ENVIRONMENTAL ACCOUNTING IN A DEVELOPING COUNTRY: A CASE STUDY OF EGYPT

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Declaration of Rights:

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ABSTRACT

The existing United Nations System of National Accounting (UNSNA) provides useful indicators of economic performance in terms of traditional macroeconomic variables such as Gross Domestic Product (GDP), investment, savings and depreciation of capital. However, they fail to account for the depletion and degradation of environmental capital and hence give a misleading picture of sustainable development. The need for a broader assessment of growth and welfare in terms of modified accounts has therefore become a pressing concern.

The main objective of this research is to modify the current Egyptian System of National Accounting (SNA) to include environmental factors, in order to provide a basis for calculating Egyptian sustainable income. Firstly, an environmental accounting approach and model is developed for Egypt to value the depletion and degradation of natural resources caused by economic activities. Secondly, valued environmental costs are incorporated into the Egyptian System of National Accounts to build up the Egyptian Environmental Macro and Sectoral Accounting, which will be helpful in decision-making, planning and policy analysis.

The main findings of this research are as follows. Firstly, the environmentally adjusted macro accounting indicators portray a totally different picture of the growth and development of the Egyptian economy compared to the one resulting from conventional SNA. In addition, they indicate that Egypt has experienced an unsustainable path in at least half of the ten-year study period. Secondly, sectoral concerns, which involve measurement of sectoral productivity and performance, indicate that both the performance and the productivity of tradable sectors decrease when their depletion and degradation costs are incorporated. On the other hand, the opposite result is found for the service sectors, which may indicate a potential leading role for the service sectors in the Egyptian economy. Finally, the results indicate that Egypt's natural wealth, which lies in its people, land, the Nile river, oil and gas, and the surrounding seas, has been depleted by many economic "development" programmes that have been carried out to date.

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LIST OF ABBREVIATIONS, ACRONYMS AND LOCAL TERMS

A.R.E.	: Arab Republic of Egypt
AAIC	: Average Annual Income Per-capita
AHCP	: Average Human Capital Cost Per-capita
ANCF	: Adjusted Net Capital Formation
AUC	: American University in Cairo
b/d	: barrels per day
BEA	: Bureau of Economic Analysis
BOD	: Biological Oxygen Demand
BV	: Bequest Value
CA	: Current Account
CAC	: Council of Arab Countries
CAPMS	: Central Agency for Public Mobilisation and Statistics
CBE	: Central Bank of Egypt
CCA	: Capital Consumption Allowance
CCA-LR	: Capital Consumption Allowance for Land Rent
CCA-SP	: Capital Consumption Allowance for Shadow Prices
CCAR	: Capital Consumption Allowances for Renewable
CEQ	: Council on Environmental Quality
CER	: Council of Environmental Research
CFC	: Consumption of Fixed Capital
COD	: Chemical Oxygen Demand
DE	: Defensive Expenditures
DEG	: Degradation of Natural Resources
DEP	: Depletion of Natural Resources
DNC	: Depreciation of Natural Capital
DTI	: Development of Trade and Industry
DUV	: Direct Use Value
ECA	: Environmentally-adjusted Current Account

ED	: Environmental Damages
EDI	: Environmentally-adjusted net Domestic Investment
EDP	: Environmentally-adjusted net Domestic Product
EDP1	: Environmentally-adjusted net Domestic Product 1
EDP1(NPI)	: Environmentally-adjusted net Domestic Product 1 for Net-Price I
EDP1(NPII	: Environmentally-adjusted net Domestic Product 1 for Net-Price II
EDP1(UC)	: Environmentally-adjusted net Domestic Product 1 for User-Cost
EDP2	: Environmentally-adjusted net Domestic Product 2
EDPCG	: EDP per-Capita Growth
EEAA	: Egyptian Environmental Agency Affairs
EGPC	: Egyptian General Petroleum Corporation
EMH	: Egyptian Ministry of Health
ENCF	: Environmentally-adjusted Net Capital Formation
ENI	: Environmentally-adjusted Net Income
ES	: Environmental Services
ESAM	: Environmental Social Accounting Matrix
FAO	: Food and Agriculture Organization
FYP	: Five Year Plan
GCF	: Gross Capital Formation
GDI	: Gross Domestic Investment
GDP	: Gross Domestic Product
GDPCG	: GDP per-Capita Growth
GNP	: Gross National Product
GOE	: Government of Egypt
GR	: Growth Rate
GS	: Genuine Savings
GSI	: Genuine Savings I
GSII	: Genuine Savings II
HAD	: High Aswan Dam
HD	: Hard Matters
HDI	: Human Development Index
I/O	: Input-Output tables

ICMA	: Institute of Cost and Management Accountants
ICORs	: Incremental Capital-Output Ratios
IEA	: International Energy Agency
IMF	: International Monetary Fund
INP	: Institute of National Planning
IUV	: Indirect Use Value
LR	: Land Rent
M	: Imports
mb/d	: million barrels per day
mcf	: thousand cubic feet
MOA	: Ministry of Agriculture
MOE	: Ministry of Environment
MOH	: Ministry of Health
MOI	: Ministry of Irrigation
MOIWR	: Ministry of Irrigation and Water Resources
MOP	: Ministry of Planning
MTOE	: Million Tones of Oil Equivalent
MVA	: Manufacturing Value Added
NA	: National Accounts
NBE	: National Bank of Egypt
NCF	: Net Capital Formation
NCHS	: National Council of Health Services
NDI	: Net Domestic Investment
NDP	: Net Domestic Product
NEAPs	: National Environmental Action Plans
NI	: National Income
NNP	: Net National Product
NPCMP	: National Planning Committee of Ministry of Planning
NPI	: Net-Price I
NPID	: Net-Price I and Degradation
NPII	: Net-Price II
NPV	: Net Present Value

NUV	: Non-Use Value
OECD	: Organization for Economic Co-operation and Development
OV	: Option Value
PAM	: Pearce-Atkinson Measure
PC	: Percentage Cost
PM	: Particulate Matters
POP	: Population
PSAs	: Profit Sharing Agreements
PSCs	: Production Sharing Contracts
PV	: Present Value
R/P	: Reserves/Production ratio (life span)
S S	: Suspended Solids
S.S.	: Suspended Sediment
SEEA	: System of Environmental-Economic Accounts
SNA	: System of National Accounts
SP	: Shadow Price
SSNNP	: Sustainable Social Net National Product
STRESS	: Stress Response Environmental Statistical System
TC	: Total Cost
TCE	: Total Cost for Egypt
TDS	: Total Dissolved Solid
TEV	: Total Economic Value
UC	: User Cost
UCD	: User Cost and Degradation
UCL	: University College of London
UK	: United Kingdom
UN	: United Nations
UNDP	: United Nations Development Programme
UNEP	: United Nations Environmental Programme
UNIDO	: United Nations Industrial Development Organization
UNSNA	: United Nations System of National Accounting
UR	: Unemployment Rate

USA	: United States of America
USSNA	: United States System of National Accounting
UV	: Use Value
WB	: World Bank
WCED	: World Commission on Environment and Development
WHO	: World Health Organization
WRI	: World Resource Institute
WTA	: Willingness To Accept
WTP	: Willingness To Pay
X	: Exports
XGS	: Exports of Goods and Services
XV	: Existence Value

CHAPTER ONE

SYSTEM OF NATIONAL ACCOUNTING AGGREGATES: THE BROAD CONTEXT

1. INTRODUCTION

Egypt, like other UN member countries, estimates its national income according to the guidelines in the United Nations System of National Accounting (UNSNA). This standard income accounting framework measures economic performance in terms of Gross National Product (GNP), which is the total value of goods and services produced and sold during a given period. The national income accounts are utilized in many ways. For example, GNP and its variants such as GDP (Gross Domestic Product) and NNP (Net National Product), are extensively used by development planners, economists, politicians, the business community, and government policy makers, to understand the performance of the economy, and also to analyze individual sectors. In addition, the GDP figure is used in international comparisons.

Even though national income accounts provide such a variety of tools in development planning, they have severe shortcomings when they are used in interpreting activities involving natural resources and the environment. The shortcomings emerge because the national income accounting conventions do not incorporate the real costs of resources used. Environmental impacts only come within the scope of the conventions once goods and services are sold in markets. Thus, the cost of natural resource depletion affects national income just through the costs of bringing resources in to use. The real, opportunity, cost of the resources used is not accounted for. The costs of restoring or maintaining stocks of the natural resources, or repairing a degraded environment, in broad terms the 'sustainability' of production, are also not included in estimates of GDP. Hence there is a need to adjust the approach used in standard national income accounting systems to recognise resource use and any degradation of the natural environment. These adjustments could provide a better understanding of the way environmental dimensions influence a nation's development.

Natural resource and environmental accounting incorporates environmental impacts into macroeconomic analyses by calculating the value of resource depletion and degradation and constructing income indicators net of these capital costs. Such an accounting for environmental capital costs is essential to calculating truly sustainable income and economic production. If a country is to maintain its wealth and productive capacity after natural resource exploitation and environmental deterioration occurs, provision must be made to restore the environment to its previous productivity, or to invest in some substitute(s) in order to generate the income which would have been derived from later environmental deterioration and resource exploitation. By incorporating natural resource and environmental costs, modified national accounts provide a more suitable measure with which to assess the trade-offs of given environment and resource use strategies, and upon which to base policy recommendations.

Developing countries are caught in a web of poverty, unemployment and low productivity. In their case, the principal problem is how to keep the environmental and natural resource base intact. In view of this, it is particularly important for developing countries to develop tools, approaches, and valuation methods that reflect both their social characteristics and objectives. Sustainable economic growth – one of the more important social objectives - must be translated into concepts that lend themselves to measurement and valuation if this objective is to be reflected in the expanded accounting system. It may not be possible to develop valuation schemes that properly measure the degree of sustainability. Yet, it is important to point out that an accounting framework modified to take account of environmental impacts, even without complete or perfect monetary valuations, can provide a data system that can be of tremendous use to those responsible for making sustainable development policy.

Thus it is important to explore ways that the national accounting system can incorporate the multi-dimensional concerns relating to the sustainability of economic activity. This is a difficult task, not only from the technical aspect of the accounting system, but also because sustainability is a complex concept. Identification, or re-definition, of sustainability is not a direct concern of this thesis, although it does recognize the need to build that concept into improvements to the national accounting system. The objectives of the research are: first, to develop an environmental accounting approach and model, appropriate to the availability of data, that can be used to modify the Egyptian System of National Accounting so as to incorporate the environmental factors; second, to utilize this model to measure environmentally-adjusted (sustainable) income for Egypt; and finally, to provide a new base on which policy implications of the role of natural resources and the environment in Egypt's development can be debated.

This chapter is structured as follows. The next section gives an overview of the development of the Egyptian SNA and its role in policy analysis and planning. This is followed by discussion of the SNA shortcomings in section three. Section four presents the different arguments for incorporating the environment into the SNA. The fifth section states briefly the data sources for the empirical analysis in this thesis. The sixth and seventh sections present the motivation and objectives of the study. Finally, the outline of the thesis is presented in section eight.

2. THE EGYPTIAN SYSTEM OF NATIONAL ACCOUNTING

2.1 The Development of the System of National Accounting

National accounting systems measure national income, a record of economic activities in a given period. This recording method is developed from monetary accounts used by businesses. The national accounts reveal not only all the details of production, expenditures, savings, capital investment, flow of funds and returns to the factors of production, but also the relationships between income and outlays. At the centre of the UNSNA is the calculation of gross domestic product (GDP), the market value of goods and services produced in a given period. Second, the SNA records changes in capital stocks. Third, the SNA, through the balance of payments accounts, allows policymakers to keep track of changes in the nation's indebtedness to foreigners and the fortunes of its export and import competing industries. The SNA finally records a nation's wealth at a particular point in time, facilitating comparisons between different years or different countries.

Broadly speaking, there are three systems of national accounting (Mahmoud, 1986). Firstly, the United Nations System of National Accounting (UNSNA), which is based on the concepts of economic activities in open economies and capitalism. The main purpose of this system was to provide all the UN member countries with the same system of national accounting. In 1953, the first UNSNA, called 'UNSNA 1953' was introduced to member nations. Then in 1968, the UNSNA 1953 was replaced by the UNSNA 1968 (UN, 1968), and it has since been widely used as the framework for national accounting. In 1993 the first revisions of the UNSNA 1968 have been undertaken, though it did not fundamentally change the core of the 1968 version. Egypt, a UN member, utilises the UNSNA 1968. It should be noted that even among the UN members there are some slight differences in practice. These adjustments in methodologies are a result of differences from country to country in the available data.

As a variant of UNSNA, there is the United States System of National Accounting (USSNA) which is similar to the UNSNA except in the formats of presentation[1]. The second system is the Material Product System which was used only among the socialist countries. The largest of centrally planned economies, such as the former

[1] The principal measure of aggregate production in the UNSNA is gross domestic product; however, the principal measure in the USSNA is gross national product. What is the difference? Gross domestic product (GDP) is the market value of goods and services produced by labor and property located within the geographical confines of a country, regardless of the residence of that labour and property; gross national product (GNP) is the market value of goods and services produced by labour and property supplied by residents of a country, regardless of whether or not that labour and property is located within the geographical confines of the country. The difference between the two measures is net factor income received from abroad, which is included in GNP but excluded from GDP (see Ruggles and Ruggles, 1970)

USSR and China, are now turning towards the implementation of the UNSNA as the basis for their national accounting.

National accounts have been developed in Egypt since 1954, by the National Planning Committee in the Ministry of Planning (NPCMP), to be used as a tool for representing economic activities and for the follow-up of development during the planning period. However, Egypt's Central Agency of Public Mobilisation and Statistics (CAPMS), has utilized the UNSNA since 1970/71 (Mahmoud, 1986; Attia, 1994). Guided by UNSNA 1968, four accounts and one table are compiled, as follows.

- National accounts which report national income estimated according to three different approaches- i.e., production, income and expenditure approaches.

- Flow of funds accounts which show the relationships between savings and investment in economic activities. In addition, investment sources and forms are also revealed.

- Balance of payment accounts which provide details of movements of commodity trade, services, donations and investments between Egypt and overseas nations.

- National balance sheet or national wealth accounts which show the country's assets and liabilities. There are two types of assets classified under the accounts, i.e., tangible and intangible assets. The tangible assets are such things as buildings, machines, accommodation, and land. On the other hand, the intangible assets are, for instance, patents, copyrights and bonds. It is worth noting that natural resources are not classified as an asset in the accounts.

- Input-output tables which show inter-industry transactions in intermediate goods, as well as structures of primary inputs in the related production process.

Among these five, the national accounts and balance of payments are the most commonly utilized in development planning and economic policy preparation. Therefore in this study, most emphasis will be given to the national accounts and balance of payments[2].

Estimation of national accounts by the CAPMS uses three approaches which are the production, expenditure and income approaches. National income according to the production approach is the sum of the total value of the final product of goods and services. Final product means goods and services that cannot be used as inputs in any other production process, but are consumed by consumers (public and private) or added to the national wealth. The total value of these final products is Gross Domestic Product (GDP). However, estimation of the value of all final product is generally not possible due to a lack of data. Indirect estimation, via the value-added method, has to be used instead. Value added by any good or service is equal to the value of that good or service net of intermediate consumption costs which occurred from inputs used in the production process, rather than from final consumption[3]. Adding together all of the value-added from every economic activity is then equivalent to GDP.

There are eleven main sectors used in the production approach in Egypt. They are:

1. Agriculture,
2. Mining and quarrying,
3. Manufacturing,
4. Electricity, gas and water,

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[2] It has to be mentioned that recently some developed countries have carried out work on the development of environmental input-output tables that could be used to analyze environment-economic interactions (see Kuhn, 1996 for Germany, Pederson, 1993 for Denmark, and McNicol and Blackmore, 1993 for Scotland). However, this type of work requires environmental and economic data which are not readily available in most, if not all, of the developing world. Therefore, one might say that developing this type of work could be planned as further steps of environmental accounting implementation in the developing world, when they build up their data-bases.

[3] By summing up the value added at each stage of the production process, double counting is avoided. Also, merchandise exports are valued on a "free on board" (f.o.b.) basis while imports are valued on a "cost, insurance, freight" (c.i.f.) basis.

5. Construction,
6. Trade, restaurants and hotels,
7. Transport, storage and communications,
8. Finance, insurance, real estate and business services,
9. Community, social and personal services,
10. Government services, and
11. Household production activities.

GDP derived from these eleven sectors can be used in estimating Gross National Product (GNP) and further on National Income (NI) by the following method:

Gross Domestic Product (GDP) at market prices
Plus net factor income from the rest of the world
equals Gross National Product (GNP) at market prices
less net indirect taxes (indirect taxes - subsidies)
equals Gross National Product (GNP) at factor cost
less provision for consumption of fixed capital (capital consumption allowance)
equals National Income (NI).

According to the UNSNA 1968, the expenditure approach to national expenditure bases its estimation on the total consumption expenditure on goods and services and on capital formation made by both private and government sectors. Total expenditures, theoretically, should be equal to GDP[4].

