MODULE 6

MACRO-ECONOMIC POLICIES, POLICY ANALYSIS AND THE ENVIRONMENT

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6.1 INTRODUCTION

Macro-economic policies have widespread impact on the use of a country's resources and ecological services. Fiscal, monetary, trade, investment, pricing and institutional policy shifts can greatly influence environmental degradation[1]. The general impacts of many of these policies on the environment were discussed in module 4. Macro-economic policies change economic signals, influencing decisions by people on which and how much of a resource or service will be used. Macro-economic policies, whether or not successful in generating economic growth, indirectly impact the environment due to changes in income, public revenues, and innovative capacity.

The precise impact of macro-economic policies on the environment is difficult to determine because of vague environmental indicators. But even a qualitative assessment of the potential environmental impact of policies designed to modify aggregate demand, counter fiscal deficits, or address balance of payment problems may suggest minor adjustments for limiting environmental damages, if these are identifiable. Inappropriate macro-economic policies can undermine the success of sector-based environmental policies. When the government of Ghana introduced a system of royalties in forestry aimed at improving the efficiency of logging, the over-valued exchange rate rendered the stumpage prices negligible relative to major traded currencies. To exporters of timber being paid in foreign currency, the new stumpage prices represented a minor cost of business and trees continued to be felled at the same rate.

Failures in environmental policies can often be traced to problems in the underlying structure of markets and institutions that accommodate the reforms. Market-based environmental policies require a well-functioning market system. In subsistence-oriented economies, environmental policies that rely on price incentives may be ineffective because many resources lack prices and people lack income. In other cases, the institutional structure may inhibit the success of environmental policies, for example when government cannot enforce pollution standards. Government many also wish to encourage investments for sustainable agriculture but that may require a well-developed rural credit network.

[1] Refer to case study 4 on trade and environment.

The exact impact of macro-economic policies on the environment is difficult to generalise and depends on specifics concerning every country's institutions, existing environmental policies, market organisations, and factor endowments. A number of analytical tools have been developed to help policy-makers understand the linkages between macro-economic policy and the environment. Some of the tools are simple and qualitative, while others are based on sophisticated models requiring extensive data. This module will examine three analytical tools. The first, Environment-Economic Policy Matrix (EEPM) is a fairly simple method that requires only a basic understanding of economics. Two other tools, general equilibrium modelling and environmental accounting, are more complex and are best left to economists with special expertise in modelling and advanced statistics.

6.2 ENVIRONMENT-ECONOMIC POLICY MATRIX (EEPM)

The EEP matrix (also called an "action impact matrix)[2] is used to show the relationship between economy-wide policies and the environment. A stepwise procedure, starting with readily available data, is used to effectively develop the EEPM[3]. First, data from NEAPs, EAs, and so forth, may be organised into a table of key environmental issues provides quantitative or qualitative indicators of damage, and helps identify underlying economic causes. In developing countries, the underlying causes of degradation that contribute to each environmental issue often include many of the contributors outlined in module 4:

- Market failure (inappropriate resource pricing, lack of clear property rights, etc.);
- Policy failure (poorly designed economic, social and environmental policies);
- Institutional failure (inadequate laws and regulations governing the environment); and
- Implementation failure (ineffective monitoring and enforcement of laws and regulations).

A simple matrix could be set, although many other approaches are possible (Table 6.1).

[2] The World Bank uses "Action Impact Matrix" for this approach; see Munasinghe and Cruz (1995). However, to emphasise the linkage between environment and economic policy, the EEPM is a more relevant title.
[3] Refer to case study 1 for an example from Swaziland.

Table 6.1: Example of matrix 1 for EEPM process

Key Environmental Issues for Country	Biophysical Indicators of Damage	Socio-Economic Indicators of Damage	Underlying Causes of Degradation
Deforestation	Decline in forest cover of 15 percent in last 5 years Average annual rate of deforestation estimated at 25,000 ha.	Decline in sustainable harvest of timber from 1.5 million m3 to 850,000 m3 per annum since 1985	Lack of clear land tenure in rural areas Low timber prices Lack of strong national forest policy regarding reforestation
Etc.	Etc.	Etc.	Etc.

Second, using information that is readily available from country economic and sector work, the main economy-wide policies (current and intended) can be set out in a second table, together with a brief review of the basic economic issues that they address and potential environmental linkages. An example is shown in Table 6.2.

Table 6.2: Example of matrix 2 for EEPM process

Macro-Economic Policy	Current Situation and Issues	Ongoing and Proposed Policy Reform	Environmental Implications
Monetary policy dealing with exchange rates	Exchange rate is overvalued relative to traded currencies, thus hindering exports and addressing BOP deficit	Exchange rate will be allowed to float and is expect to depreciate by 20%, thus promoting exports	Increase in commercial and illegal forest harvesting, log exports, etc. Increase in cash crops grown for agriculture
Etc.	Etc.	Etc.	Etc.

The information from these two tables can then be combined to develop a final table showing linkages between specific environmental issues and specific macro-economic policies (Table 6.3). Where a (-) sign is indicated, the linkage between the economic policy and the environment is negative; in other words, the policy change is expected to exacerbate the environmental issue. On the other hand, a (+) sign indicates some positive linkages. In the example below, the exchange rate policy change will cause higher deforestation but also increase employment and government revenues.

Table 6.3. Example of matrix 3 for EEPM process

Macro-Economic Policy Reform	Deforestation	Other Key Environmental Issues
Flexible exchange rates and likely devaluation	Increase in illegal harvesting (-) Increase in log exports (-) Increase in employment and forestry revenues to government (+)	Etc.
Other Macro-Policies	Etc.	Etc.

