen *et al.*, 1987, p.21

Table 3: A Norwegian resource account.
Use of energy outside the extraction and conversion sectors in 1985.

	Coal	Coke	Bio-mass	Gas	Gaso-line	Kero-sene	Light fuel	Heavy fuel	Elect-ricity
	1000 tons	1000 tons	1000 t.o.e.	1000 tons	1000 tons	1000 tons	1000 tons	1000 tons	GWh
Agric. and fishing	5	-	-	-	21	3	559	17	779
Mining	-	1	-	0	0	0	39	28	905
Manufacturing	718	11 989	304	874	20	3	320	508	43 382
Man. paper prod.	-	-	176	-	0	-	3	67	5 429
Energy int. manuf.	373	1 007	2	859	2	1	49	201	30 374
Other manufact.	345	191	126	15	18	2	268	239	7 579
Build., constr.	-	-	-	-	9	1	417	1	706
Transportation	-	-	-	-	91	440	1 634	3 435	1 411
Railroad etc.	-	-	-	-	-	-	20	-	660
Other dom. tr.	-	-	-	-	49	-	443	-	-
Foreign shipping	-	-	-	-	-	-	706	3 281	-
Air transport	-	-	-	-	-	440	-	-	-
Post and telecom.	-	-	-	-	42	-	33	-	751
Trade, services	-	-	-	-	412	11	522	16	14 396
Households	18	28	416	2	1 130	224	351	21	30 632
Total	741	1 227	720	876	1 683	682	3 842	4 026	92 211

Source: Alfsen *et al.*, 1987, p.19

Table 4: **A Norwegian resource account.**
Emissions to air excluding emissions associated with production of oil and gas and ocean transport.

1000 tons. 1976-1986.

	1976	1978	1980	1982	1983	1984	1985	1986	Average annual growth rate (%)
SO_2	148	142	140	116	103	95	99	94	-4.4
NO_x	128	131	125	130	133	144	149	162	2.4
CO	578	598	575	551	543	648	688	755	2.7
Pb	0.675	0.712	0.697	0.496	0.474	0.311	0.328	0.296	-7.9

Source: Alfsen *et al.*, 1987, p.29

Table 5: A resource depreciation account. The forest resource in Indonesia.

	1970	1975	1980	1981
ADDITIONS (million cubic meters)				
Net growth	51.9	51.9	51.9	51.7
Reafforestation/ Afforestation	19.6	19.6	18.6	13.1
DEPLETIONS (million cubic meters)				
Extraction	10.7	17.1	22.0	13.8
Deforestation	99.0	99.0	99.0	108.0
Degradation	6.6	6.6	6.6	6.6
NET RESOURCE FLOW (million cubic meters)	-44.8	-51.2	-57.1	-63.6
RENT ($/cubic meter)*	6.0	14.5	55.2	52.4
DEPRECIATION (million $)*	-268.8	-742.4	-3151.9	-3332.6

* Monetary data in US dollars at current rates of exchange and prices.

Source: Gilbert & James, 1987.

Table 6: The defensive expenditures approach. Total expenditures for environmental protection, Federal Republic of Germany.

Millions of DM in 1980 prices.

Year	Industry	Government	Industry & Government
1975	7,140	10,200	17,340
1976	7,190	10,940	18,130
1977	7,180	10,340	17,520
1978	7,200	11,470	18,670
1979	7,190	12,380	19,570
1980	7,810	12,750	20,560
1981	8,160	11,940	20,100
1982	8,820	11,130	19,950
1983	9,070	10,720	19,790
1984	9,090	10,630	19,720
		Average Annual Change in %	
1975/84	+2.7	+0.5	+1.4
1975/80	+1.8	+4.6	+3.5
1980/84	+3.9	-4.4	-1.0

Source: Leipert & Simonis, 1987, p.49

Note: This does not include expenditure on environmental protection by other economic sectors such as agriculture, forestry, trade, transport, communication and other services.