The third approach to estimating GDP uses factor incomes, and measures GDP as the sum of compensation to employees (i.e., return to labor) plus gross operating

[4] It has to be mentioned that the utilisation of the expenditure approach, in national income estimates, is the most reliable one. This is mainly because the expenditure approach estimates are derived from the household and business surveys, which are normally conducted on a regular basis in both developed and developing countries.

surplus (i.e., normal return to capital and land) plus a return for special risk/entrepreneurship[5].

The estimates of GDP from these three approaches should be the same. However, in practice there are some technical constraints such as incomplete data and time lags (CAPMS, 1991/92). Thus, it is common to have statistical discrepancies, but these should not be higher than 1-2 per cent of the GDP in that year

2.2 The Policy Role of the System of National Accounting

It is obvious that there is a wide range of data available from the national accounts to anyone who wishes to analyze the performance of the economy over time. The accounts can provide a complete picture of the national economy. As Richter (1994) observes, one main reason for the popularity of the national accounts is that they provide a consistent and coherent picture of the economic processes within a defined period. Moreover, they track down the importance of each production sector by identifying its contribution to the economy, including the export sector. Finally, they provide information on the status and performance of the economy.

For example, the accounts are an important tool in evaluating the success in national development plans by identifying economic growth or GDP growth, or the per capita income and productivity of the population. Studies based on the expenditure side can reveal trends in investment and expenditures by the government and private sectors. This knowledge can give investors general guidelines or help in making decisions on investment plans. Moreover, the government can also outline appropriate policies based on the knowledge gained from the studies. In Egypt, the accounts provide general guidelines for national planning, such as setting a GDP growth target. Both the production and expenditure sides need to be analyzed in order to understand the

[5] Based on the UNSNA 1968, there are eight income groups including compensation of employees, independent professional income, asset earnings, corporation savings, corporation taxes, government earnings from assets and public enterprises.

relationships between demand and supply of produced goods and services, so as to provide a realistic target for growth plans. The understanding developed in this process could lead to refinements in national development or economic growth targets.

An important use of national income accounts is in international comparisons. As Richter (1994) argues, the standard approach to national accounts provides comparability on an international level, even though a number of compromises due to inconsistency of availability of data in different countries have to be made. When GDP growth is based on the same estimating system it is a very important indicator that can be used to compare the success of countries in a particular year or over a certain period of time. In turn, GNP or GDP per capita can then be used in the comparison of levels of development between countries.

The Central Agency of Public Mobilisation and Statistics (1991/1992) states that an important part in planning and presenting an annual budget is the national accounts. This is partly because the accounts provide a significant amount of important data concerned with previous sources and amount of government expenditures and revenues. These data are crucial in forecasting government spending. Feasibility studies on large scale projects can also utilize the data in the accounts. For private business purposes, the accounts can also have a role in forecasting trends in a particular product market. Analysis based on time series data taken from the production sector can help predict the future of markets for goods and services. This analysis can also reveal the demand for inputs of particular matters, which is very important in business planning. The GDP based on the national accounts provides a very important tool for a wide range of users. It is not surprising that the estimates of GDP have already been used unchanged world wide for half a century, Repetto et al (1989) claim that the national accounts have become 'so much a part of our life'.

Some activities which fall outside the formal market are imputed in national income. The general rule is that those activities with clear market proxies will be imputed, but coverage varies widely among countries. The decision to include imputations, and the methodologies employed, vary by country. Subsistence farming, for example, is often, but not necessarily, included in measures of national income. Some significant activities, however, are explicitly excluded from the national accounts. The value of services rendered by a household employee is included, for example, while the value of the same services performed by family members is excluded entirely. It is argued that the level of household services that would necessarily be imputed and added to national income would reorient the system away from its current purpose as a record of monetary transactions (United Nations, 1993).

Capital depreciation is the most commonly imputed measure in the national income accounts. In order to measure net domestic and national income, depreciation must be deducted from total income; the net national product (NNP) is thus the GNP less capital depreciation. Likewise NDP is defined as GDP less capital depreciation. Depreciation does not record an economic transaction, but is imputed to capture the declining income-generating potential of an asset over time, and indicates the level of investment necessary for a country to maintain its productive capacity.

Hicks (1946), in "Value and Capital", highlighted the importance of capital maintenance. He defines income as the maximum which can be consumed without reducing one's wealth, i.e., without impairing one's ability to consume in the next period. Income exists only after the capital at the beginning of the period has been maintained. This definition of income, often called "sustainable income" or "Hicksian income" is income which can be sustained into perpetuity. Because depreciation is not deducted from GDP, GDP is not a measure of sustainable, or Hicksian, income. Rather, NDP is frequently considered to be a measure of the highest sustainable income achievable given the stock of capital available at that point in time. Many believe that net income is a more relevant amount that society may consume after allowing for capital maintenance. Ignoring or underestimating the deterioration of the capital stock, or focusing on GDP rather than NDP, may lead to policy errors with serious, long-term consequences (Nassar, 1993; Attia, 1996).

In fact, depreciation is imputed and deducted only for wear and tear on reproducible, man-made capital. When natural assets are depleted and the environment is degraded, e.g., when forests are cleared, waters are over-fished, mineral deposits are mined, or air and water are polluted, no analogous depreciation is recorded. The exploitation of resources and degradation of the environment undoubtedly lessen an economy's productive capacity, particularly for those developing economies which rely heavily on resource-extracting industries. This being the case, it is clearly inconsistent and misleading to deduct depreciation for productive man-made capital, while ignoring the analogous depreciation of productive natural and environmental capital.

3. SYSTEM OF NATIONAL ACCOUNTING SHORTCOMINGS

As mentioned earlier, although GDP measures are widely used, it is important to understand they indicate only the movements of market-based production in the economy. These movements cannot significantly describe all the aspects of the well-being of a country's population, a comment made in a variety of contributions to the literature that is used (e.g., Nordhaus and Tobin 1972, El Serafy and Lutz 1989, Daly 1989, and Peskin and Lutz 1993). All these researchers come to a similar conclusion - that the accounts are frequently abused, misused and can be misleading. A major source of problems is the incorporation only of goods and services that are sold through markets. The accounts omit products of some economic activities if they are carried on outside the enterprise sector. This omission is a particularly serious one for environmental policy.

There are several common criticisms that environmental analysts make of the standard System of National Accounts (SNA):

(i) the accounts measure the goods but not the 'bads' (in the form of pollution) associated with production activities;

(ii) some environmental protection expenditures are measured as final output (the defensive expenditures issue);

(iii) the depletion and degradation of natural capital is not reflected in national income;

(iv) and finally, environmental assets and natural resources are not measured in national wealth[6].

However, the main problem with the standard SNA is that there is no means to determine if an economy is on a sustainable path.

While commercial natural, non-renewable, resources are measured directly in the accounts, in the sense that the value added associated with their exploitation is measured in national income, the economic value of these resources as assets appears only implicitly. The value of a subsoil resource deposit or standing forest as an asset is related to the flow of economic rent that results from its exploitation; for a given resource deposit this rent is measured as the difference between the market price of the resource and the full marginal cost of its extraction/harvest, including normal returns to capital. Therefore resource rents show up as a portion of operating surplus for the resource sectors, but are not explicitly measured. Consequently the value of economic depreciation of a resource deposit as a result of exploitation is not measured either, which means that resource depletion does not enter into the calculation of net product, NNP or NDP.[7]

Non-commercial environmental resources are treated more indirectly in the accounts. To the extent that there is a commercial activity associated with an environmental asset, such as tourism or hunting, then the value added in this activity appears as part of national product. But the underlying asset, the pristine lake or wilderness, is not valued explicitly. When environmental quality deteriorates the effects may show up

[6] However, commercial resources, at least, do appear in the wealth accounts in the revised SNA 93 (see SNA, 1993).

[7] While the guidelines for the balance sheet accounts in the SNA call for the valuation of subsoil or standing natural resources, the change in value of these assets from year to year is recorded as a reconciliation item, and so again does not alter net product estimates. In other words the revised UNSNA 1993 was focused in the expansion and modification of SNA stock accounts more than flow accounts which are normally the main concern of all economic analysis.

indirectly in a variety of forms: loss of tourism industry income (as the lake is polluted, for instance); lost productivity of agriculture and living natural resources; increased repair and maintenance costs for buildings and other assets damaged by pollution; increased costs of inputs when water, for instance, must be cleaned prior to use in productive activities; increased health expenditures and lost productivity as a result of increasing morbidity and mortality; and diversion of resources from other valuable employment when accidents, such as oil spills, need to be cleaned up. All these effects are there in the accounts, but not directly and identifiably. There is a common thread running through the literature on environmental and natural resource accounting, which is that use of the environment and natural resources represents asset consumption, and that one of the key problems with standard national accounts is that this is not reflected in the measures of income and product. Moreover, this literature is concerned with making explicit what is currently only implicit in the accounts with respect to natural resources and the environment.

Production and consumption of goods and services not only directly deplete natural resources, but they can also degrade environmental quality by their side-effects or externalities. These externalities have to be borne by the public, yet they have never been counted as costs in the national accounting system. If any environmental restoration takes place, national income will actually increase, as the work will be seen as another production activity (Drechsler, 1976). An alternative view is that the restoration expenditure is actually a cost needed to be met to maintain resources, perhaps to meet objectives of sustainable production in that sector. Hence the expenditure should be deducted from the value of production of the sector. In some cases, the activities concerned with environmental protection expenditure carried out by different agents can have different effects on the accounts, regardless of their purpose and the part they play in production and consumption (Harrison, 1989).

Robert Repetto of the World Resources Institute (1989) points out, "If toxic substances leak from a dumpsite to pollute soils and aquifers, measured income does not go down, despite possibly severe impairment of vital natural resources. If the government spends millions of dollars to clean up the mess, measured income rises, other things equal, because such government expenditures are considered to be purchases of final goods and services. If industry itself undertakes the cleanup, even under court order, income does not rise because the same expenditures are considered to be intermediate production costs if carried out by enterprises. If the site is not cleaned up, and nearby households suffer increased medical expenses, measured income again rises because household medical expenses are also defined as final consumption expenditures in the national income accounts". This illustrates that the national accounts system has serious problems in dealing with environmental issues. In particular, national accounts in their present form do not provide the information or insight required to address concerns of the sustainability of current development. This is partly because national accounting ignores the value and levels of resource use, but also because natural resource depletion, as well as environmental degradation[8], is not considered as a cost of earning national income.

Thus, a country that follows UNSNA guidelines could "exhaust its mineral resources, cut down its forests, erode its soils, pollute its aquifers, and hunt its wildlife and fisheries to extinction, but its measured income would rise steadily as these assets disappeared" (Repetto, 1989). Hence the assumptions of UNSNA can provide false signals to policy-makers concerned with resource sustainability, so that the stock of resources, and the cost of their maintenance or replacement is rarely considered at the macro-economic level where national planning decisions are normally made. This is why many decisions to promote economic growth in fact lead to higher rates of resource depletion and environmental degradation. This kind of decision leads to 'unsustainable development' unless, according to Pearce and Atkinson (1993), the country's genuine savings, the weak sustainability measure which will be discussed later on in this chapter, that is equal to gross savings minus the depreciation of man-made and natural capital, is equal to or greater than zero. In other words, net capital

[8] Identifying renewable resources depletion and degradation may be problematic. For instance, the measurement of net changes in resources may be difficult to calculate because growth rates are not precisely known. Furthermore, a distinction must be made between depletion and degradation of natural capital. When consumption of the resource permanently or temporarily reduces its quantity, the quantitative reduction is called depletion. When consumption of a portion of the resource diminishes the quality of remaining resources, this qualitative change is called degradation (Landefeld and Carson, 1994a).

formation from investment in resource management equipment and techniques is larger than the natural resource depreciation.

National accounts provide the most widely used indicators for the assessment of economic performance, trends of economic growth and the economic counterpart of social welfare. However, national accounts have certain drawbacks that cast doubt on their usefulness for measuring sustainable economic development. While they are valuable for indicating short - to medium-term changes in economic activity, the national accounts are less useful for gauging longer-term trends. There are several reasons why the SNA may provide a misleading picture of long-term economic health. These include: (1) economic activities are valued at private cost rather than social cost; (2) a zero valuation is placed upon certain essential goods and services; (3) the concept of capital maintenance applies only to fixed capital, limited account is taken of the contribution of the environment to economic activity; (4) and, finally, no account is taken for human or social capital. (Harrison, 1990). Moreover, Ernst Lutz of the World Bank notes, "The GDP is certainly an important management tool at the macroeconomic level, but it has a number of shortcomings, and if focused on too much can turn the authorities away from sustainable development policies", (Lutz, 1993).

As a result of neglecting the role of the environment and natural resources in the economy, sustainable income will be overstated by an amount equal to the consumption and/or depreciation of natural capital. The policy implications in the latter case are more serious. By overstating income from natural resource-related activities, policies which in fact draw down natural assets, degrade the environment, and decrease future productive capacity, appear to be particularly profitable, productive activities.

4. THE INCLUSION OF ENVIRONMENT IN SNA

It is obvious that there are many shortcomings in the conventional UNSNA, especially where the utilization of natural resources and environment is concerned. These shortcomings can lead to a rapid deterioration in the natural environment when the false signals given by data on GDP can lead to inappropriate policy applications. To strengthen perspectives on sustainability, and reshape policy to avoid some of the unfavourable environmental outcomes outlined above, the natural environment needs to be incorporated into national accounts in a coherent and transparent manner.

Economists approach including the environment in the system of national accounting in, at least, three ways. First, the sustainable income view, which is held by many environmental advocates. Income, or national product, is sustainable only if it can continue into perpetuity. Clearly, a measure of income conforms to the principle of sustainability only if that measure is not the result of a decline in the value of capital stock. Stated crudely: a measure of the income derived from wealth should not include the consumption of the principal. Use of the environment must be recorded in the national economic accounts. Otherwise, societies, especially those of developing countries, could tend to over-consume by selling off and degrading the natural capital in the short run. Theorists who allow for unconstrained elasticities of substitution between fixed capital and natural capital support a measure known as "weak sustainability". They believe that an economy is weakly sustainable if it saves more than the combined depreciation of man-made capital and natural capital. That is, $Z > 0$ if $S > (\delta_F + \delta_N)$ where Z is a sustainability index, S is a savings, δ_F is the value of fixed capital depreciation, and δ_N is the value of natural capital depletion and degradation (Pearce and Atkinson, 1993). A value of $Z > 0$ implies weak sustainability. It is assumed in this thesis that weak sustainability - allowing investments in fixed capital to replace depleted and degraded natural capital - is sufficient to calculate Hicksian (sustainable) income[9].

Second, the economic growth accounting view, which is, also, concerned with the correct calculation of GDP and NDP. Growth accounting measures and analyses the

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[9] Increasingly, many of the world's policy-makers are coming to realize that economic production cannot be measured without accounting for environmental concerns. While revenues derived from resource extraction have the potential to finance investments in industrial capacity, infrastructure, and education, a reasonable accounting representation of the process would recognize that one type of asset has been exchanged for another. If natural capital elements can be identified and purged from income measurements, a more accurate level of income would emerge which better reflected economic performance and provided an improved basis for policy prescriptions.

structure of production, the sources of growth, and attempts to track all inputs which contribute to production. National productivity studies and research on the national savings and investment rates also make use of SNA data. What gets measured in the SNA and what does not, directly affects the outcome of these studies. If natural resources are considered a free gift of nature - an assumption made until recent years - then the contribution and importance of natural resources and the environment to productivity and economic growth will be neglected.

Finally, the welfare economics view, which considers the constituents of social well-beings. The conventional national income can also provide mistaken impressions of the quality of life in economic welfare (Richter, 1994). The concept of welfare is obviously much broader than what can be measured in money terms. It covers many dimensions of subjective well-being and in this context, aspects of the environment can be a key consideration (E1 Serafy and Lutz, 1989). Subjective well-being could be enhanced by improvement of the environment, and confidence in the sustainability of life styles. To reflect that perspective, the costs to maintain resource stock or repair environmental damage, so that subjective well-being is enhanced, need to be part of the estimation of GDP[10].

In sum, there are several arguments for incorporating the use of the environment in a measurement of national income and wealth:

1) improve the ability of the national accounts to measure sustainable income;

2) increase the information available for analysing the economics of production, growth and employment;

3) contribute to a more comprehensive measure of social welfare; and finally,

[10] However, some economists interested in sustainability have taken the view that GDP is not the place to start. Daly and Cobb (1990) make a number of adjustments to private consumption in order to drive, for the USA 1958-1986, an Index of Sustainable Economic Welfare, ISEW. Daly and Cobb make adjustments for: changes in distribution of incomes; extra-market household labour; some defensive expenditures; resource depletion and environmental degradation. Subsequently, ISEW series have constructed for a number of other countries such as Germany, Austria, Netherlands, UK, and Sweden (see Jackson and Marks, 1994; and Jackson and Stymne, 1996).

4) create a more complete data set at the macro level for conducting research on the effect the production and consumption have on the environment.