The EEPM process may be developed further to assist in analysis and remediation. For example, more detailed analyses may be carried out for negative economy-wide policies and environmental links identified in the cells of the third matrix. This, in turn, would lead to a more refined final matrix, which would help quantify impacts and formulate additional measures to enhance positive linkages and mitigate negative ones. They may range from the application of conventional sectoral economic analysis methods appropriately modified in scope to incorporate environmental impacts to fairly comprehensive system or multi-sector modelling efforts. The EEPM process is limited in that it is not quantitative. Also, it is sometimes difficult to link the biophysical and socio-economic indicators with actual pressure from economic policies. However, it is a simple approach that policy-makers can easily understand and work with at both the national and sectoral levels. The level of detail depends on how much time and data are available.

6.3 COMPUTABLE GENERAL EQUILIBRIUM MODELLING (CGE)[4]

Briefly, the CGE approach lays out the theoretical structure of a model incorporating how output in each sector is produced, how incomes are generated and distributed, how these incomes feed into consumption and savings patterns and how the macroeconomic balance between aggregate demand and aggregate supply is achieved. This theoretical construct will comprise a set of endogenous variables, whose values are to be determined by the model; exogenous variables, whose values are set outside the model but which might subsequently be changed by outside events; and parameters - normally production and consumption

[4] Much of the material in this section is derived from Mabugu and Milne (1997).

elasticities[5]. Data are then obtained from statistical publications and the model is calibrated around that data, an exercise which involves adjusting the parameters so that, together with the given exogenous figures, the model generates the same endogenous variables as those reported in the government statistical publications. The calibrated model thus attempts to replicate the working of the national economy. This serves as the base case.

In its simplest form, the CGE approach uses this base model to perform 'experiments'. The value of one or any combination of the exogenous variables is changed and observations are made on how the new values generated in the model differ from the base case. This allows the separation of the influence of one factor on the economy; it is a controlled experiment. Strictly speaking, many macro-economic indicators can be used for evaluation in this approach, for example employment, income distribution, balance of payments, tax revenue, etc.

With the environment, the model can be used to estimate the impacts of policy change on macro-economic performance. As an example, the impact of environmental law reform and/or introducing economic instruments such as "green taxes", can be compared to the base case. In modelling policy change, it is important to remember that policies have effects through two main channels: first, through the exogenous policy variables and second, by changing the nature of behavioural relationships. An industry survey could provide data on how the proposed environmental tax would impact on output, expenditures and employment. These variables in turn then are incorporated into the model and aggregate impacts can be derived.

Linking environmental degradation with a CGE model is not easy and must rely on monetary measures of environmental change as inputs[6]. Then, the economic implications on employment, fiscal revenues, etc. can be estimated. With forestry, the model could assess the long-term effects of deforestation on sector employment and income, and government revenues. In the short-run, the impact of currency devaluation might be increased forestry activity and hence economic benefits as defined in the model. However, in the longer-term as forest stocks decline, forestry activity could also decline, thus causing a negative linkage with some of the model parameters.

[5] Refer to the Annexure after module 10 on microeconomics for an explanation of elasticities.

CGE models are complex and require extensive data on the economic sectors included. They can only provide an abstract representation of the economy and results must be interpreted carefully. In several countries in the region, the Ministry of Finance or Reserve Bank (or both) use some form of CGE to trace the impact of policy changes on the macro-economy. Universities sometimes have similar models, usually in the Department of Economics. With adequate data and expertise, these models can help increase our understanding about the linkages between macro-economic policies and the environment. They can provide monetary values of environmental degradation or the net benefits of policy change. In the political arena, money talks, and is often the most effective way of convincing decision-makers about the cost of an environmental issue or benefits of implementing new policies.

6.4 ENVIRONMENTAL ACCOUNTING

6.4.1 General Background on National Income Accounting

The existing System of National Accounts (SNA) measures total economic output as transactions in the marketplace. The result is seen as national income, often represented by gross national product (GNP) and gross domestic product (GDP)[7]. These measures can be further refined as per capita values (gross values divided by national population), and real values (corrected for inflation), either in total or per capita terms. The SNA is well established in most countries and thus provides for reasonably consistent measures of national income over time and between nations. The traditional SNA can measure national income three ways (Figure 6.1).

[6] Refer to case study 2 for an example of CGE environmental analysis from Zimbabwe.
[7] GNP represents the value at market prices of all final goods and services produced by a country during a year both inside and outside its borders. GDP is the value at market prices of all final good and services produced during a year within a country.

Figure 6.1: Three methods of measurement of GNP

a)	**GNP AS THE SUM OF INCOME**		**b)**	**GNP AS THE SUM OF FINAL DEMAND**
	Compensation of employees			Personal consumption expenditures
+	Net interest		+	Gross private domestic investment
+	Rental income		+	Govt. purchases of goods and services
+	Profits		+	Net exports = Exports - Imports
=	NATIONAL INCOME		=	GROSS NATIONAL PRODUCT
+	Indirect business taxes		**c)**	**GNP AS THE SUM OF VALUE ADDED**
-	Subsidies			Sum total of the value added component of each industry
=	NATIONAL PRODUCT			
+	Depreciation on man-made capital			
=	GROSS NATIONAL PRODUCT	=		TOTAL VALUE ADDED
		=		GROSS NATIONAL PRODUCT

6.4.2 The System of Integrated Environmental and Economic Accounts (SEEA)

The System of National Accounts (SNA) was developed after the Second World War, and not surprisingly, it exclusively focused upon measuring economic growth. Most people saw no need for better treatment of natural resources and the environment at that time; resources were considered abundant and the environment as an inexhaustible sink. The 1968 SNA guidelines (United Nations), which were valid until 1993, considered depreciation of produced or manufactured capital but did not deal with natural capital and its linkages with the economic system[8]. Under the general guidance of the Intersecretariat Working Group on National Income Accounts (consisting of the Commission of the European Communities, OECD, UNSTAT, the IMF, and the World Bank), expert meetings were held from the mid-1980s and to the early 1990s to address various issues in national accounting. One major thrust was to include an environmental element[9].