Adjusting the Egyptian national accounts to fit this new area of concern is the practical focus of the research. As mentioned before, the research is concerned with developing a new approach to modify the Egyptian SNA. The approach needs to have three aspects. First, as the natural resources do provide inputs into economic production, they should be seen as a cost; second, as they are used, an allowance for resource loss needs to be made; and third, as damage to the environment can limit economic growth, so the approach needs to recognise expenses for maintenance or repair. All three elements need to be incorporated into the national accounting system. This is especially relevant to Egypt, where a growth-oriented strategy has been central to development policy, as seen in the emphasis on industrialisation in the past national plans. The most recent national plan indicates that environmental issues are now becoming a major concern (Ministry of Planning, 1991/92).

5. DATA SOURCES

Constructing integrated environmental accounts, or even amassing statistics for satellite accounts, is not problem-free. It has to be admitted that it is a very difficult task to collect sound and accurate data, which are normally a prerequisite for valuation purposes. From developing countries' experiences it will be noted that the most pressing problem in conducting natural resource and environmental accounting has been the broad array of statistical data, compiled by different public and private institutions for a variety of purposes. Likewise, fragmentation of data may serve as a major obstacle to the construction of environmental accounting. For this research most data have been collected from unpublished sources from government offices in the Ministry of Planning, Ministry of Agriculture, Ministry of Manpower, Central and National Banks of Egypt, Ministry of Petroleum, Institute of National Planning, Central Agency for Public Mobilization and Statistics, Egyptian Environmental Agency Affairs, Ministry of Irrigation and Water Resources, and Academy of Scientific Research and Technology. More details about sources and characteristics of the data will be provided in Chapters Five and Six, which are allocated for the accounting of natural capital depletion and degradation.

6. THE IMPORTANCE AND THE MOTIVATION OF THE STUDY

The two main functions of accounting will be performed in this study, which are (1) measurement (2) and reporting and disclosure. Environmental cost will be measured first, then it will be incorporated into the accounts in order to give some guidance for policy analysis and planning. The study emphasises the need for incorporating the environmental factors into Egypt's national accounting framework, because the current development programs are mainly financed by depletion and degradation of the country's limited environmental and natural resources. If Egypt had accounted for the environmental depletion and degradation in the last decade (1981-1990), the national accounts would have shown that natural and environmental resources, valued at more than one half year's GDP, had been depleted and degraded during those ten years. However, the annual accounts of national income, expenditure, savings, and capital formation did not reflect that ongoing dis-investment. Instead, the accounts show only continuing growth in national income, and a high rate of capital formation, until the economy crashed in the late 1980s.

The national accounts gave no warning that the basis for continuing growth was being destroyed. Moreover, even after economic crisis struck in the 1980s, it was labelled a "debt crisis", not an environmental crisis. The international organisations such as the IMF and WB came with programs to stabilise the monetary situation, but nobody ever spoke of stabilizing the economy in terms of conserving the environmental and natural resource base. Finally, throughout the previous decade, the depreciation of natural resource assets, as an annual percentage of GDP, dwarfed the balance of payments deficit. The difference was that the balance of payments deficit and the accumulation of external liabilities was recorded, transparent, and scrutinized. The decumulation of domestic assets went unrecorded, unnoticed, and uncorrected.

The other important reason to be concerned about environmental and natural resources is that optimal allocation of natural resources requires long-term planning in order to assure an efficient and fair distribution of welfare over time. For developing nations, such as Egypt, which especially depend on their environmental and natural resources for growth, failure to take account of the depreciation of environmental and natural resources as capital stock might seriously distort perceptions of the nation's true economic wealth. In addition, although the focus of this study is Egypt and its particular environment, it furnishes a basis for launching similar work in other developing countries, or for comparison with other national and international situations in order to highlight the role of environmental accounting in national economic development. It can also be considered as a source of information about the state of the Egyptian economy and environment.

Finally, one has to bear in mind that the pre-condition for an efficient use of environmental accounting is the political willingness to make sustainable development an objective of policy making. This means that there are other elements needed to be taken into consideration such as public awareness, regulatory terms (i.e., environmental laws), and co-ordination between all the public bodies which are dealing with environmental issues in many different ways. In other words, the results of this thesis are not a sufficient condition to provide optimal environmental policy. The objective of this thesis, however, is rather to provide the policy-maker with a new expanded set of information that could be useful for the formulation of future government policies in this regard.

The research draws its motivation from the need to refine and enhance national accounts to incorporate environmental considerations. This need emerges in three particular contexts:

1. The conventional income accounting based on the UNSNA 1968, revised in 1993, does not fully incorporate and integrate natural resource and environmental concerns into the conventional SNA framework. Thus it is important to show how the standard income accounting can be modified or expanded in order to count or present the costs of the natural resources used, or the environment degraded, in a way consistent with the general approach.

2. New approaches have been introduced in many forms and in many countries, but they reflect particular concerns and uses. Egypt, however, has not participated in this type of innovation so these new perspectives have not been utilised in that country. The current research has therefore been designed to address the lack of attention that has been given in Egypt to this crucial area. In addition, in the past thirty years, natural resources have been depleted, and the environment of Egypt has been severely degraded, but there has been no measure of these effects in the estimation of national accounts. In other words, natural resource and environmental accounting is urgently needed for Egypt, in order to find out costs incurred by the natural environment from the recent rapid economic development.

3. The environmental and natural resource depletion and degradation of Egypt have effects predominantly on the mining, agriculture, construction, and manufacturing sectors. In these sectors resource depletion and environmental degradation have occurred. The thesis develops some measures of environmental impacts by these sectors to re-value their performance and productivity, and to incorporate concerns about sustainability.

7. OBJECTIVES OF THE STUDY

As a response to these three circumstances, the thesis proposes that:

A new system of environmental accounting can be developed, using currently available data sets, to produce estimates of economic rent, depreciation or user costs, and deterioration costs that reflect the depletion and degradation of natural capital and show the real economic outcome of resources development. The general objective of the thesis is: to develop and apply a new format for environmental accounting in Egypt. This should provide policy-makers with a wider view of economic development as it will link environmental development planning with standard national accounts. As mentioned before, the specific objective of this study ***is to modify the current Egyptian System of National Accounting (SNA) to include the environmental factors***, in order to provide a basis for calculating Egyptian sustainable (long-term) income. To achieve this objective the following sub-objectives have to be achieved.

- ***The first,*** is to propose the appropriate approach that will be used in modifying the System of National Accounts of a developing country, Egypt, to include the environmental factors.

- ***The second,*** is to develop an environmental accounting model that could be used to value the environmental costs caused by economic activities.

- ***The third,*** is to utilize available sets of data on environmental resources in order to account for the depletion of non-renewable natural resources such as oil and gas; and to account for the depletion and degradation of renewable natural resources such as land, water and air.

- ***The fourth,*** is to incorporate the cost of environmental depletion and degradation into the Egyptian System of National Accounts, in order to build up the Egyptian Environmental Macro and Sectoral Accounts, and that allows re-expressing the rate of development of Egypt, by creating an environmental accounting indicators such as Environmentally-adjusted net Domestic Product (EDP), Environmentally-adjusted net Domestic Investment (EDI), and Environmentally-adjusted net Current Account (ECA), that allow for environmental issues.

- ***And, finally, the fifth,*** is to draw the policy implications, which will be helpful in decision-making, planning and policy analysis, from the Environmental Macro and Sectoral Accounting, so that concerns over sustainability of environmental resources can begin to be addressed.

8. OUTLINE OF THE STUDY

Given these objectives, the thesis is constructed in four parts. The first part (Chapter Two) provides an overview of the Egyptian economy; examines the macro and sectoral performance of the Egyptian economy; examines the status of the environmental and natural base in Egypt; and finally, discusses the main linkages between population, economy, and environment in order to stress the necessary dimensions which need to be taken into consideration when trying to define and to measure the sustainability of the Egyptian economy. Therefore, this chapter is setting the foundations for the following ones. This chapter provides a basis for the incorporation of the environmental dimension in the national accounts, and provides the broad context for the thesis.

Part B will look into the alternative approaches to and the valuation techniques used in natural resource and environmental accounting. Chapter Three will propose an appropriate approach that could be used in modifying the Egyptian System of National Accounts, through examining a series of natural resource and environmental accounting country case studies and highlighting some struggles in environmental accounting in developing countries. This chapter concludes with the specification of the appropriate approach that can be used, for a developing country, in Egypt. In Chapter Four an environmental accounting model for a developing country, Egypt, will be developed. In this chapter theoretical discussions about valuation techniques for non-renewable and renewable natural resources will be undertaken. This chapter, therefore, specifies the valuation techniques that are appropriate to each resource type, to provide an effective and useful way to incorporate the environmental costs into the system of national accounts. These two chapters represent one of the key contributions of the thesis.

In Part C (Chapters Five and Six) the environmental accounting model, which is developed in Chapter Four, will be operationalized in order to account for the depletion and degradation of environmental and natural resources. In Chapter Five the depletion of non-renewable resources such as oil and gas will be accounted for. The depletion and degradation of renewable natural resources such as land losses, soil erosion, and air and water pollution will be accounted for in Chapter Six.

In part D, Chapter Seven incorporates the value of natural capital depletion and degradation into the macro and sectoral accounts frameworks for the 1981-1990 period as benchmark years, and offers several indicators for sustainable development, which represents another key contribution of this thesis. In Chapter Eight, the policy implications for macro and sectoral policies in Egypt based on the findings of the thesis will be presented and proposed. Finally, in Chapter Nine the findings and the links between the outcome of the research and the ongoing efforts to improve the national accounting system will be established.

PART A

ECONOMY, ENVIRONMENT, SUSTAINABLE DEVELOPMENT IN EGYPT

CHAPTER TWO

EGYPT: ECONOMY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Nobody can deny that damaging the environment, especially in the poorer countries, erodes the very basis of economic prosperity, and that the poor often buy short-term survival at the price of long-term sustainability. Such behaviour undermines growth as well as development in its wider sense. But if accounts are made to reflect this behaviour, a major task will have been accomplished (El Serafy, 1993a).

1. INTRODUCTION

Egypt covers an area of about one million km^2 in the hyper arid regions of North Africa and West Asia. More than 95% of the land is desert. At present, more than 90% of the population lives on less than 4% of the land area. They are concentrated on the banks of the River Nile and on the agricultural land in the Nile Valley and Delta Regions. Egypt's current population is estimated at about 60 million, with a growth rate of about 2.5%. The urban population is about 50% of the total population.

There are several challenges confronting the Egyptian economy. These are: meeting foreign exchange requirements for payment of debts; providing for the basic needs of the growing population; reducing deficit in the balance of payments; and reducing unemployment, especially that of university graduates. Natural resources in Egypt are very limited and inefficiently managed. The most critical resources are: water, land, and energy. The major environmental pollution problems are air and water pollution, soil erosion, solid waste and noise pollution.

There is a growing recognition in Egypt that economic activity and population growth have brought with them rapid environmental depletion and degradation of natural resources. This has led to an increasing concern about integrating these neglected environmental considerations into national development decision-making, planning and policy analysis in Egypt.[1] Therefore, the purposes of this chapter are to: first, provide an overview of the Egyptian economy; second, examine the macro and sectoral performance of the Egyptian economy; third, examine the status of the environmental and natural resource base in Egypt and finally; fourth, discuss the main linkages between, population, economy, and environment in order to stress the necessary dimensions which need to be taken into consideration when trying to define and to measure the sustainability of the Egyptian economy. Therefore, the purpose of this chapter is to set the foundations for Chapter Four, which aims at developing an environmental accounting model for Egypt. This model will include the most important and urgent environmental issues which could be an obstacle to sustaining the economic development and growth of the Egyptian economy.

2. SOCIO-ECONOMIC DEVELOPMENT

2.1 The Demographic Base

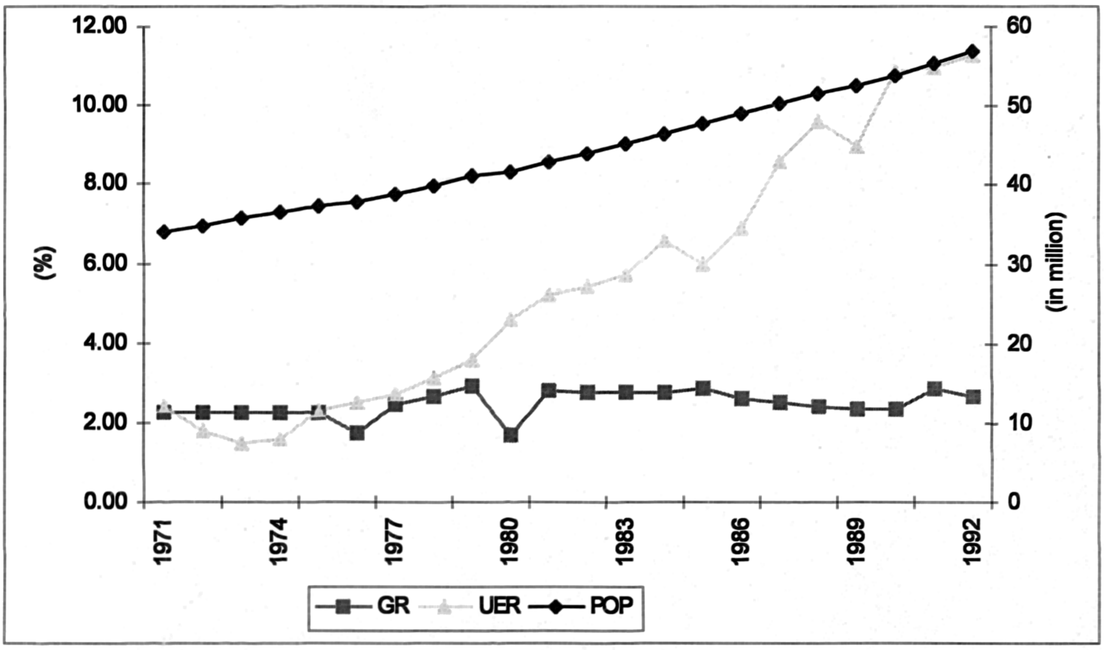
The total area of Egypt is 386,900 sq. miles (1,002,000 sq. kilometres), just over four times the United Kingdom's area, but about 96.0% of that area is desert. The arable land is mostly restricted to the Nile Valley and Delta. Relating the population, estimated at 47.254 million at the 1986 census, to the inhabited area (about 35,200 sq. km), gives 5.7 persons per acre of arable land, representing one of the highest man/land ratios in the world (CAC, 1991).

The increase in the population of Egypt follows more or less the same pattern as the world's population. From the creation of the world until 1930 only 2 billion people lived on this Earth. The second 2 billion were added in 45 years, by 1975. It is

[1] In this context, in early 1991, the government of A.R.E. decided to prepare a National Environmental Action Plan (NEAP) to strengthen the management of environmental affairs in Egypt.

expected that the third 2 billion will be added the year 2000, a span of 25 years (Tolba, 1992). Egypt's population nearly doubled from 9.7 million to over 18 million persons in the 50 years from 1897 to 1947. The second doubling took less than 30 years (from 1947 to 1976). In the last census, 1986, the total population was 49.05 million. Egypt's population in 1992 was about 56.94 million and it is expected to reach about 64 million by 2000 and about 90 million in 2025 (Hassan, 1992). Between 1971 and 1981 the population grew by an annual average of 2.31%, but this rose to 2.61% between 1981 and 1992. However, the growing acceptance of modern birth control techniques, together with continued emigration, is officially projected to lead to a slowdown in population growth to about 1.8 per cent per annum. (Table 2.2 & Figure 2.1). Urbanisation in Egypt is also growing rapidly. The urban population was about 17.2% in 1907 and had doubled by 1947. It reached about 44% in 1986 and now it is nearly 50% of the total population. The population pyramid of Egypt is characterised by a wide base, due to high fertility rates and births for long periods in the past. In the last census, 1986, the population ratio of those below 15 years old was estimated at about 40% of the total population. People of more than 60 years of age and those aged between 15-60 years were estimated at 6% and 54% respectively of the total population (CAPMS, 1996a).

Figure 2.1: Population and unemployment growth rates, 1960-1992 (in millions)



Note: GR = Growth Rate; UER= Unemployment Rate; POP = Population

Despite the high rates of population growth, the past few decades have witnessed a significant improvement in the standards of public health and education. The latest available indicators show the daily caloric intake rose from an average level of 2,336 calories per capita in 1965 to 3,281 calories per capita in 1988, while the average life expectancy increased by 11 years to 59 years for men and by 12 years to 61 years for women between 1965 and 1990. Primary school enrolment has also made considerable progress, reaching 97 per cent of the relevant age group in 1989 compared to only 75 per cent in 1965; for secondary schools, the figures rose even more impressively during the same period, from 26 per cent to 81 per cent (INP, 1998).

On the employment side, during the decade from 1981/82 to 1991/92, employment increased by 3.4 million employees. Agricultural employment decreased from 39% of the total labour force in 1981/82 to about 33% in 1991/92 but is still the major sector. Employment in the social services sector increased from 28% in 1981/82 to about 29.5% in 1991/92 while employment in the industrial sector increased slowly from 12.1% in 1981/82 to about 13.7% in 1991/92, and its share of total employment is small. However, unemployment, especially among university graduates, is one of the major problems of Egypt. Essentially, it results because skills and educational qualifications do not match the actual needs of the labour market. In fact, training and education in public institutions in Egypt are not linked to the human resources needs of the various sectors of the economy. Consequently, a very large group of young people can not satisfy their basic needs. Those who are fortunate enough to have experience and skills get jobs in oil-rich Arab countries. Therefore, despite this outflow of qualified personnel, the level of graduate underemployment has remained high, it rose from an annual average of 3.12% between 1970-1981 to 8.69% between 1981 and 1992 (Table 2.2 & Figure 2.1). This prompted the government to take active measures to encourage the establishment of social funds and aid programmes aimed at providing professional and skilled jobs for its labour force, as well as at extending vocational training opportunities in both the urban and rural areas.

2.2 Economic Development

2.2.1 General Features of the Economy

From the 1880s until 1952, the date of Gamal Abdel Nasser's consolidation of power, Egypt's economy was characterised by private enterprise[2], free trade and a moderate-size public sector. Development policies were driven mainly by export promotion through public investment in agriculture since 1930, limited protections for industry, and a few agricultural products (Hansen, 1991). During the time of Nasser (1952-1970) increasing public sector, major trade restrictions, import substitution, and domestic economic policies predominated. In the 1970s, the era of President Sadat, the economy still had huge public sector and domestic market subsidies. But from 1973 onwards, important political and economic changes took place in Egypt due to economic liberalisation and an open-door policy. In particular, four factors contributed to increasing economic activity and foreign exchange

[2] Include extensive subsidies for industrial and agricultural inputs, energy products, and foodstuffs.

earnings, namely: reopening the Suez Canal; an increase in tourism; oil export and worker remittances from abroad.

In the era of president Mubarak, the Government of Egypt (GOE) adopted two five-year plans (FYP), 1981/82-1985/86 and 1986/87-1990/91. Those two plans were characterised by intensive efforts to rehabilitate the productive base of the national economy, that is the infrastructure requirements of the economy. In brief, they were oriented towards reforming the domestic and foreign distortions of the past. In the third FYP, 1992/1993-1996/1997, the GOE is attempting to reform economic policy gradually towards full economic liberalisation. The forthcoming FYP is characterised by a number of features affecting the path of development, namely: full liberation of economic units from administrative and price restrictions and gradual transformation from public ownership of production units to private ownership; adopting a privatisation policy to increase the role of the private sector; removing domestic market subsidies gradually; freedom for farmers in taking decisions relating to cultivating agricultural crops and creating competitive circumstances in the domestic market according to market mechanisms represented in the forces of supply and demand and free competition (Ministry of Planning, 1992).

2.2.2 Macro and Sectoral Performance

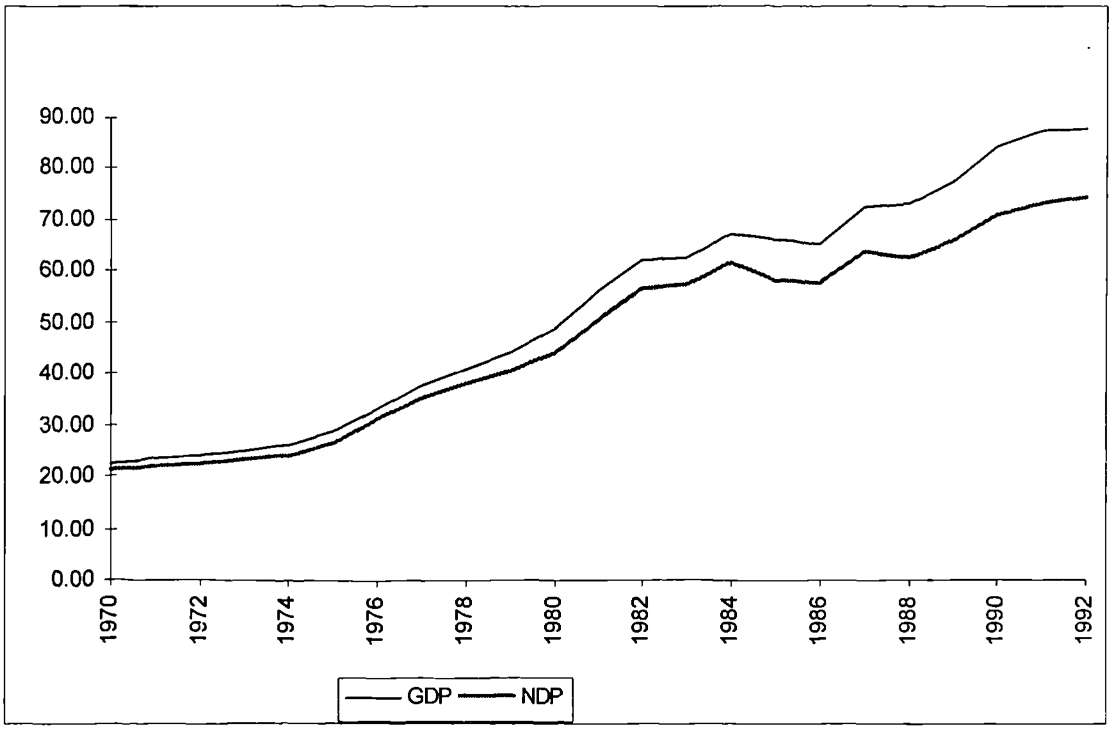
The System of National Accounts (SNA) provides information to identify a country's assets and liabilities at particular points in time, as well as to keep track of transactions such as purchases of goods and services, payments of wage and profit to the earners, import payments and export revenues for goods and services. Through its ability to measure disparate goods and services using a common metric, the SNA has become the standard framework used for measuring macroeconomic and sectoral performance, analysing trends of economic growth, and providing the economic counterpart of social welfare. At the heart of the SNA is the calculation of Gross Domestic Product (GDP), the market value of goods and services produced by all economic sectors in a given period.

Macroeconomic Performance

Economic Growth

The developments of the Gross Domestic Product (GDP), population growth and GDP per capita, for the period 1960-1990, are presented in Table 2.2 and Figure 2.2. For the 12-year period covered by the growth-rate figures for 1961-1972, the annual growth rates of real GDP averaged 4.92%. The figures give an impression of fairly rapid growth between 1962 and 1964. The first five-year plan (1960-1965) had a difficult start in the first and second years; a cotton-crop failure adversely affected the rate of growth. The five-year growth target, aiming at a 40% increase in national income between 1960 and 1965, was virtually fulfilled, however. The Six Day War (June 1967) did not mark a downturn in economic performance; this had already started, because of a lack of finance, a few years before. In fact, the Seven-year Plan (1965-72), which aimed to double real income by its end, was frustrated by lack of finance. Thus, after two years of uncertainty, a three-year plan, beginning July 1967, was proclaimed. This new plan was dropped as a result of the 1967 war. The war, of course, did worsen the economic situation, but it was not the initial cause of the poor achievements of the Suez Canal revenues and of the Sinai oil and the decline in tourism, which slowed down economic growth. The annual percentage increase of GDP fell from 9.94% in 1964 to –0.28% and –1.0% in 1967 and 1968. This was followed by a short recovery in 1969-71. Again, because of the 1973 war, the Egyptian economy suffered a slow-down in the GDP rate of growth. The GDP rate of growth fell from 5.1% in 1972 to nearly 3.86% in 1973.

Figure 2.2: Egyptian national income, 1970-1992 (billions of £E 1990)



Egypt experienced rapid GDP growth in the 1970s. However, the rate of growth slowed significantly in the 1980s.

During the decade following the introduction of the Open Door Economic Policy (1974-1982) the Egyptian economy grew rapidly. The average annual rate of growth of real GDP was 8.77% over this period. Although the first half of the 1970s witnessed no evident change in the GCF and GDS[3] as a percentage of GDP, the second half was a turning-point. For the years 1975-1979 the GCF as a percentage of GDP averaged 28.36%. Private investment, both domestic and foreign, played the key part in this increase. GDS as a percentage of GDP more than doubled in 1975 (12.3% of GDP) from its previous year level (5.7% of GDP) and remained in excess of this new level through to 1986, reaching a peak of 18.5% of GDP in 1977. In 1987 GDS as a percentage of GDP fell back to its 1972 level (6.6% of GDP) and remained at a level of less than 10% of GDP through to 1990 (Table 2.3 & Figure 2.3).

[3] GCF = Gross Capital Formation; GDS= Gross Domestic Savings.

Figure 2.3: Domestic investment as % of GDP, 1970-1992

NDI fell from 25.60% of GDP in 1979 to 4.40% of GDP in 1990.

To sum up, the two major changes (i.e. the opening policy, and the increases in oil prices) which occurred after 1973, resulted in a development in the economic growth indicators and the most important are: the increase in gross and net domestic product, the investment rate, and in both exports and imports as shown in Table 2.2 and 2.3. Table 2.3, for example, shows that investment increased from 13.14% of GDP at 1990 prices in 1973 to 32.11% of GDP at 1990 prices in 1981. On the other hand, gross domestic saving increased from 8% at 1990 prices of GDP in 1973 to 16.9% at 1990 prices of GDP in 1981. Although the resource gap defined as the difference between gross investment and domestic saving, increased from 5.14% of GDP in 1973 to 15.21% of GDP in 1981, this can, however reflect the role of foreign capital in financing domestic investment in Egypt. This was followed by declining investment rates which had a significant impact upon the growth of the economy. Table 2.3 and Figure 2.3 indicate a clear downward trend in domestic investment from 1981 to 1992. Whereas gross domestic investment (GDI) was 33.11% of GDP in 1981, GDI fell to 19.79% by 1992. Net domestic investment (NDI), on the other hand, fell from 25.60% of GDP to 4.68% of GDP for the same years, respectively.

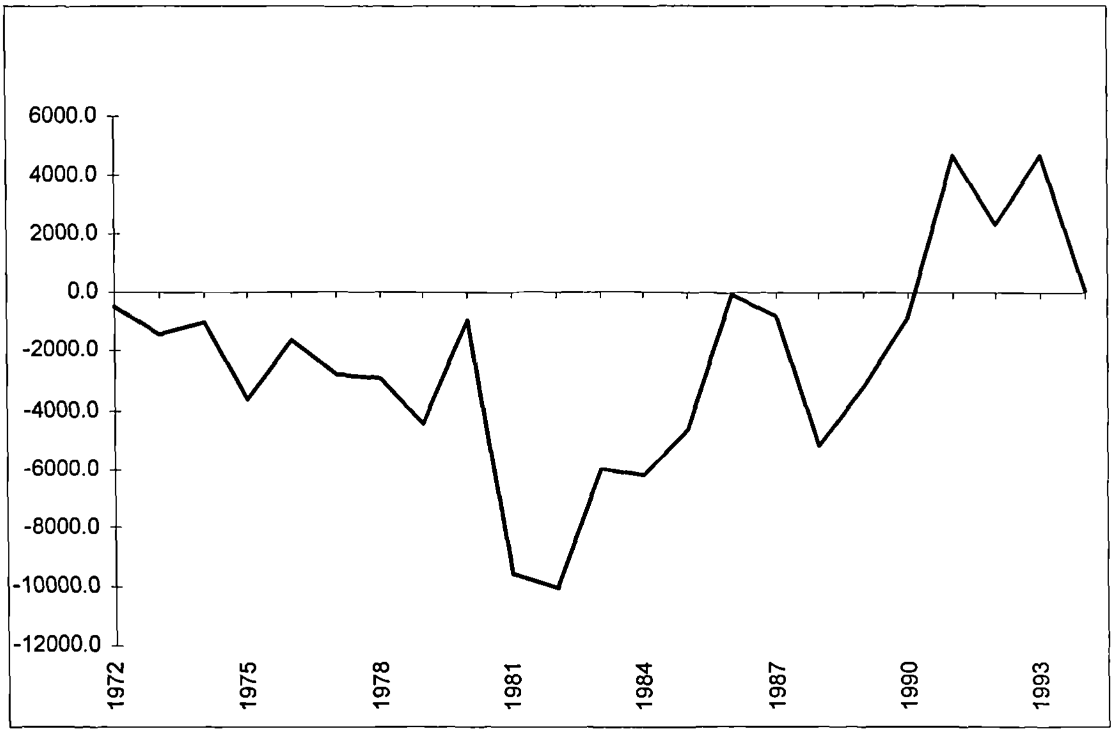
Egypt in the International Arena

Perhaps Egypt's economic situation from 1960 to 1992 is best understood through an examination of the nation's balance of payments, particularly its current account (Table 2.5 & Figure 2.4). The current account is an important critical macroeconomic indicator which measures the size and the direction of international borrowing. When a nation imports more than it exports, it is buying more from foreigners than it sells to them. As a nation can import more than it exports only if it is able to borrow the difference from abroad, a country with a current account deficit must be increasing its net foreign debt by the amount of deficit. Krugman and Obstfeld in 1991 stated that a country with a current account deficit is importing present consumption, exporting future consumption. A country with an account surplus is exporting present consumption, importing future consumption.

Egypt's balance of payments, and of course its economy, is relying heavily on four main sources for foreign exchange. These are petroleum exports, cotton exports, worker remittances, and tourism. Therefore, Egypt's main sources for foreign exchange are to an extreme degree out of its control. Petroleum revenue, Suez Canal dues, and emigrant remittances are highly vulnerable to the vagaries of world oil demand. The world-wide oil glut of the mid-1980s, for example, not only reduced Egypt's oil revenue but also led to fewer employment opportunities for Egyptians wishing to work in the surrounding oil-producing countries, and reduced the level of traffic using the Suez Canal. The other two sources of foreign exchange, cotton and tourism, are in a no less vulnerable position. Tourism, for example, has been affected by the tension in the region, mainly the wars in Lebanon and the Gulf. Income from cotton exports, on the other hand, has always been under the influence of world demand and crop failure. In 1974 cotton accounted for 47.0% of Egypt's total merchandise (f.o.b.) export revenue. Since then, however, its share in total merchandise export earnings has been in decline, falling to less than 9.0% (0.6% of GDP) in 1987 (Table 2.4).

Egypt, like many developing countries, ran current account deficits throughout the 1970s and 1980s, following several devaluations of the Egyptian pound. The nation exchange rate was almost fixed during the 1970s, despite significant inflation in Egypt compared to its trading partners, giving rise to the appreciation of the exchange rate and the deterioration of the current account. The Egyptian pound was supported during this period by oil receipts, Suez Canal revenues, cotton exports, worker remittances and foreign borrowings. In the 1980s, the current account deficit reached about 12% of GDP, the result of the downward trend which began in 1979. This large deficit of the current account throughout the 1970s and 1980s could be explained by the following facts. First, the adverse movement in the terms of trade, largely because of a fourfold increase in the price of imported wheat, unmatched by comparable rises in the price of cotton exports. In 1974 and 1975, for example, the prices of both exports and imports rose unevenly but significantly. Relative prices moved against Egyptian exports by 12% between 1973 and 1974. A more telling indicator is the movement in the cotton export-agricultural imports price ratio, which dropped by some 35% between 1974 and 1975. Second, the unfavourable increase in imports compared to exports. After 1973, import volumes increased and exports decreased. The expansion in domestic demand (for both consumption and investment) seems to have stimulated imports and diverted exports (other than petroleum) away from foreign into domestic markets. The deficit in goods and services accordingly increased from 223.3 million Egyptian pounds in 1973 to 498.4 million Egyptian pounds in 1978.

Figure 2.4: Current account, 1972-1994 (millions of £E 1990)

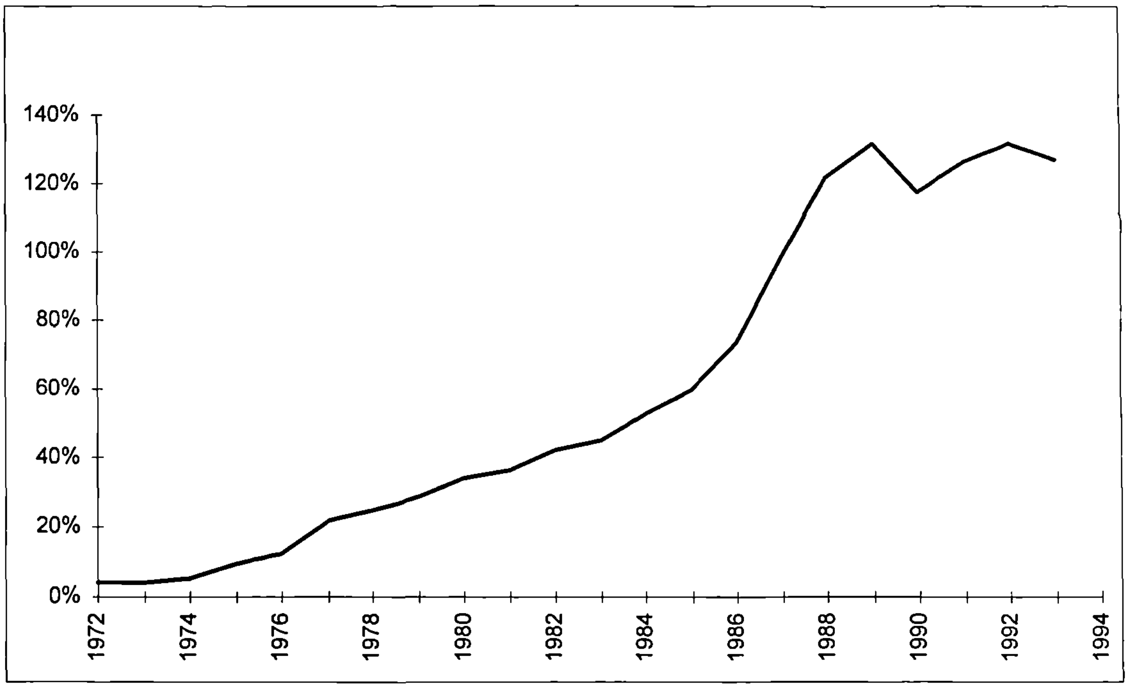


Egypt's current account deteriorated in the late- 1970s. The current account began to recover when the £E was devalued. However, the current account deficit grew in the mid-1980s following a decline in world oil prices.