[8] The reader is invited to refer to module 2 for a discussion of manufactured and natural capital in a sustainable development model.

[9] For more information on the theoretical basis of integrated environmental accounting, refer to United Nations (1993), Lutz (1993), and Sheng (1998).

From the environmental perspective, the two most significant changes introduced in the 1993 SNA were:

- A more comprehensive view as to what constitutes an asset - all assets that contribute to marketable production are included. Such assets include land, subsoil resources, cultivated plants and livestock, and non-cultivated natural assets that yield products such as timber. Where harvests exceed a sustainable yield, and where therefore stocks are being drawn down, the excess is subtracted from current income.
- A recommendation that integrated environmental and economic accounting should be done in satellite (i.e. supplementary) accounts that are linked with the main (or 'core') accounts of the SNA. A full integration of integrated environmental and economic accounting into the main accounts was not considered feasible because of the limited case study work that had been done up to that time and because of outstanding conceptual and valuation issues.

The SEEA delineates a series of accounts concerning resource stocks and flows, pollutant flows and environmental protection expenditures, with explicit links to the existing national accounts. While the SEEA lays out a useful structure for satellite accounts on natural resources and the environment, it does not (yet) provide firm guidelines on valuation. There is a broad consensus that a greener national income - what the SEEA terms 'Eco-Domestic Product (EDP) - would deduct the value of depletion of natural resources and degradation of the environment from traditional net domestic product. But several issues remain: including the choice of the appropriate discount rate to be used in valuation and the measurement of the resource rents that are the basis of valuation.

When it comes to valuing environmental damage from pollution there is little unanimity in the literature. The SEEA favours 'maintenance cost' approaches, where damage is valued as the cost of returning the environment to its state at the beginning of the accounting period. Other approaches involve the cost of meeting a given environmental standard or of exploiting the environment at a sustainable rate. There is also the question of what proportion of environmental protection expenditures should properly be included in an EDP.

The general conclusions from a number of studies are:

- Valuing depletion of exhaustible resources involves either measuring Hotelling rents[10] (i.e., price minus marginal cost of extraction), which assumes efficient resource pricing over time, or the El Serafy (1989) method which assumes constant profits from extraction over time;
- Valuing depletion of living resources requires the measurement of the rental value of harvest minus natural growth (so that sustainable management of the resource will entail no depletion charge);
- In the particular case of forest resources the question of land use arises - if land is deforested then depletion has occurred only if the present value of returns to this land under the alternative use is less than the present value of returns to the land as a forest that yields a sustainable supply of timber and non-timber benefits; and
- As just noted, for the majority of pollutants where there is a rising marginal damage curve, the quantity of pollutant emitted times the marginal damage gives the deduction that should be made from EDP.

6.4.3 Policy Uses of Resource and Environmental Accounts[11]

Apart from the construction of new national accounting aggregates, there are a variety of accounts that countries are developing[12]. The first category is adjusted national accounting aggregates, such as EDP or genuine savings. Secondly, there are natural resource accounts where the emphasis is on balance sheet items, the opening and closing stocks of various natural resources, and the flows that add to and subtract from the balance sheet position. Next there are resource and pollutant flow accounts that typically embody considerable sectoral detail and often are explicitly linked to the Input-Output Accounts, a part of the SNA. The environmental expenditure accounts are, obviously, measured in values and, as a breakout of existing figures in the SNA, can be viewed as classical satellite accounts.

[10] Refer to module 5 for more information on Hotelling rents.
[11] Refer to case study 3 for an example of environmental accounting from Namibia.
[12] For country examples, see Repetto et al (1989) and Perrings et al (1989). A synthesis of progress in Africa is provided in United Nations ECA (1998).

a) Genuine savings and the financing of development

Given the centrality of savings and investment in the economics of development, it is perhaps surprising that the effects of depleting the environment have not, until recently, been considered in the measurement of national savings and investment. This omission may be explained both by the models used by economists, which typically rely on gross measures of activity, and the fact that the System of National Accounts (SNA) ignores the depletion and degradation of the natural environment in the standard measures of income and product. To correct this, genuine saving is defined as net saving less the value of resource depletion and the value of environmental degradation (see for example, Hamilton *et al* 1994; Hamilton 1994; World Bank 1995). Box 6.1 shows example graphs of genuine saving for high-income countries and the countries of sub-Saharan Africa.

The policy implications of measuring genuine saving are quite direct: sustained negative genuine savings must lead, eventually, to declining welfare. Moreover, the consideration of genuine savings provides an essential linkage between the interests of ministries of natural resources, environment, finance, and planning.