To restore the current account in the 1980s, the Egyptian pound was devalued by 10% in 1982, 12% in 1985 and 39% in 1987, depreciating substantially in real trade-weighted terms as well. In 1986, the exchange rate regime was switched from a fixed rate to a floating rate, and the Egyptian pound has depreciated strongly in both nominal and real trade-weighted terms since that time (Kheir El-Din and El-Dersh, 1992). However, following a fall in oil prices in late-1985, the current account deficit grew once again before improving at the end of the decade (Table 2.5 and Figure 2.4).

With the erosion of the current account in the late-1970s, policy-makers avoided macroeconomic adjustments by accumulating foreign debt (Table 2.6 & Figure 2.5). In 1971, before the oil boom, Egypt's foreign debt totalled U$2,277 million, equal to 3.8% of GDP. In the 1973-78 period the deficit was largely financed through grants from Arab countries, capital flows on concessional terms from Arab and OECD countries, and multilateral institutions such as the World Bank. From 1979 to 1986 a period in which the current account deficit grew dramatically, the foreign debt grew more than quadrupled. A 1993 World Bank country study notes that a substantial portion of the borrowed funds was used to finance consumption and investments yielding returns that came nowhere near covering their share of total debt service.

Figure 2.5: Egyptian external debt as a % of GDP



External debt grew from 3.85% of GDP in 1972 to 132% of GDP in 1992.

Egypt's external debt rose rapidly during the 1980s. The rise in budget deficits in the early 1980s and the collapse of oil prices in 1986 are the main factors that have contributed to the rise in Egypt's external debt. By the end of 1983 the total net external debt stood at US$ 32.631 billion, compared to US$ 20.915 billion at the end of 1980. [4] By the end of 1984, 1985, and 1986 the net external debt stood at US$ 35.689, 42.136 and 45.469 billion, and this debt was around U$ 50.0 billion for the years 1987, 1988, and 1989. Egypt external debt is mostly on a long-term basis. Short term debt, i.e., debt which has an original maturity of one year or less, as a percentage of total debt[5] stood in a range between 19.2% and 11.3% over the 1980-

[4] The source of all figures in this section is the World bank (1996) "World Debt Tables 1995-1996: External Finance for Developing Countries, Volume 2, Country Tables".
[5] Total debt = long-term debt + short-term debt + Use of IMF credit.

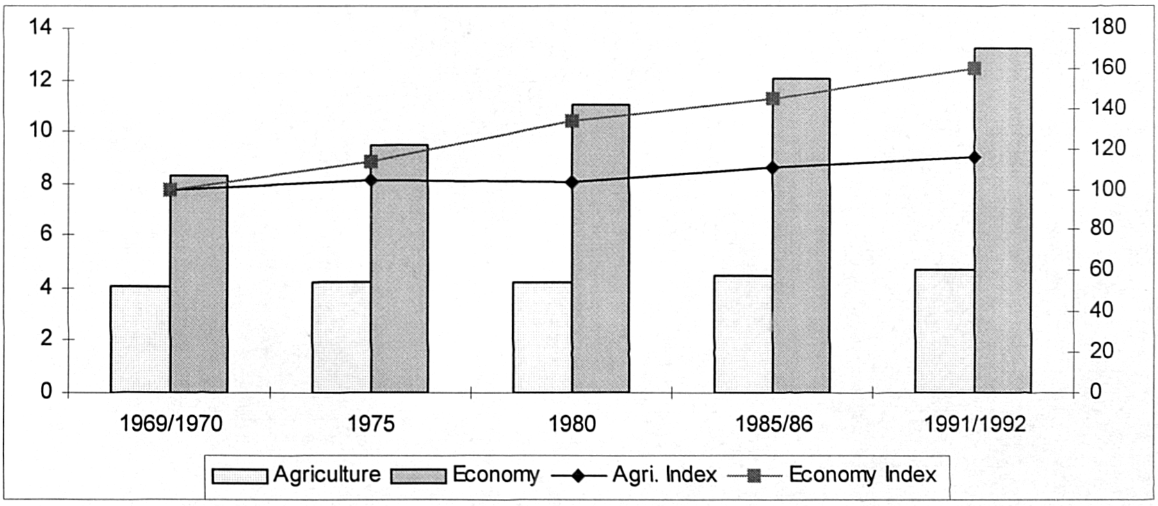
1990 period. Also, Egypt's long-term debt is mostly public and publicly-guaranteed (private debt which is guaranteed for repayment by a public entity) debt. Private long-term non-guaranteed debt stood in the range of US$ 265 to US$ 1,131 million between 1980 and 1988. The increase in external debt was accompanied by similar increases in the debt services. Total debt service was put at 28.7% of XGS[6] at the end of 1986, compared to 14% of XGS in 1980.

Sectoral Performance

Agriculture

Although the share of agriculture in total GDP fell from 25.6% in the 1985/86 year to only 19.7% in 1990/91, the sector is still a major source of employment, particularly in the rural areas and smaller towns, and accounts for more than one-third of the labour force (Figure 2.6). Moreover, it still forms the second most important economic sector, behind trade, finance and insurance, which had a share in GDP of 20.54% in 1990. Its contribution to GDP exceeded the contribution of manufacturing sector which was about 17.9 %.

Figure 2.6: Number of persons employed in the agriculture sector and in the Egyptian economy, 1970-1992 (in millions)



[6] XGS = Exports of Goods and Services

The agriculture sector's contribution in the total value added declined in the late 1970s and early 1980s due to inappropriate pricing and production policies that led to soil erosion and the unrecoverable loss of the best fertile agriculture land due to urban and industrial expansion; however, an improvement in its output has been recorded since the introduction of a number of reforms in 1986, such as decontrolling of prices and changes in marketing procedures. This has permitted the achievement of self-sufficiency in several important commodities such as rice, beans, fruits and vegetables, as well as increased exports of certain products. Despite this increase in output levels, the high rates of population growth have necessitated a continuing increase in food imports, particularly of wheat. Imports of processed foods, beverages and livestock increased by 6% alone in the 1992 fiscal year, while the overall import bill for foodstuffs climbed to more than £E 8.1 billion (CBE, 1993).

Mining and Quarrying

The development of the oil sector in Egypt has played an important role in its economy. The importance of this sector has grown since 1973 when oil prices rose sharply. In 1972 petroleum exports accounted for only 6.51% of Egypt's total merchandise (f.o.b.) export revenue, compared to 25.0% in 1976. By 1980 they provided 64.0% of that revenue and this level was in excess of 50.0% through to 1986 (the year in which oil prices collapsed). In 1980 crude-petroleum production was about 600,000 barrels per day (b/d), compared with 420,000 b/d in 1977, and it continued to rise thereafter. One of the factors leading to the increasing in oil production in 1980 was the return by Israel of the Alma oilfield, renamed the Sha'b Ali oilfield, in the Gulf of Suez, in November 1979. In 1982 Israel also returned the Sinai oilfield, which produced 200,000 b/d, contributing to further increases in Egypt's oil production. Egypt's proven oil and gas reserves at the end of 1991 were 5.6 billion barrels (i.e., 0.42% of total world proven oil reserves) giving a reserves/production (R/P) ratio of 14 years (EGPC, 1992)

The oil revolution which resulted in oil price increases in 1973 and 1979, up to the fourfold of world oil prices, was the other factor behind the changes taking place in the Egyptian economy after 1973 in general and in the petroleum sector in particular. The steady increase in oil production since 1974 as shown in Table 2.7 and the sharp rise in oil prices characterised the importance of the petroleum sector in the Egyptian economy accounting for about 4.0% of GDP at current factor cost in 1976 increased, 6.2%, 6.9%, 15.8%, 17.0%, and 18.8% in 1977, 1978, 1979, 1980, and 1981, respectively. On the other hand, figures supplied by the Central Bank of Egypt show that oil resources are the most important source of foreign exchange in Egypt. The average contribution of oil exports in the total Egyptian exports was 50% on average during the 1981-1992 period (Table 2.4).

The oil boom radically transformed public sector finances. Efforts to collect non-oil taxes diminished, public sector consumption and low-return investments increased, and government subsidies expanded. Where oil revenues were insufficient to cover public spending, the government borrowed from abroad. Public sector expenditure became strongly dependent on oil receipts and external borrowing during the1980s (Table 2.8 & Figure 2.7). By the end of the 1970s and at the beginning of the 1980s more than 50% of the public sector was financed by oil revenues accrued by EGPC, the state oil company; however, in the 1985-1990 period this figure fell to 25% on average, reflecting the decline in world oil prices in this period.

Figure 2.7: Percentage of public sector expenditure attributable to oil exports

Manufacturing

It is widely believed that rising oil prices in the 1970s and early 1980s and the resulting increase in importance of the oil sector occurred at the expense of manufacturing industry (the so called "Dutch disease"). Though some kind of industrialisation efforts had already started in Egypt in the early years of the 19^{th} century, it is only since the end of World War II that the industrial sector began to play an important role in the Egyptian economy. Industrialisation was given greater attention by Nasser, who took power after the 1952 Revolution.

The industrial base in Egypt is very narrow, is dependent on imported inputs, and is directed to the domestic market. The share of consumer durable goods as a percentage of industrial gross value-added was in the range of 0.5% to 9.3% between 1947 and 1974. The remaining share (99.5% and 90.7%) was provided by basic consumer goods (foodstuffs, textiles) and intermediate goods (fertilisers and building materials). Food processing and textiles have traditionally taken the lion's share in the industrial sector, contributing about 55%-66% of total value of industrial output in the mid-1970s. Manufactured goods accounted for 31.0% of Egypt's total commodity export, and their share was in excess of 25% of that commodity export up to and including 1978. Their share, however, was reduced to only 8.2% and 10.1% in 1982 and 1985, and nearly doubled to 20.1% in 1986. Egypt's imports of manufactured goods as a percentage of total commodity imports was relatively stable during the years 1971-1986 (the lowest and highest shares were 45.1% and 66.5% in 1974 and 1979, respectively). Imports of foods, beverages and tobacco amounted to 44.3% and 30.0% in 1974 and 1986.

However, over the last decade the manufacturing sector has played an important role in the Egyptian economy. As shown in Table 2.7, it has expanded at very rapid rates since the mid-1980s, with the share of Manufacturing Value Added (MAV) in total GDP estimated to have risen from about 13.3% in 1987 to almost 18% by 1990. The latest available data indicate further that food processing (including the production of beverages and the processing of tobacco) was the most important activity within the manufacturing sector, accounting for almost 24 % of total MVA in 1990. Other important activities were the manufacture of metal products 23%, textiles and garments 14%, chemicals 14%, machinery and transport equipment 12% and non-metallic mineral products 8% (UNIDO, 1994).

Trade, Tourism and other Services

The contribution of tourism and trade to the Egyptian economy's total output increased from about 8% to 12.2% in the first half of the 1980s and since then has fluctuated between 12% and 15%. Tourism in particular has gained considerable importance during the past decade as a vital earner of foreign exchange and a major contributor to the balance of payments. Between June 1987 and June 1990 revenues from this subsector rose from $1.2 billion to $2.1 billion. After a sharp fall to only $1.2 billion in 1991 in the aftermath of the Gulf war, they began to rise again, reaching $1.7 billion by the end of 1991/92 (INP, 1995).

To sum up, the structure of the gross domestic product (GDP) during the period 1955/56-1991/92 shows that agriculture was the major sector in the 1950s and 1960s. Its share of GDP was 32.3% in 1955/56 followed by other services, 21.6%, and industry and mining (including petroleum), 17.6%. After 1973, major changes to the GDP structure occurred due to the liberalisation and open-door policies. Petroleum, Suez Canal, tourism, and trade sectors have grown increasingly. The GDP share of petroleum increased from 2.7% in 1974 to about 10.6% in 1991/92, while the trade and finance share of GDP increased from 9.5% in 1960/61 to about 21.2% in 1991/92. The agricultural sector contribution to GDP decreased from 30.5% in 1974 to about 16.5% in 1991/92 due to the government policy of investment allocation and structural economic changes. The industrial sector share of GDP declined from 21.6% in 1965/66 to about 13.7% in 1981/82 and increased again slowly to reach about 17% in 1991/92. The performance of this sector is weak, and its indicators of growth in labour absorption, export earning, productivity change and economic rates of return are therefore low. Although government policy in the 1970s was for an open-door to attract foreign investment to Egypt, unfortunately most of the industrial investment was in the consumer goods industry such as food, beverages, textiles, and cigarettes and essential intermediate goods such as building materials, petroleum products, fertilisers, chemicals, paper. The capital goods industry such as machinery, tools and implements is small.

3. STATE OF ENVIRONMENTAL AND NATURAL RESOURCE BASE

Having examined the macro and sectoral growth and performance of the Egyptian economy and the main changes which have occurred in it, the study now turns to examining the impact of the economic activities on the Egyptian environmental and natural resource base. The purpose is to show to what extent the past development programs have contributed to the depletion and degradation of the environmental and natural resources base in the name of achieving economic development and growth of the economy. Therefore, the main purpose of examining the state of the Egyptian environmental and natural resource base is to point out the environmental depletion and degradation that need to be accounted for, as soon as possible, in order to sustain the contribution of the environmental and natural capital in the economic growth for the welfare of the present and future generations.

Environmental issues, in general, have two aspects. The first is pertinent to the natural resource-base and involves land development to support food production, water shortage and quality, availability of energy and management of the natural heritage. The second is concerned with the decay of environmental quality such as air pollution and water pollution, soil erosion, solid waste and noise pollution. In the following subsections, we will highlight the most pervasive environmental issues in Egypt.

The Egyptian natural resources-base could be classified into four main categories, namely:

1. Non-Renewable Resources:

such as fossil fuels (oil, natural gas and coal), minerals and metals, and deep desert ground water.

2. Renewable Resources:

- Biotic or living organisms: terrestrial biomass (flora and fauna), aquatic biomass (such as fisheries).
- Abiotic or non-living organisms: water and land.

3. Semi-Renewable Resources: such as: soil quality, assimilative capacity of the environment.

4. Natural Heritage: This consists of three types of sites:[7]

- Cultural heritage sites,
- Natural protected areas, and
- Coastal shores and marine areas.

In this study, we will concentrate on natural resource issues of high priority for Egypt and which are relevant to agricultural land, water and air, and energy resources.

3.1 Energy Resources

Energy is a critical natural resource in Egypt. A small quantity of coal exists in Sinai. Oil is known around the Gulf of Suez and the northern parts of the western deserts, and natural gas is found in the Nile Delta. Since 1972, Egypt has become an oil exporter. Fossil fuels (oil and gas) are still the primary sources of commercial energy in Egypt, and oil is one of the main sources of foreign exchange. However there are two energy issues which need to be addressed. The first is that the lifetime of the proven reserves of fossil fuels are not large and that production cannot continue to increase very long into the future. Second, the emissions resulting from energy transformation and use have consequences on environmental quality.

[7] For more details see: Egyptian Environmental Action Plan (1992c).

The net production[8] of oil in 1991/92 was 35.29 million tons and consumption was only 28.65 million[9], leaving a balance of 6.64 million tons for export. However, it is expected that by 1999/2000 production would increase to 39.97 million tons, while consumption would jump to 42.33 million, leaving about 3.36 million tons to be imported. The situation is expected to become even worse due to the increasing population, by 2004/2005, with production predicted to reach 41.78 million tons and consumption 54.02 million. Thus, unless alternative sources of energy become economically available, 12.24 million tons will have to be imported to make up the difference.

Egypt, however, enjoys high rates of solar radiation over all its territory (an average of 6 kwh/m^2/day), favourable wind resources in coastal areas (5-8 m/sec), and considerable biomass resources including agriculture, animal, and municipal solid wastes. In addition, more than 20 locations for mini-hydroelectric power generation, some low-to-medium temperature geothermal sites in the Sinai and along the Red Sea coasts and some oil shale deposits have also been identified. These have the potential of producing about 250 Mwh/year (INP, 1991).

Therefore, energy decision-makers in Egypt are challenged by: (a) step-wise transfers to alternative types of non-polluting renewable resources, for example solar, wind, and biomass energies, but economically expensive resources to meet future increased energy demand; (b) optimally utilising existing reserves to conserve the share for future generations by: (1) encouraging the discovery and exploration of new oil and gas fields and developing those fields to increase the proven reserves of oil and gas; (2) reducing local consumption rates in such away that the depletion rate is equal to the rate at which renewable substitutes are developed.

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[8] Total production is actually higher but a certain share goes to the oil companies.

[9] This high ratio of consumption with respect to total production resulted mainly from the subsidies that are given to petroleum products. This, in turn, encourages the wasteful misuse of a finite resource with a price which does not reflect its scarcity. This issue will explored in great detail in Chapter Five.

3.2 Agriculture Land Issues

The issues of agricultural land losses, either in quantity or quality, are the major causes of the decline of food self-sufficiency since the 1960s. The agricultural land problems can be summarised as follows:

1. *Land losses.* Agricultural land suffers by losing areas with the best fertile soil due to the spread of buildings in urban and rural areas. During the last 30 years, land losses are estimated in 1990 at more than 840,800 feddan (World Bank, 1990).

2. *Land quality degradation.* Soil erosion is often considered one of the major environmental problems in Egypt. Degradation of agricultural land in Egypt is mainly due to: (a) soil salinization and water logging because of an inefficient drainage system. Presently, more than 35% of agricultural land, 2.5 to 3 million feddans, is reportedly affected by salinity, the major portion of which is found in the lower delta, 2 million feddans (EEAA, 1992c); (b) loss of the fertility of agricultural land due to scraping; (c) chemical and biological pollution. Soil pollution may occur because of the disposal of industrial waste on agricultural land, atmospheric fall out, the use of sewage effluent or sludge, and overuse of fertilisers and pesticides that could be seen from the very high rates of fertilisers and pesticides application compared to other developed or developing countries[10] (Table 2.9); (d) and finally loss of fertility because of desertification.

3.3 Air Pollution

Critical air pollutants in Egypt, mainly in urban areas, include Suspended Particulate Matter, Sulphur dioxide, Carbon Monoxide, Lead and Ozone. All of these pollutants in most, if not all, urban areas, exceed national and international levels. The three main causes of air pollution in Egypt are as follows. First, the large concentration of polluting industries in and around the major urban areas such as Cairo and

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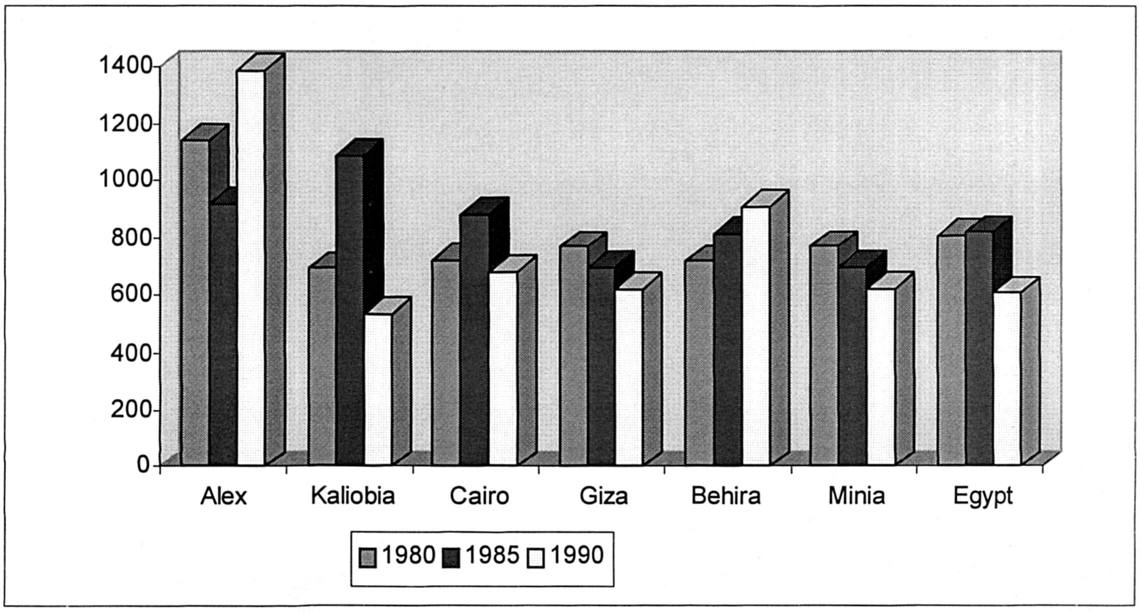
[10] Another important cause of land degradation in Egypt is the distortion of the land tenure system that makes it difficult for the majority of poor farmers to make long-term investment in sound environmental management (CER, 1986).

Alexandria, especially the steel, cement, fertiliser, and chemical industries, which contribute to high levels of dust and SO_2, which now exceed maximum safe levels by 2 to 10 times (Table 2.10 & 2.11). Second, the use of high sulphur fuel in industry and for thermal power generation also contributes to a high SO_2 level in the air. Industry pollution contributes 98% of all Sulphur Dioxide, 46% of Nitrogen Oxides emissions, and 75%f suspended particulates[11]. Particulate matter and sulphur dioxide are Egypt's most damaging pollutants, and are more dangerous than ozone or lead, and their emissions were above the WHO standard between 1980 and 1990 (Figures 2.8 & 2.9). Third, the heavy use of subsidised leaded gasoline for transportation in urban areas leads to its overuse and a high level of lead dust in the air. This is compounded by traffic management problems, congestion and large numbers of poorly maintained vehicles. The negative side effect of air pollution is its damaging impacts on human health, soil and vegetation, economic materials and constructions, the income from tourism, and the physical properties of the atmosphere.

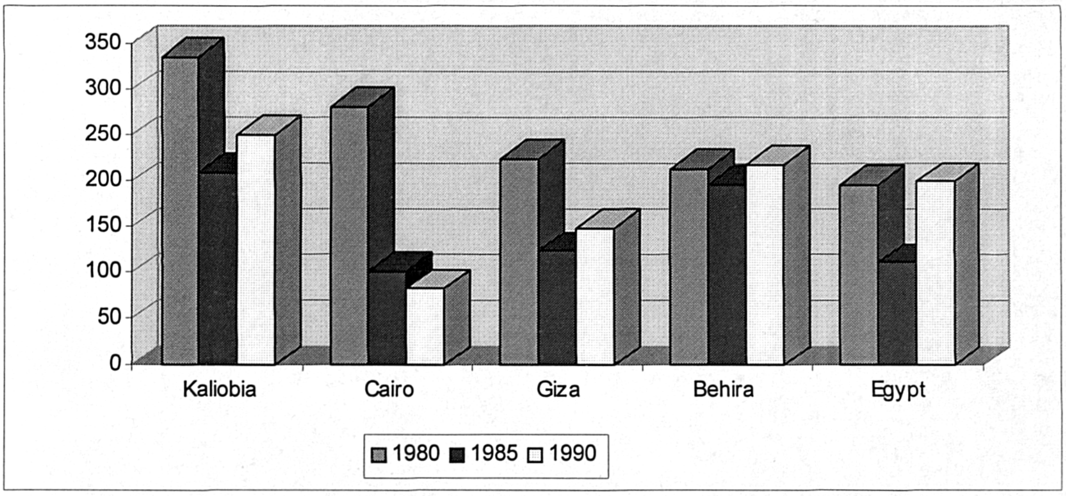
Figure 2.8: Annual average concentration of suspended matter in urban areas, 1980-1990 ($\mu g/m^3$)



WHO guidelines = 150 ($\mu g/m^3$)
Source: EEAA (1992a) Environmental Monitoring Centre.

[11] Other causes include burning wastes of cities (garbage) and agricultural waste.

Figure 2.9: Annual average concentration of sulphur dioxide SO_2 in urban areas, 1980-1990 ($\mu g/m^3$)



WHO guidelines of SO_2 = 40-60 ($\mu g/m^3$)
Source: EEAA (1992a) Environmental Monitoring Centre.

3.4 Water Pollution

In Egypt, water quality degradation of the River Nile, the Lakes, and agricultural drains is mainly related to the discharges of untreated effluents and drains from industrial effluents, agricultural drains, raw sewage from the expanding unserviced areas, and other sources such as navigation and weed control. Therefore, the main causes of water pollution in Egypt are: (1) *Industrial Effluents.* More recent information, based on a 1990 study prepared by the General Organisation for Industrialisation about the analysis of industrial waste water shows that Egyptian public industry uses 638 million m^3/yr of water, of which 549 million m^3 are discharged to the drainage system. Industrial activities in the Greater Cairo and Alexandria regions use 40% of the total. The Nile River supplies 65% of the water supply and receives more than 57% of the effluents. More detailed information about industrial water consumption, waste discharge, and the total pollution resulting from the different industrial activities are shown in Tables 2.12 - 2.15. (2) *Agricultural Drainage.* Agriculture drainage water in Upper Egypt is discharged back into the River Nile. This slightly affects the quality of Nile Water as its salinity increases from 250 ppm at Aswan to 350 ppm at Cairo (EEAA, 1992b and 1992d). The Nile Delta drainage water is of poor quality, and is drained and discharged to the Mediterranean Sea. However, the agriculture sector effluents in the water is not a serious problem compared to the industrial sector; the agriculture sector effluents are still under the standard national and international levels. Therefore, one can say that the industrial sector is the most responsible sector for the water pollution problem in Egypt. Bilharziasis disease (as a water-borne disease from water pollution) is a threatening sickness and death disease for most poor farmers. In that sense, addressing the water pollution problem would be particularly important to the poor.

4. POPULATION, ECONOMY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

4.1 Population-Environment

The Egyptian rate of population increase, as discussed in detail above, although showing a small improvement in the past few years, is still higher than the average rate in many developing countries. Such observed population growth is at the root of most, if not all, environmental problems, which include resource depletion and degradation. Population growth in urban and rural areas leads to: (1) increasing demand for access to safe fresh water; (2) increasing agricultural land losses for the best fertile land; (3) increasing domestic waste, untreated sewage and non-recycled solid wastes contribute to environmental pollution. The environmental system in rural areas, in particular, inherited a number of old environmental problems. Some of them are connected with the general level of cleanliness and some behavioural aspects. Development in the method of farming is accompanied by a number of environmental problems, such as polluting the environment with chemicals (fertilisers and pesticides).

On the other hand, the natural environment offers a life support service for the human species, such as air to breathe, sun, energy, water, and land. But in Egypt now, as a negative feedback of human behaviour and its economic activities toward natural environment, the impact on humans includes: (1) deaths and health risks linked to water-borne diseases; (2) in urban areas, the concentration of air pollution has a negative impact on human productivity, mortality and morbidity rates; (3) in rural areas, the lack of access to safe water and sanitation affects human health and well-being; (4) and finally, it provides amenity support (e.g., recreational opportunity)[12].

4.2 Economy-Environment

The mutual relationship between the economic and environmental systems is highly complex and interwoven. In the past, there was no trade-off between economic growth and environmental depletion and degradation. Many factors contribute to the present accumulated environmental problems. The major factors are: unsound government policy in the past, Egyptian human behaviour toward the environment and an inefficient management of the most densely populated urban regions. The factories release their wastes and effluents without treatment into the Nile River and the Lakes in addition to the emission of air pollutants, without control, in urban areas which are of high population density.

The economic system is responsible for the natural-resource-base depletion and degradation[13], such as: losses of fertile soils due to the expansion of buildings in urban and rural areas; losses of water resources due to inefficiency of irrigation and water management systems; depletion of non-renewable resources such as fossil fuels; the present high levels of water and air pollution and over-fishing.

On the other hand, the natural environment performs a valuable economic service: (1) as a source of natural resources for economic development. The scarcity of natural resources in Egypt has a negative effect on the growth of economic production. For example: the problems of agricultural land losses, either in quantity

[12] For more details (see Abdel Rahman, 1981; Hass, 1990; and Tolba, et al., 1992).

[13] The current economic policies and market failures concerning natural resources and the environment are responsible for the current environmental depletion and degradation.

or quality, and water scarcity are the major causes of the decline of food self-sufficiency; (2) as a resource of tourism, Egypt's cultural and natural heritage acts as an important source of foreign exchange[14]; (3) the natural environment acts as a receptor and assimilator of pollutants generated by economic activities. But in Egypt now, the levels of air and water pollution exceed the assimilative capacity of the environment; (4) it provides beneficial environmental conditions, for example in terms of soil and climate conditions for agriculture and marine quality for fishing[15].

4.3 Sustainable Development

The previous analysis of the Egyptian economy has made clear that it is important to give a practical dimension to the concept of sustainable development that is introduced by World Commission on Environment and Development (WCED) in 1987, also known as Bruntdland Report. WCED defined sustainable development as "the paths of human progress which meet the needs and aspirations of the present generations without compromising the ability of future generations to meet their needs". This definition may indicate the general direction, but translating it into practical goals, programs, and policies which nations, like Egypt, could apply is not an easy task to accomplish. So, it invited some authors to make it more specific by trying to describe the necessary conditions for sustainability, or ways of achieving sustainability, or the indicators for measuring sustainability. Some of the definitions and measurement indicators for sustainability concepts found in the literature are presented below[16].

- ***Sustainable income.*** Daly in 1989, for example, proposed two adjustments for

[14] However, this valuable and scarce natural and historical heritage is now in real danger resulting from its exposure to high emission rates of air pollution from the surrounding industries. Evidence can be seen from the soiling of the Sphinx nose (See Nasralla, 1993; El Gamal, 1994).

[15] Previous studies concerning the impact of global warming, due to the anthropogenic release of greenhouse gases into the atmosphere, indicated that Egypt is extremely vulnerable to climatic changes. The potential negative impact might affect natural resources, economy, and the people (Onyeji and Fisher, 1993).

[16] For a review of the numerous definitions and interpretations of sustainability concepts see, for example: Yusf, J. A. et al., 1989; Perman et al, 1996 and 1999; WB, 1995 and 1997; WRI et al., 1992; Daly, 1989; Barbier and Markandya, 1989; Pezzy, 1989; Steer and Lutz, 1993 and 1994.

the SNA to replace the present income measure- GDP- by a measure of "sustainable" income. One adjustment is simply to extend the principle of depreciation to cover consumption of natural capital stocks depleted through production. The other is to subtract "defensive expenditures" to protect or restore the environment from the unwanted side effects of our aggregate production and consumption. That is, the correlated income concept, "Sustainable Social Net Domestic Product" (SSNDP), is defined as:

$$SSNDP = NDP - DE - DNC \qquad (4.3.1)$$

Where:

NDP = Net Domestic Product

DE = Defensive Expenditures

DNC = Depreciation of Natural Capital (Depletion and Degradation)

- ***Environmentally sustainable development.*** Barbier and Markandya (1989), among others, interpret environmentally sustainable development as the maximisation of net benefits of economic development, subject to maintaining the services and quality of natural resources over time. That is, if the resource base is a composite of non-renewable and renewable (including semi-renewable and waste-assimilative capacity), sustainability requires:

I. utilising renewable resources at rates less than or equal to the natural or managed rates of regeneration;

II. generating wastes at rates less than or equal to the rates at which they can be absorbed by the assimilative capacity of the environment; and

III. optimising the efficiency with which exhaustible resources are used, which is determined, inter alia, by the rate at which renewable resources can be substituted for exhaustible and by technological progress.

A workable measure for Barbier and Markandya's definition for sustainable development has been proposed to be estimated as follows:

Sustainable Income = Measured Income

- Household Defensive Expenditures

- Monetary Value of Residual Pollution
- Depreciation of Man-made Capital assets
- Depreciation of environmental capital (ecosystem function damage, renewable capital, exhaustible capital).

This definition, although conceptually similar to that given above, provides a basis for empirical estimation.

The United Nations, however, in 1993 endorsed the calculation of two measures for sustainable development: (1) Environmentally-adjusted net Domestic Product (EDP); (2) Environmentally Adjusted Net Income (ENI). These concepts are equivalent to the earlier concept of SSNDP or sustainable income by Barbier and Markandya. The EDP is arrived at by deducting imputed charges for the depletion of minerals and other natural resources, and cost of degradation of land, water, air, and other environmental amenities, resulting from production activities, from the GDP. The EDP measure does not include damage unrelated to production activities, such as natural disasters, naturally occurring erosion, and so on. These costs are reflected in the measure ENI. To arrive at the ENI, according to Lutz and Munasinghe (1994), the following five items are subtracted: (1) Environmental protection expenditures of governments and households, (2) Environmental effects on health and other forms of human capital, (3) Environmental costs of household and government consumption activity, (4) Environmental damage from capital goods that are discarded, and (5) Negative environmental effects caused by production activities in other nations, and negative environmental effects transferred abroad. These empirical computations require knowledge of the process relating to the production activities with environmental effects not only in the country (region) but also in those with which trade takes place[17].