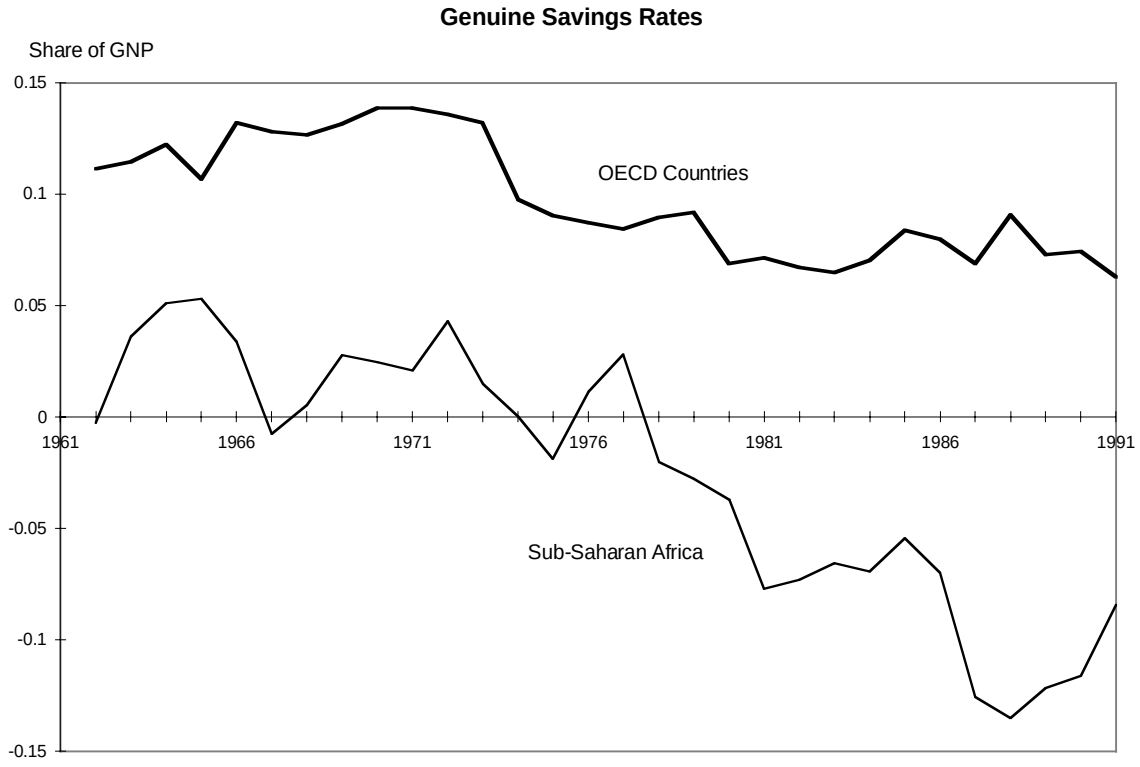
Any attempt to broaden the measure of wealth, which is in essence what genuine savings is about, should take stock of human capital. Because the SNA treats current (as opposed to capital) expenditures on education as consumption, the obvious correction is to include these expenditures in genuine savings - then all education expenditures would be treated as investment. This is not, obviously, an attempt to value human capital, but it does send the correct policy signal to developing countries by saying that one way to boost genuine saving is to expand education. Box 6.2 shows how expanded wealth accounts might help to shift the priorities in development strategies.

Genuine saving is concerned with the financing of development in the following sense: total investment (including education) may be viewed as being financed out of foreign borrowing, a depreciation allowance, a depletion allowance, and an environmental degradation allowance. Governments that wished to be provident would ensure that funds were set aside in the form of these allowances; positive rates of genuine saving measure the extent to which new wealth is being created for the future.

Box 6.1: Measuring Genuine Savings

One of the prime motivations for developing a green GNP is to measure progress towards sustainable development. Deriving truer measures of income is clearly important, but adjusting the level of national income does not necessarily yield usable signals for policy-makers; moreover, comparing growth rates for green GNP with regular GNP produces equivocal signals.

Greener measures of wealth and saving have more direct policy implications regarding the sustainability of development. Figure 1 displays 'genuine' savings rates (i.e., national savings less depreciation of produced assets, depletion of natural resources and damage to the environment) for the countries of the OECD and Sub-Saharan Africa.