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[17] Proops and Atkinson (1996) and Common and Sanyal (1998) have extended the Hartwick/Solow indicator to cover the depreciation of non-renewable resources (oil and gas) that takes place in international trade, between exporters and importers. Their idea is to treat each trading economy as if it were a single sector in the global economy, and then using the input-output methods to calculate the measures of depreciation of man-made and natural capital capital in each economy on account of domestic and overseas final demand, D^{IN}, and a measure of the global depreciation attributable to final demand in each economy, D^{ATT} (for details see Proops and Atkinson, 1996; Common and Sanyal, 1998).

- ***Net and Genuine savings***, rather than EDP, is the national accounting aggregate with the clearest policy implications for sustainable development. Hamilton (1994) argues that 'green GNP' per se is not particularly useful for policy applications, even though it is important to know the true level of income in an economy. What does have much greater policy salience is the rate of genuine saving, i.e., net savings adjusted for environmental depletion and degradation. Pearce and Atkinson (1993), from University College London (UCL), have proposed an indicator of weak sustainability based on the neo-classical assumptions inherent in the Hartwick/Solow approach, in that man-made and natural capital are assumed to be perfect substitutes for each other, as shown in equation (4.3.2) below.

$$S_g = GDP - C - \delta_M - \delta_N \geq 0 \qquad (4.3.2)$$

Where:

S_g = genuine savings,
C = public and private consumption,
δ_M = depreciation of produced assets, and
δ_N = depletion and degradation of natural assets.

In Pearce-Atkinson Measure (PAM) if PAM ≥ 0 the economy is judged to be on the sustainable path. Equation (4.3.2) states that PAM will be only positive if gross savings (GDP-C) exceed the sum of depreciation on man-made (δ_M) and natural (δ_N) capital. Pearce and Atkinson argue that this is a useful rule, in that if countries fail even this weak test of sustainability, they are unlikely to pass a stronger test.

In 1995 and 1997 the World Bank adopted the idea and proposed two measures for sustainability; Genuine Savings I that is similar to PAM; and Genuine Savings II (GSII) that is equal to in addition to investment in human capital E_H, as shown in equation (4.3.3) below. The World Bank argument is that, since the emphasis is on sustainable development, educational and health expenditures should be considered to be saving for the future as well. For current education and health expenditures E_H

therefore, genuine saving becomes:

$$S_g = GDP - C - \delta_M - \delta_N + E_H \geq 0 \qquad (4.3.3)$$

For governments concerned with sustainability, virtually all of natural resource policy, the targets for environmental quality, public investment programmes (particularly for the development of human capital), and large elements of monetary and fiscal policy, are all germane to the question of avoiding negative genuine savings. By expanding the asset base under consideration, green national accounting leads to a conception of economic development as a process of portfolio management. The efficient exploitation of resource assets, the shrinking of pollution liabilities to efficient levels, and changing the mix of produced and human capital in line with the highest rates of return on the marginal investment, all should become components of development policy.

- ***Carrying capacity.*** Many authors have defined sustainability in terms of carrying capacity, a concept used to describe the maximum population of people, or farm animals, or wildlife that the environment can support on a continuing basis. When applied to people, carrying capacity indicates "the number of people that a given region (or a given amount of land) can support" (see e.g., Perman et al., 1996 and 1999).

Other authors, however, have defined some dimensions for measuring and achieving sustainable development[18]. WRI et al., for example, in 1992 suggested that sustainable development is a process requiring simultaneous progress in a variety of

[18] UNDP, for example, in 1990 adopted the use of Human Development Index (HDI) as a measure for sustainable development. HDI is a component of three equal weighted indicators; they are knowledge (adult literacy), health (life expectancy at birth), and income (GDP per capita). According to UNDP 1992 HDI report, Egypt HDI was only 0.385 as compared to 0.976 for USA, 0.981 for Japan, and 0.982 for Canada. This ranks Egypt as 110th as compared to USA (Six) and Canada (First) on a list of 160 countries investigated. For a review of Egypt's HDI rank for the 1990-1995 period see table 2.16 in Appendix 2.1. It has to be also noted that UNDP has not so far included an environmental component in HDI, although it recognises that the environment cannot be completely ignored. This why the researchers and organisations are now researching ways to incorporate an environmental dimension into HDI model (Proops, 1998).

dimensions: economic, human, environmental and technological, as follows:

- *Human Dimension.* Population stabilisation; redistribution of population as well as vigorous rural development to help slow migration to cities; redirecting or reallocating resources to ensure that basic human needs, such as literacy, primary health care, and clean water are met.

- *Economic Dimension.* Steady reduction in wasteful levels of consumption of energy and other natural resources through improvements in efficiency and through changes in life-style; alleviating absolute poverty; reducing the growing disparity of incomes and access to health care.

- *Technological Dimension.* Shifting to technologies that are cleaner and more efficient –as close to "zero emissions"- and that minimise consumption of energy and other fossil fuels, which are a major source of urban air pollution; limiting the global rate of increases of greenhouse gases; preventing degradation of the Earth's protective ozone layer.

- *Environmental Dimension.* More efficient use of arable lands and water supplies; avoiding over use of chemical fertilisers and pesticides, so that they do not degrade rivers and lakes, threaten wildlife, careful use of irrigation, to avoid salinization or water-logging of crop land; conserving water by ending wasteful uses and improving the efficiency of water systems. It also means improving water quality and limiting groundwater withdrawals to the rate of regeneration; conservation of the Earth's biodiversity for future generations.

Bishay in 1992, however, defined sustainable development for Egypt as: "achieving a dynamic balance between the pressing basic needs for economic development in face of a staggering population increase and gross underdevelopment, with the unique limitations of the Egyptian environment – primarily the country's dependence on the

River Nile for its very existence and scarcity of land available for development". In their report, Bishay addressed the general economic, social, and environmental problems in Egypt and proposed general strategies for managing these problems[19]. Unfortunately, they did not mention the need for the economic valuation for the depletion and degradation costs of natural capital, when calculating the national and sectoral income from SNA, as a necessary condition for achieving the sustainability of the Egyptian economy; and also, they did not define explicit indicator(s) for measuring sustainable development in Egypt.

As can be seen from the above analysis, although there are many partial interpretations of sustainability, whether social, economic, or ecological, the more comprehensive concept of ecologically sustainable economic development requires three broad, sometimes conflicting, policy goals to be satisfied, namely: economic efficiency; environmental integrity; and intergenerational equity. From our point of view, there are some urgent issues that need to be taken into consideration when trying to define and to measure the sustainability of the Egyptian economy, namely:

- Accounting for the depletion of non-renewable resources, mainly for oil and gas;
- Accounting for agricultural land losses in quality and quantity (i.e. land degradation), since water and land are the major constraints for sustainable agriculture;
- Estimating the cost of water pollution problems resulting from the industrial sector, municipal waste water and chemical fertilisers and pesticides;
- Estimating the cost of air pollution problems;
- Estimating ground water and fish depletion;
- Applying carrying capacity concepts, especially in the regions of high population density;

[19] However, the management of natural resources in Egypt is constrained by the poor and the lack of information on environmental deterioration. In addition, policy-makers do not have reliable quantitative data on the status of natural resources, economic values of resources, and the environmental costs of environmental depletion and degradation. Interestingly, the same conclusion has also been reached by Clark et al., 1997 and Clark 1998 in the cases of Kenya and Ethiopia. Apparently, this is a common case in most, if not all, of the developing world (see Clark et al., 1997; Clark, 1998).

- Alleviating poverty, because there is a strong link between poverty, development, and environmental degradation;
- Development of tourism as an important sector for driving the economy;
- Avoiding illiteracy problems, especially among women; and
- Stabilisation of population growth.

5. CONCLUDING REMARKS

Examining the main changes which have taken place in the macro and sectoral performance of the Egyptian economy during the last three decades, the study has revealed that: (1) the economy has experienced a transition from a system characterised by public ownership of the means of production and rigid regulations on foreign trade before 1973, to a more liberalised system and the re-emergence of an active private sector after 1973; (2) there are two main factors which have led to the main economic developments which have occurred in the Egyptian economy in particular after 1973. These two factors are the opening policy and the oil revolution resulting in the increases in oil prices; (3) examining the role of the economic sectors in the growth of the Egyptian economy the study shows that: (a) the petroleum sector contribution to the Egyptian economy measured by some indicators related to the level of foreign exchange earnings, balance of payments, financing public expenditures, revealed the importance of this sector in the Egyptian economy; (b) the manufacturing sector contribution to the total value added has increased from about 13% in the 1970s to about 18% in the 1980s; (c) finally, the agriculture sector contribution has fallen dramatically from more than 30% in the 1960s to about 20% in the 1990s.

On the other hand, examining the state of the environmental and natural resource base as well as the linkages between the population, economy, and environment in Egypt for the same period, the study revealed that the most urgent and important issues to be addressed for achieving sustainable development in Egypt are: (1) the depletion of oil and gas and agriculture land losses due to urban and industrial expansion; (2) the degradation of air, water and land (i.e., water and air pollution, and soil erosion pollution, which constitute the most serious environmental problems in Egypt). One may finally conclude that Egypt's debts are not only financial, but also demographic (a high population growth rate of 2.6%), social (insufficient investment in human capital) and finally environmental (depletion and degradation of natural resources base). Without drastic improvements, Egypt's development efforts will become increasingly unsustainable. An urgent change to an integrated and sustainable approach is vital for economic decision-making, planning, and policy analysis.

However, for the purpose of this study only the environmental dimension, the depletion and degradation costs of the environmental and natural capital, will be valued. These costs will be used to modify the current Egyptian SNA framework with the purpose of producing environmental macro and sectoral indicators second. These indicators, finally, will be used to test the sustainability of the Egyptian economy and to re-evaluate the performance and productivity of the economic sectors. To do so, an environmental accounting model that should reflect the country characteristics, has to be developed. This is the task of the next two chapters (Chapters Three and Four).

Table 2.1: Land use by sector and location in 1990 (million feddan)

Region/ Use:	*Nile valley*	*Nile delta*	*New valley*	*NW coastal plains*	*Sinai*	*Total*
Non agricultural land						
-desert						228.0
-inland waters						0.6
-urban and industrial areas						1.1
and public utilities						
Agricultural land						
-rain fed				0.3	0.1	0.4
-irrigated (old lands)	1.9	3.8		-	-	5.7
-reclaimed (< 1980):				-		
cropped	0.1	0.5	.	-		0.6
uncropped	0.1	0.1	0.1			0.3
-reclaimed (1980-1987):						
cropped		0.3		-		0.3
uncropped		0.2		-	-	0.2
-under reclamation	0.1	0.6		-	-	0.7
(1987-1992)						
-to be reclaimed later	0.1	0.7	0.2		0.3	1.3

Note:
One hectare (ha) = 2.383 feddans
Source: The Ministries of Public Works, and Water Resources, and Agriculture, and Land Reclamation

Table 2.2: GDP, NDP, unemployment rate, population, and GDP Per/Capita, 1960-1992

Year	*GDP (billions £E 1990)*	*NDP (billions £E 1990*	*Unemployment rate (%)*	*Population (in millions)*	*GDP 1990/Capita (£E)*
1960	19.06	n.a	2.9	25.92	799
1965	20.88	n.a	2.8	29.39	764
1970	22.54	21.38	2.4	33.33	676
1971	23.49	22.14	1.8	34.08	689
1972	24.10	22.51	1.5	34.84	691
1973	25.33	23.39	1.6	35.62	711
1974	26.30	24.33	2.3	36.42	722
1975	28.96	26.70	2.5	37.23	778
1976	33.44	31.43	2.7	37.87	883
1977	37.80	35.51	3.1	38.79	974
1978	40.71	37.99	3.6	39.82	1022
1979	43.92	40.30	4.6	40.98	1071
1980	48.67	43.95	5.2	41.67	1168
1981	56.33	50.51	5.4	42.84	1315
1982	62.04	56.70	5.7	44.02	1409
1983	62.67	57.46	6.6	45.23	1385
1984	67.01	61.54	6.0	46.47	1442
1985	65.89	58.20	6.9	47.81	1378
1986	65.20	57.93	8.6	49.05	1329
1987	72.48	63.76	9.6	50.27	1441
1988	73.14	62.61	9.1	51.48	1420
1989	76.89	65.80	10.9	52.69	1459
1990	84.00	70.87	11.1	53.92	1558
1991	87.21	72.99	11.3	55.47	1572
1992	87.62	74.38	10.2	56.94	1538
1970-81	8.77	8.24	3.12	2.31	6.32
1981-92	4.19	3.71	8.69	2.62	1.53
1970-94	6.48	5.97	5.90	2.46	3.93

n.a = not available because of non available data for fixed capital depreciation.

Table 2.3: Domestic investment as % of GDP, 1970-1992 (£E million 1990)

Year	GDP (billions)	Increase in Stocks	GFCF	GDI	GDI as a% of GDP	NDI as a % of GDP
1960	19.06	0.0	3461.5	3461.5	16.71%	-
1965	20.88	0.0	3547.1	3547.1	15.80%	-
1970	22.54	74	3074.6	3148.6	13.96%	8.80%
1971	23.49	62	3323.2	3385.2	14.41%	8.63%
1972	24.10	40	3529.3	3569.2	14.81%	8.18%
1973	25.33	38	3289.6	3327.6	13.14%	5.47%
1974	26.30	80	4303.8	4383.8	16.66%	9.15%
1975	28.96	100	7272.4	7372.4	25.45%	17.60%
1976	33.44	195	7659.4	7854.4	23.49%	17.46%
1977	37.80	561	10250.6	10811.6	28.60%	22.52%
1978	40.71	416	12277.3	12693.3	31.18%	24.49%
1979	43.92	593	14273.3	14866.3	33.84%	25.60%
1980	48.67	266	12503.9	12769.9	26.24%	16.53%
1981	56.33	100	16518.1	16618.1	33.11%	19.17%
1982	62.04	100	17334.9	17434.9	30.95%	19.49%
1983	62.67	200	13745.0	13945.0	22.48%	13.92%
1984	67.01	200	16888.6	17088.6	27.27%	17.33%
1985	65.89	200	14552.3	14752.3	22.01%	10.71%
1986	65.20	200	10886.8	11086.8	16.82%	5.85%
1987	72.48	100	12946.7	13046.7	20.01%	5.97%
1988	73.14	150	16820.4	16970.4	23.41%	8.79%
1989	76.89	240	15993.7	16233.7	22.19%	6.69%
1990	84.00	240	16839.8	17079.8	22.21%	4.40%
1991	87.21	410	19340.0	19750.0	22.65%	6.34%
1992	87.62	309	17034.0	17343.0	19.79%	4.68%

Note:

1. GFCF = Gross Fixed Capital Formation; GDI = GCF + Stocks Change

2. Source:

* *CAPMS (1970-1992) " Egyptian National Accounts", Various Issues.*
* *Ministry of Planning "Annuals and Five Year Plans", Cairo, Egypt.*
* *Central Bank of Egypt and Egyptian general Petroleum Corporation*

Table 2.4: Exports of petroleum, exports of Cotton, and Suez Canal Dues, 1970—1992 (£E million 1990)

Year	*GDP (billions £E 1990)*	*Petroleum Exports*		*Cotton Exports*		*Suez Canal Dues*	
		£E	% of GDP	£E	% of GDP	£E	% of GDP
1960	19.06	-	-	-	-	-	-
1965	20.88	-	-	-	-		-
1970	22.54	119.5	0.53%	1122.9	4.98%	-	-
1971	23.49	23.5	0.10%	1306.3	5.56%	-	-
1972	24.10	168.7	0.70%	1169.0	4.85%	-	-
1973	25.33	382.5	1.51%	1294.4	5.11%	-	-
1974	26.30	315.7	1.20%	1752.2	6.66%	-	-
1975	28.96	307.1	1.06%	1190.6	4.11%	197.0	0.68%
1976	33.44	795.9	2.38%	826.0	2.47%	648.8	1.94%
1977	37.80	741.1	1.96%	839.4	2.22%	771.3	2.04%
1978	40.71	785.7	1.93%	545.5	1.34%	834.6	2.05%
1979	43.92	1862.4	4.24%	931.2	2.12%	1436.3	3.27%
1980	48.67	4307.7	8.85%	934.6	1.92%	1460.3	3.00%
1981	56.33	4255.8	8.48%	938.5	1.87%	1821.8	3.63%
1982	62.04	3898.2	6.92%	771.8	1.37%	1774.5	3.15%
1983	62.67	3493.2	5.63%	769.4	1.24%	1693.9	2.73%
1984	67.01	2839.2	4.53%	764.6	1.22%	1497.9	2.39%
1985	65.89	3638.9	5.43%	616.5	0.92%	1347.0	2.01%
1986	65.20	1904.5	2.89%	566.7	0.86%	1403.6	2.13%
1987	72.48	1551.9	2.38%	391.2	0.60%	1219.3	1.87%
1988	73.14	1696.1	2.34%	420.4	0.58%	1203.2	1.66%
1989	76.89	2893.1	3.96%	673.0	0.92%	1704.4	2.33%
1990	84.00	2813.1	3.66%	562.2	0.73%	2492.0	3.24%
1991	87.21	4906.5	5.63%	361.9	0.41%	3177.6	3.64%
1992	87.62	3408.6	3.89%	355.2	0.41%	5707.9	6.51%

Note:

1. *Trade conversion factors are national currency units per one US$.*
2. Source: Ministry of Planning and Central Bank of Egypt.