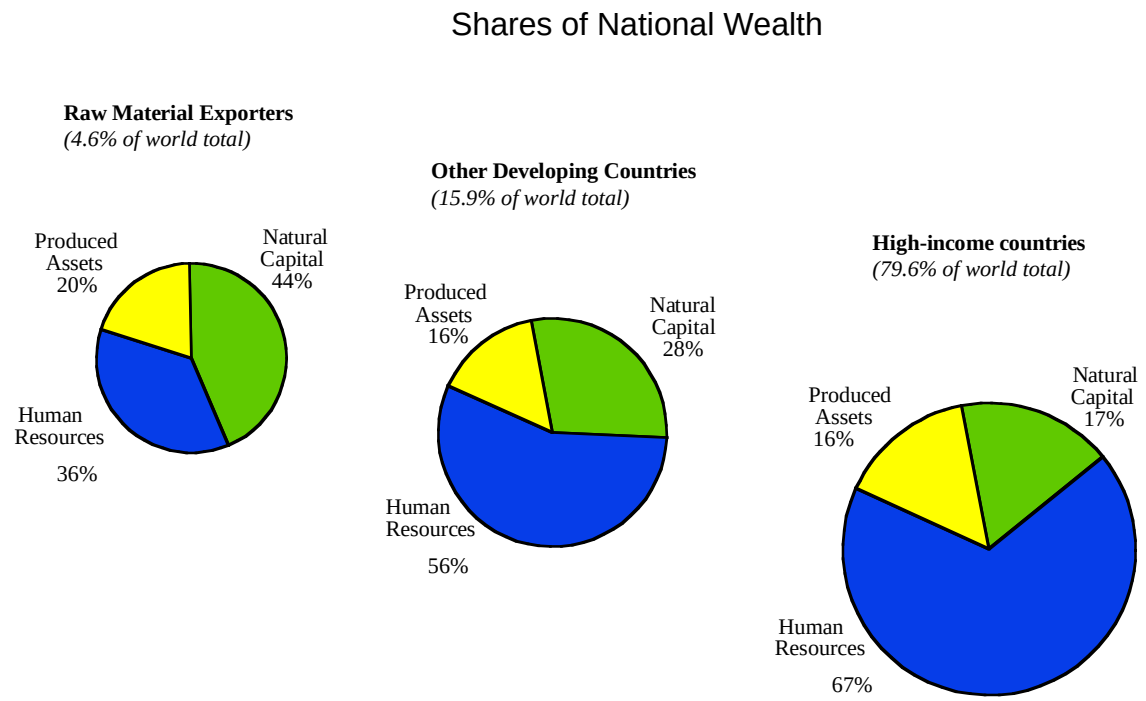


Persistent dissaving, as in the case of Sub-Saharan Africa after the 1973 oil shock, must eventually lead to declining well-being. Savings rates near zero should be cause for concern. The policy issues raised by the analysis of genuine savings include natural resource tenure and royalty regimes, public investment policies, policies regarding environmental pollution, and the broader fiscal and monetary policies that determine public and private savings and consumption.

Source: World Bank (1995)

Box 6.2: The Wealth of Nations

Back of the envelope calculations of the wealth of nations were presented in *Monitoring Environmental Progress* (World Bank 1995). By taking the present value of the stream of income over the expected lifetime of the current population, a crude total wealth measure for each country was derived. Separate estimates of the value of natural resources and produced assets permitted the calculation of a value of human capital as a residual. While the resulting figures for individual countries do not bear close scrutiny, broad trends across regions and income categories can be seen, as in the figure below.



The basic message from this analysis is that development can be conceived as a process of portfolio management. Countries have a given natural endowment that may be transformed into other forms of wealth (with due consideration being given to global externalities); natural resource exporters aiming to develop their economies need to balance human resources and produced assets in this process of transformation. What is remarkable about the charts is that produced assets make up a near-constant proportion of total wealth across different country groupings. If there is a lack in developing countries it is in human resources.

The World Bank (in press) has prepared national indicators that extend the linkage between economic activity and environmental change (Table 6.4). Estimates of genuine savings for selected countries in eastern and southern Africa are derived by: gross domestic saving less

depreciation of produced assets less depletion of mineral, energy, and net forest growth, less pollution damage (CO^2) plus investments in human capital (education expenditures). Table 6.4 shows that for the countries selected, genuine savings in 1997 was positive for five countries and negative for three. This table presents a snapshot for one year. A better picture would be portrayed by the trends in genuine savings over time. Policy-makers should be worried if the trend shows increasing negative genuine savings, signalling dissipating wealth.

Table 6.4: Genuine savings estimates for selected countries eastern and southern Africa 1997

Country	Gross Domestic Savings (%)	Depreciation Productive Assets (%)	Net Domestic Savings (%)	Resource Depletion (%)	CO^2 Damage (%)	Education Investment (%)	Genuine Domestic Savings (%)
Angola	27.3	6.0	21.2	20.7	0.4	2.6	2.7
Botswana	44.7	13.3	31.4	0.8	0.3	6.9	37.2
Madagascar	3.6	4.9	-1.3	-	0.2	2.3	0.8
Malawi	2.1	6.4	-4.3	8.6	0.2	3.2	-9.8
Mozambique	13.6	3.6	10.0	13.9	0.2	3.9	-0.2
Namibia	14.2	13.8	0.4	0.6	-	1.7	1.5
South Africa	17.0	13.8	3.2	4.3	1.4	6.6	4.1
Zambia	9.8	9.9	-0.1	9.7	0.4	3.8	6.3
Zimbabwe	11.9	6.0	5.9	13.4	1.0	8.2	-0.3

Note: Depletion estimates for diamonds are not included, thus genuine savings rates for Botswana and South Africa are overstated.
Source: Hamilton (1999).

One of the determinants of genuine savings rates for developing countries is the value of resource depletion. However, it would obviously be incorrect to conclude that the policy response regarding savings and natural resources is to boost genuine savings by restricting resource exploitation. One of the key lessons from growth theory is that the discovery of a natural resource, properly managed, leads to a permanent increase in the sustainable stream of income for a country. The question with regard to natural resources is therefore one of what constitutes 'proper management.' Key policy questions surrounding adjusted national accounts are shown in Box 6.3.

Box 6.3: Key Policy Considerations Surrounding Adjusted National Accounts

- Do tenure regimes encourage sustainable exploitation?
- Are royalties set correctly, to capture resource rents while leaving the exploiting firms with adequate rates of return?
- Are the royalties from natural resources invested or consumed? What kinds of investments are made?
- Do policies to promote natural resource exports also embody plans for the investment of the resource royalties?
- Do policies with respect to pollution emissions aim for the economic optimum, where total social benefits and total abatement costs are equated at the margin?
- Even if the optimum is achieved, are sufficient savings being made to offset any increments to pollution stocks that this may entail?
- Is the level of government current expenditure appropriate and sustainable?
- Does the tax system penalise or encourage saving?
- Does monetary policy set positive real interest rates?
- Do government policies support a viable financial sector?

A critical point determining the permanence of income from natural resources, even for non-renewable, is how savings are re-invested. First, not all saving is the same. For example, savings sitting in foreign bank accounts belonging to a small elite within a country are unlikely to lead to development. In other words, there are distributional issues to be considered. Second, not all investment is the same, in the sense that there are both productive and wasteful investments. A government buying Mercedes Benzes, military equipment and a presidential jet is not making productive investments. A key concern that follows from the consideration of genuine savings, therefore, is the quality of investment. Investments in human capital, especially in primary education in developing countries, are likely to be important in this regard. Further, if savings are invested in man-made or manufactured capital (that in turn is used to generate productive assets) and renewable resources, then a country can conceivably see a permanent increase in the sustainable income stream.

b) Natural resource accounts

As previously noted, natural resource accounts generally have a balance sheet flavour, with their emphasis on opening and closing stocks, in quantity and values, of natural resources including both commercial natural resources and non-commercial or environmental resources. As such, resource accounts form the basis of the expanded national balance sheet accounts in the revised SNA. The principal policy and analytical uses of these accounts include:

- Measuring physical scarcity. The origins of natural resource accounts lie in the 1970s when the physical scarcity of crude petroleum seemed to present a threat to economic development. Resource accounts permit the calculation of crude scarcity indicators such as the reserves to production ratio, which gives the remaining years of resource supply at current extraction rates. However, it must be recognised that physical scarcity and economic scarcity are not the same thing, and that it is the latter that represents the constraint on development. Measures of physical scarcity can be important for critical materials, and may be an important input into such policy questions as determining the need to maintain strategic reserves of particular materials[13].

- Resource management. Again, one of the concerns when resource accounts were first established in the 1970s was that there was excessive exploitation of natural resources. What constitutes 'excessive exploitation', however, is a question lying outside the accounts - it is certainly an economic concept, considering efficiency conditions such as the Hotelling rule in resource economics. But there are physical constraints as well, such as the fact that excessive pumping of crude petroleum from a given deposit will decrease the total amount ultimately available, as the oil reserves lose contiguity. Given a criterion for excessive exploitation, resource accounts can provide the empirical evidence for it. A variety of policy remedies can then be explored, including tenure arrangements and royalty schemes.

- Balance sheet of the resource sectors. The existing national accounts are substantially incomplete with regard to the resource sectors because the values of natural resource assets are not measured. This affects the analysis of economic performance for these sectors, which in turn affects government policies with regard to the natural resource sectors.

- Productivity measurement. This is related to the previous point. Because the balance sheet of the resource sectors does not measure the value of resource assets in the standard national accounts, the measure of productivity in these sectors is distorted, which then distorts national measures of productivity. Productivity comparisons between resource-rich and resource-poor countries are also affected by this gap.

[13] Refer to module 5 for more information on this topic.

- Portfolio analysis and management. Measuring natural resources in the national balance sheet implies that governments can work with a measure of total wealth in examining policies for sustainable development - see the section on alternate national accounting aggregates below. The balance of natural versus produced assets in this measure of total wealth then becomes an important indicator as governments consider development options. This approach would be even more powerful if the value of human capital could be estimated and brought into the balance sheet (difficult in practical terms however).

- Valuing depletion. A value for resource depletion is a simple by-product of the stock-flow accounting that makes up a natural resource account. Current measures such as net domestic product do not value the depletion of natural resources. The liquidation of important components of national wealth therefore does not have any effect on standard measures of economic performance.

- Effects of environmental degradation. By building living natural resources such as forests and fisheries into a resource account, and ultimately into the national balance sheet, one of the economic effects of deteriorating environmental quality can be measured as damage to these resources. This can be an important input into policy decisions concerning the optimal level of pollution abatement and control for pollutants such as SO_2 emissions or emissions of toxics into water.

c) Resource and pollutant flow accounts

Resource and pollutant flow accounts are generally conceived as physical extensions to the monetary Input-Output (I/O) accounts. For each production and final demand sector in the I/O tables these accounts associate a physical flow of natural resources, typically as inputs such as energy to production processes, and a physical flow of wastes and emissions in the form of SO_2, NO_X, biochemical oxygen demand (BOD), etc. With links to the I/O tables these accounts lend themselves naturally to policy modelling. Examples of policy uses include:

- Measuring the incidence of environmental regulations and taxes. Models based on flow accounts can be used to estimate the impact (on output and profits, for example) of existing and prospective regulations and taxes with regard to the environment. Measuring the burden of policies is an important element of policy design.

- Estimating emission tax rates. Where market-based instruments are being considered as a policy option, computable general equilibrium models using pollutant flow accounts can be used to estimate the approximate size of a tax. An example would be a CO_2 emissions tax, required to achieve a policy goal, the limitation of emissions to 1990 levels by the year 2000, as many nations have committed themselves informally under the Framework Convention on Climate Change and formally under the recent Kyoto protocol.

- Efficiency of resource use. One important determinant of the burden that production activities place on the environment concerns the efficiency of use of natural resources. Resource flow accounts can be used directly to measure these efficiencies in different sectors, or overall per unit of GDP, and models can be constructed to examine the effects of different policies on efficiency of use.

- International trade. Both resource use and pollution emissions can be linked to the level and structure of international trade through I/O based models. This provides the link between trade policies and the pollution burden associated with a particular structure of trade; for instance, countries that export raw and semi-finished materials will typically incur a large burden of air emissions associated with energy use. This approach can be used for both current analysis and prospective modelling.

- Structural change. As in the case of linkages to international trade, resource and pollutant flow accounts in combination with I/O models can be used to explore the ramifications of structural change in the economy. This provides a link between development and industrial policies and their likely effects on the environment.

- Macro-models. Tying resource and pollutant flow accounts to the standard macro-economic models governments use for projections would permit the reporting of environmental effects (in terms of resource throughput and pollution emissions) as a standard component of the output from such models. Consideration of environmental effects could then become as routine as consideration of balance of payments effects when policy analysts produce projections.

- Dispersion and impact models. Whichever modelling approach described above is employed, the calculation of pollution emissions is the required input for 'downstream' models of dispersion and impact. Once impacts on health, living resources, produced assets and natural ecosystems have been estimated, valuation of these impacts becomes possible. This implies that the net benefits of policies with regard to trade and development, for instance, can be estimated, which may lead to adjustments of these policies in order to maximise benefits.

d) Environmental expenditure accounts

Environmental expenditure accounts generally consist of detailed data on capital and operating expenditures by economic sectors for the protection and enhancement of the environment. The accounts may or may not include detail on the type of pollutant controlled or the environmental medium being protected. The prospective uses of these accounts are fairly straightforward:

- Measurement of the total economic burden of environmental protection. By measuring explicitly what is only implicit in the standard national accounts, environmental expenditure accounts permit macro-level consideration of whether the costs of environmental protection are commensurate with the benefits.

- Measurement of sectoral costs. Environmental expenditure accounts also permit policy-makers to gauge the sectoral distribution of the costs associated with environmental regulations and taxes, an important consideration with regard to equity.

- Measurement of unit abatement costs. If the survey vehicles used to collect data on environmental expenditures also collect data on the amount of abatement achieved, it is possible to estimate average unit abatement costs. These costs then become a basic input to the estimation of abatement cost curves, widely used in policy modelling, and the valuation of environmental degradation from emissions.

It should be noted, however, that measuring environmental expenditures is a subject fraught with definitional and measurement problems. To give just one example, it is now often the case that firms are introducing new production technologies that jointly increase productivity

and decrease emissions - in such a case there is no meaningful way to establish what was the 'environmental' expenditure.

6.5 SUMMARY

Macro-economic policies greatly influence the use of a country's resources and ecological services. Fiscal, monetary, trade, investment, pricing and institutional policy shifts all affect the scale and rate of environmental degradation. Understanding the linkages between macro-economic policy and the environment is difficult. Appropriate tools to assist in understanding these linkages include the Environment-Economic Policy Matrix, general equilibrium modelling and environmental accounting.

The policy analysis matrix is a simple concept that can incorporate quantitative data and professional experience from selected fields. The concept strives to build a series of matrices. The first matrix typically contrasts key environmental issues with biophysical and socio-economic indicators of change and then considers underlying causes from economic factors such as market and policy failure. The second matrix then evaluates the general environmental impacts of specific macro-economic policies. The final matrix combines previous information: specific macro-economic policies are linked with specific environmental issues. Where negative linkages exist, further work may be necessary to assess sectoral linkages and develop corrective policies.

The general equilibrium model is a theoretical structure of the macro-economy, incorporating how output in each sector is produced, how incomes are generated and distributed, how these incomes feed into consumption and savings patterns and how the macroeconomic balance between aggregate demand and aggregate supply is achieved. Identifying environmental linkages with a CGE model relies on monetary measures of degradation, as inputs into the model. Then, the economic implications on employment, fiscal revenues, etc. can be estimated. Another application is to trace the impact of environmental policies on macro-economic performance. With adequate data and expertise, these models can help increase our understanding about the linkages between macro-economic policies and the environment.

Natural resource and environmental accounting is a developing field with important implications for policies for sustainable development. While elaborate accounting exercises can be expensive, rapid assessments of resource depletion and environmental degradation can yield useful indicators of sustainability. The UN System of Environmental and Economic Accounts has been instrumental in standardising the structure of these accounts, but some issues of valuing individual elements in the accounts remain. Of the range of types of satellite accounts, the resource use and pollution emission accounts, tied to the Input-Output accounts, have the most direct policy relevance. These accounts can feed into a variety of macro, general equilibrium and I/O impact models to enhance the policy analysis of resource and environmental issues, and to design policy responses.

Natural resource accounts are, in addition, likely to be important for resource-rich nations concerned about sustainable development. An emerging tool for the integration of economic and environmental concerns lies in the development of new, greener, national accounting aggregates. Of these aggregates, measures of genuine savings (or genuine investment) will have greater policy relevance than 'green GNP.'

The policy questions that are raised by the analysis of genuine savings go far beyond the obvious admonition to save more and consume less. A wide range of policies affecting the exploitation of natural resources and the emissions of pollutants to the environment is relevant, as well as the more traditional elements of monetary and fiscal policy as they affect public and private saving and investment behaviour.

CASE STUDIES

CASE STUDY 1: Environment-Economic Policy Matrix for Swaziland[14]

a) Background

The environment-economic policy matrix (EEPM), in its simplest form, requires little quantitative data. A series of matrices are used to build linkages between policy and environment. The broadest approach is to focus on macro-economic policy reforms as a point of departure. Further analysis can be carried out where negative linkages are identified. Also, sectoral policies can be examined in terms of environmental linkages. The method can help identify economic contributors to environmental problems, for example inappropriate natural resource prices, subsidies, externalities, and poorly defined property rights. Policies with positive linkages require no further action.

An EEPM process was used in Swaziland in 1999 to help senior economic planners, representing a cross-section of Ministries, understand the economic-environment linkages[15]. Following a discussion of global, national and local influences on the National Development Strategy, four broad environmental issues and eight economic policy reforms were evaluated over a two-day period.

b) Results of the Strategic Environmental Economic Assessment

Matrix 1 – contribution to environmental issues by prices, institutions and policies

The matrix clearly illustrates that all four environmental issues have underlying causes from market and policy failure. Pricing of most natural resources does not reflect economic rents and contributes to poor allocation and utilisation. Examples often cited were water and forests. Unclear property rights appear to be a very important factor in environmental degradation. Externalities also form an underlying contributor to these environmental issues, especially urban and industrial pollution. Policy failures such as subsidised cattle dipping, and reducing government expenditures for monitoring of natural resource use, also contribute to environmental degradation.

[14] Author: Dr. Grant R. Milne, International Consultant, Harare, Zimbabwe.

[15] This project was funded by the Department for International Development (DFID-UK), as part of a two-year support programme to the Swaziland Environment Authority.

Matrix 2 – general environmental implications of macro-economic policy reforms

All eight ongoing/proposed macro-economic policy reforms have general environmental implications. Many of the linkages are negative, for example where parastatal reform causes retrenchments among people who then turn to illegal harvesting of natural resources to earn a living. On the other hand, there are positive linkages such as increasing fuel taxes, which will reduce fuel consumption and subsequent gas emissions. For some of the policy reforms such as continuing to connect monetary policy to South Africa, the environmental implications were not as easy to identify.

Matrix 3 – linking macro-economic policy reforms and specific environmental issues

Some economic policy thrusts like the public enterprise reform, and increasing sales tax, fuel tax and the sugar levy, mainly have positive linkages with the four environmental issues. Other policy reforms such as credit support and reducing the corporate tax rate (after widening the tax base) appear to have predominantly negative linkages with the four environmental issues. Positive linkages can be ignored since the environment will benefit (or have neutral impacts) from the proposed policy reforms. The focus of attention should be on potentially negative linkages in the matrix.

c) Ongoing and Proposed Economic Reforms from the National Development Strategy in Swaziland

Contributing Policy Frameworks

- Internal structural adjustment programme (ISAP)
- Public sector management programme (PSMP)
- Economic and social reform agenda (ESRA)

Eight Strategic Macro-Policy Areas

- Good governance
- Sound economic management
- Economic empowerment
- Human resource development
- Agricultural development
- Industrialisation
- Research for development

- Environmental management

Macro-Economic Policy Issues

- Declining economic growth
- Narrow economic base (centred around agriculture)
- Growing fiscal deficit (public expenditures exceed public revenues)
- Poor diversification of revenue sources (dependence on SACU revenues)
- Linkage of monetary and trade policy to South Africa
- Linkage of inflation, exchange and interest rates with South Africa
- Balance of payments deterioration (from worsening trade deficit)
- Reduction in foreign direct investment (growing regional competition)
- High formal unemployment, rural-urban migration, growing informal employment
- Domination of industry by foreign shareholders
- Gender discrimination in economic activity

Ongoing and Proposed Macro-Economic Policy Reforms

- Commercialisation or privatisation of public enterprises to reduce government expenditures and fiscal deficits
- Emergence of public deficits: tight fiscal policy will result in a targeted decrease in public expenditures (ISAP)
- Increases in charges for public services to cost-recovery levels, and where justified, cushioning adverse impacts on income distribution
- Increase in sales tax, fuel tax (possibly by 10 cents per litre) and the sugar levy. Improve collection of various taxes and levies
- Credit support for small and medium scale enterprises and export credit scheme
- Increase in corporate tax base and general reduction in corporate tax rate to improve private sector competitiveness
- Reduction in some trade tariffs through compliance with World Trade Organisation Agreement obligations
- Continue linking of monetary policy with South African Rand through membership in the SACU and CMA

d) Cross-Cutting Environmental Issues In Swaziland

1. *Declining Water Quality And Quantity*

- Soil erosion and siltation of water reservoirs from poor agricultural practices
- Contamination of surface water caused by livestock
- Pollution of surface and ground water by industries and urban sources
- Pollution of surface and ground water from agricultural fertilisers and pesticides
- Inadequate water supply in rural areas to meet basic human needs
- Lowering of water table through exotic forest species such as eucalyptus

2. *Loss Of Terrestrial And Aquatic Biodiversity*

- Urban and industrial pollution and, resulting impacts on biodiversity
- Land conversion (often to monoculture forestry and agriculture crops)
- Encroachment of alien woody species in forests and open areas
- Increased use of chemicals from conversion of food crops to cash crops
- Desertification

3. *Deforestation And Soil Erosion*

- Excess cattle stocking levels, mainly in extensive communal grazing areas
- Deforestation through land conversion, fuelwood cutting, fires
- Inadequate use of conservation measures in environmentally sensitive areas
- Soil erosion from general overstocking, and compaction at watering points

4. *Urban And Industrial Pollution*

- Excess waste production and poor disposal methods
- Inefficient conversion of natural resources used in production processes
- Key industries are mining, forestry and agriculture (primary and secondary)
- Unplanned peri-urban settlements and resulting pollution