Table 2.5: Balance of payments current accounts, 1972-1994

Year	*Balance of Current Account (millions in Current U$)*	*Trade Conversion Factor(North Africa Report 1996)*	*Balance of Current Account (current millions of £E)*	*Balance of Current Account (millions of £E 1990)*
1972	-174	0.40	-69	-490.9
1973	20	0.40	-217	-1446.9
1974	-335	0.48	-161	-977.6
1975	-1440	0.46	-656	-3647.0
1976	-658	0.50	-331	-1647.0
1977	-1074	0.57	-612	-2774.4
1978	-1070	0.66	-705	-2933.4
1979	-1843	0.70	-1290	-4460.3
1980	-436	0.72	-313	-926.2
1981	-2135	0.74	-1579	-9625.8
1982	-2006	0.81	-1628	-10060.7
1983	-921	0.86	-791	-6006.8
1984	-1819	0.93	-1692	-6206.2
1985	-2112	0.96	-2017	-4615.7
1986	-2148	1.07	-2296	-70.8
1987	-880	1.27	-1120	-783.4
1988	-539	1.76	-949	-5206.5
1989	-2359	1.94	-4568	-3207.4
1990	-2637	2.23	-5877	-801.3
1991	1903	3.01	5726	4675.1
1992	2812	3.32	9345	6389.8

Source: Central Agency of Public Mobilisation and Statistics (CAPMS), international foreign trade issues.

Table 2.6: Egyptian external debt, 1972-1993

Year	GDP(billions of current £E)	Trade Conversion factor	External Debt(millions in current US$)	External Debt (£Emillion)	External Debt (millions of £E 1990)	External Debt as a % of GDP
1972	24.103	0.40	2277	903.51	6424.0	3.85%
1973	25.330	0.40	2563	1014.43	6751.4	4.21%
1974	26.309	0.48	2815	1354.86	8215.0	5.35%
1975	28.968	0.46	5477	2498.60	13871.1	9.50%
1976	33.441	0.50	7094	3571.82	17756.1	12.33%
1977	37.809	0.57	12760	7274.47	32962.7	21.75%
1978	40.711	0.66	14155	9336.63	38805.9	24.69%
1979	43.925	0.70	16637	11645.91	40263.4	28.61%
1980	48.675	0.72	20915	15058.83	44431.5	34.28%
1981	56.332	0.74	23917	17698.58	51710.1	36.36%
1982	62.046	0.81	29525	23974.30	64617.9	42.56%
1983	62.674	0.86	32636	28034.32	69968.7	45.18%
1984	67.014	0.93	35689	33197.91	74536.9	52.97%
1985	65.898	0.96	42136	40244.09	82890.2	60.05%
1986	65.203	1.07	45469	48606.36	88743.7	73.76%
1987	72.481	1.27	50469	64247.04	101935.7	98.53%
1988	73.148	1.76	50193	88389.87	121209.8	121.95%
1989	76.894	1.94	49818	96487.52	113367.0	131.91%
1990	84.009	2.23	40572	90434.99	90435.0	117.61%
1991	87.214	3.01	35339	106335.10	86817.0	126.57%
1992	87.623	3.32	34640	115119.11	78714.0	132.00%

Source: World Bank (1996) "World Debt Tables: External Finance for Developing Countries, Volume 2 Country Tables"

Table 2.7: Distribution of GDP by sector (Percentage share at current factor cost).

Year	*GDP*	*Agriculture*	*Mining*	*MVA*	*Utilities*	*Combined Industry*	*Other*
1975	100	29.0	2.9	17.4	1.7	22.1	48.9
1976	100	28.3	4.0	16.1	1.6	21.7	50.0
1977	100	27.1	6.2	14.9	1.4	22.5	50.5
1978	100	25.3	6.9	14.6	1.3	22.9	51.8
1979	100	20.9	15.8	13.6	1.1	30.5	48.6
1980	100	18.3	17.0	14.3	0.8	32.1	49.7
1981	100	20.1	18.8	13.0	0.9	32.7	47.2
1982	100	19.6	15.4	13.3	0.6	29.3	51.1
1983	100	19.6	16.1	13.2	0.7	30.0	50.4
1984	100	20.1	14.5	13.2	0.8	28.5	51.5
1985	100	20.0	13.8	13.5	0.8	28.2	51.8
1986	100	20.8	12.6	13.3	1.1	26.9	52.3
1987	100	17.7	9.2	16.8	1.4	27.3	55.0
1988	100	17.2	8.1	18.2	1.5	27.8	55.0
1989	100	16.9	7.4	18.8	1.5	27.8	55.4
1990	100	16.4	7.2	18.0	1.6	26.8	56.8
1991	100	16.0	6.1	16.9	1.7	24.6	59.4
1992	100	16.5	6.1	17.1	1.9	25.0	58.6

Source: UNIDO, Ministry of Planning, and National Bank of Egypt.

Table 2.8: Oil exports and public sector expenditures (£E million 1990).

Year	*GDP (billions of £E 1990)*	*Public Expenditure*	*Public Expenditure as a % of GDP*	*Petroleum Exports*	*Petroleum Exports as a % of GDP*	*Petroleum exports as a % of public sector's expenditure*
1972	24.10	6481.9	25.07%	168.7	0.70%	2.98%
1973	25.33	7118.6	26.37%	382.5	1.51%	6.17%
1974	26.30	5408.6	26.89%	315.7	1.20%	4.87%
1975	28.96	6995.4	28.10%	307.1	1.06%	4.31%
1976	33.44	7894.6	20.56%	795.9	2.38%	14.72%
1977	37.80	6993.1	24.15%	741.1	1.96%	10.59%
1978	40.71	7613.2	23.61%	785.7	1.93%	9.95%
1979	43.92	7168.5	18.50%	1862.4	4.24%	26.63%
1980	48.67	9046.3	18.70%	4307.7	8.85%	56.58%
1981	56.33	7549.9	16.32%	4255.8	8.48%	59.37%
1982	62.04	8875.7	18.59%	3898.2	6.92%	43.09%
1983	62.67	9244.2	15.04%	3493.2	5.63%	46.27%
1984	67.01	9349.7	15.76%	2839.2	4.53%	31.99%
1985	65.89	11149.8	14.90%	3638.9	5.43%	39.36%
1986	65.20	10441.0	14.92%	1904.5	2.89%	20.37%
1987	72.48	10074.3	16.64%	1551.9	2.38%	13.92%
1988	73.14	10845.5	15.84%	1696.1	2.34%	16.24%
1989	76.89	10112.1	15.45%	2893.1	3.96%	28.72%
1990	84.00	11265.8	14.96%	2813.1	3.66%	25.94%

Source:

- *CAPMS (1970-1992) " Egyptian National Accounts", Various Issues.*
- *Ministry of Planning "Annuals and Five Year Plans", Cairo, Egypt.*
- *Central Bank of Egypt and Egyptian general Petroleum Corporation*

Table 2.9: Fertiliser and pesticide use in various developed and developing countries, 1990.

	Cropland		*Fertiliser use*		*Pesticide use (active ingredient)*	
Country	*(000 ha)*	*ha per capita 1990*	*75-77 (kg/ha/y)*	*85-87 (kg/ha/y)*	*75-77 (kg/ha/y)*	*82-84 (kg/ha/y)*
Algeria	7540	0.31	19	37	2.2	2.8
Egypt	2560	0.05	188	347	10.5	7.6
Iraq	5450	0.30	8	36	n.a.	n.a.
Morocco	8462	0.35	23	36	0.3	0.4
Sudan	12478	0.51	6	4	n.a.	n.a.
France	19459	0.35	266	301	4.3	5.1
Germany	7476	0.12	436	425	3.2	4.0
Netherlands	924	0.06	751	748	7.1	10.5
United Kingdom	6988	0.12	275	364	3.6	4,9
United states	189915	0.77	102	93	2.4	2.0

Source: FAO, 1993 (Food and Agriculture Organisation); and Arab Organization for Agriculture Development (1994)

Table 2.10:: Summary of air pollution concentrations (1987-1990), in $\mu g/m^3$

Type	*Level*	*Cairo Centre*	*Residential areas*	*Industrial areas*	*Standards[20] International*	*Standards Egypt*
TSP	AVG	700	590-600	600-840	50-70	
	Max	(?)	900	1200-1800	120-150	60
Smoke	AVG	140	70-130	60-150	50	-
	MAX	250	140	760	-	150
SO2	AVG	260	100	105-155	50-80	-
	MAX	(?)	(?)	2430	125-150	200
NO2	AVG	200	100	90-140	95	-
	MAX	-	160	200	150	200
Ozone						
MAX (1h)		275	410	196-350	150-235	
CO MAX (1h)						
Street Level			42-57		30-40	
Lead AVG			2.8-12.5		1.5	
(3h)						
AVG (3mdr)			0.6-3.0		0.5-0.1	

Note:

TSP = Total Suspended Particulate; AVG = Annual Average Value; MAX = 24 hour maximum value; (1h) = average time 1 hour ; (3h) = average time 3 hours; (3mdr) = average time 3 month.;
Source: EEAA, 1992a.

[20] The international standards given for comparison are the US National Primary Standards, WHO Guidelines, and ECE European Standards.

Table 2.11: Ranking of air pollution sources according to their emissions

Source	*TSP*	*SO_2*	*NO_2*	*CO*	*HC*	*Hazardous/Heavy Metals*	
Power Plants	Sig	Dom	Sig	N	N	N	N
Industry fuel consumption	Sig	Dom	Sig	N	N	N	N
Industry, processes	Dom	N	N	N	Sig	Dom	Dom
Commercial & housing	Sig	N	N	N	N	N	N
Transport sector	Dom	N	Sig	Dom	Dom	Sig	Dom
Open burning	Sig	N	N	N	Sig	N	N

Dom = dominant; Sig = significant; and N = negligible source.

Table 2.12: Industrial water use in 1990 (Mm^3/yr.)

Area	*Nile*	*Canals*	*Groundwater*	*Total*
Upper Egypt	184	6	22	212
Cairo	84	41	37	162
The Delta	105	15	27	147
Alexandria	36	52	22	110
Other Gov.	4	4	0	8
Total	413	118	108	639

Table 2.13: Industrial water use and waste water discharge in 1990 (Mm^3/yr.)

Industry	*Number of Plants*	*Water Use*	*Waster Discharge*	*(Approximate) % Consumption*
Chemical	53	127	98	23%
Food	119	296	277	6%
Textile	75	114	88	23%
Engineering	39	13	12	8%
Mining	11	69	60	13%
Metal	33	19	14	26%
Total	330	638	549	100%

Table 2.14: Industrial wastewater discharge 1989 (Mm^3/yr.)

Area	*Nile*	*Canals*	*Sewage Canal*	*Lakes (ground) (Approximate)*	*Total (Approx.)*	*Number of plants*
Upper Egypt	192	5	2	5	204	35
Cairo	80	21	20	7	128	126
The Delta	27	85	13	1	126	60
Alexandria	13	7	33	35	88	85
Other Gov.	0	0	3	1	4	24
Total	312	118	71	49	550	330

Table 2.15: Industrial wastewater discharge (Mm^3/d) and pollution Loads (ton/d)

Area	*Flow*	*BOD*	*COD*	*Oil*	*SS*	*TDS*	*HM*
Upper Egypt	204	72	37	5	68	532	0.20
Cairo	128	71	120	93	97	135	0.75
The Delta	125	34	42	24	86	224	0.50
Alexandria	88	91	186	45	40	246	0.17
Other Gov.	5	2	3	1	5	15	0.03
Total	550	270	388	168	296	1152	1.65
Chemical	98	26	178	23	33	241	0.94
Food	277	182	142	110	168	666	0.17
Textile	88	39	47	24	64	191	0.30
Engineering	12	5	7	2	3	13	0.03
Mining	60	15	14	8	24	29	0.20
Metal	14	3	0	1	4	11	0.01
Total	549	270	388	168	296	1151	1.65

BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand; SS: Suspended Solids; TDS: Total Dissolved Solids; HM: Hard Matter

PART B

DEVELOPING AN ENVIRONMENTAL ACCOUNTING MODEL FOR A DEVELOPING COUNTRY, EGYPT

CHAPTER THREE

ACCOUNTING FOR NATURAL RESOURCES AND ENVIRONMENT

"This difference in the treatment of natural resources and other tangible assets [in existing national accounts] reinforces the false dichotomy between the ***economy*** *and the* ***environment*** *that leads policy-makers to ignore the latter in the name of economic development" (Repetto et al., 1989).*

1. INTRODUCTION

Increasing concern about environmental degradation, resource depletion and the sustainability of economic activity have made the development of natural resource and environmental accounting an area of significant activity. Approaches to environmental and natural resource accounting have been tested in some developed and developing countries. Types of natural resources and measures of the environment in these studies vary from country to country, reflecting the particular concerns of each country. Even in two countries utilising the same approach, details of methods are still slightly different from one to another. It is worth reviewing the reasons why and how these developing countries have utilized natural resource and environmental accounting systems and some of their common obstacles.

The main goal of this chapter is to investigate an appropriate approach that could be used in modifying the Egyptian System of National Accounts, through examining a series of natural resource and environmental accounting country case studies, and to explore some of the actual and potential policy implications for natural resource and environmental accounting. The rest of this chapter, therefore, is divided into four sections. The first section describes and assesses the range of natural resources and environmental accounting approaches that have been conducted so far in both developed and developing countries. The case studies reveal a variety of motivations which underlie attempts by governmental departments or national statistical offices or individual researchers to incorporate environmental concerns into national accounting practice. The second section reviews and examines the variety of approaches that have been used in applying environmental accounting in both developed and developing countries, in order to propose the most appropriate approach for Egypt and developing countries. The third section examines the potential policy uses of natural resources and environmental accounting, in particular, greener national accounting aggregates such as 'genuine savings' and 'Eco-Domestic' Product. The fourth and final section presents the conclusions.

2. INTERNATIONAL EXPERIENCE IN ENVIRONMENTAL ACCOUNTING

For the purpose of the present study, we can divide the efforts of establishing the natural resource and environmental accounting into three groups, namely: those of some developed countries (members of OECD); of some developing countries; and finally, of the international organisations (UN, WB, OECD, IMF). These efforts are briefly outlined as follows.

2.1 Experience in Developed Countries

A growing number of countries have begun to explore environmental accounting. Probably in the lead is Norway, whose government has developed what are perhaps the most extensive and most commonly cited examples of resource accounts to date. The Norwegian accounts are constructed in terms of physical units. These "physical accounts" are advocated as indisputable measures of environmental change that can be used to influence public opinion and policies. They are simpler to construct and less controversial than accounts of value, but they can not be used to clarify economic trade-offs. The purpose of Norway's natural resource accounts was not to create a more accurate measure of true income, but to make information available for the optimal management of resources. They include material, biotic, and environmental resources that are considered economically or politically important such as petroleum, minerals, forest products, fisheries, and hydropower. Environmental accounts are also compiled to record land use statistics and the discharge of specific pollutants (Peskin, 1993).

Similar efforts are being undertaken in France (Lutz, 1993). In 1978 the French designed an ambitious system, 'the patrimony accounts', to assess the state of the nation's heritage. This system attempts to describe all interactions between man and the environment (economic, ecological, and social) and extends beyond the physical environment to include objects of cultural or historical heritage as well. The French accounts comprise seven levels of aggregation, ranging from actual field data to global indices of welfare. However, while the design of the system has been studied extensively, actual implementation of the accounts has proceeded slowly. A consistent valuation method, for example, has not been clearly established. Opinion remains divided among market value, opportunity or replacement costs, and discounted future revenues as bases for valuation of the physical units. Hence at this stage, only resource level data, similar to that found in the Norwegian accounts, have been compiled.

In the United States the most noteworthy developments may be those which have taken place in the political area since actual accounting has been limited to recording data on pollution control expenditures. In 1989, however, Public Law 101-45 was passed requiring the Department of Commerce to calculate and publish a measure of "gross sustainable productivity". The Commerce Department is the agency responsible for publishing NA in the United States. In addition, the law requires the United States representatives to the United Nations, the Organisation for Economic Co-operation and Development (OECD) and the multilateral banks, to encourage modifications of the current system of income accounting (Lutz and Peskin 1993). Bureau of Economic Analysis (BEA) of the United States Department of Commerce attempted to green the United States accounts for the first quarter of 1994 to reflect the depletion of natural resources, it fully integrated the upward reassessment of hydrocarbon stocks into the flow accounts - just as the study of Indonesia (Repetto et al., 1989), which will be explained in great detail in the next section (Landefeld and Carson, 1994b).

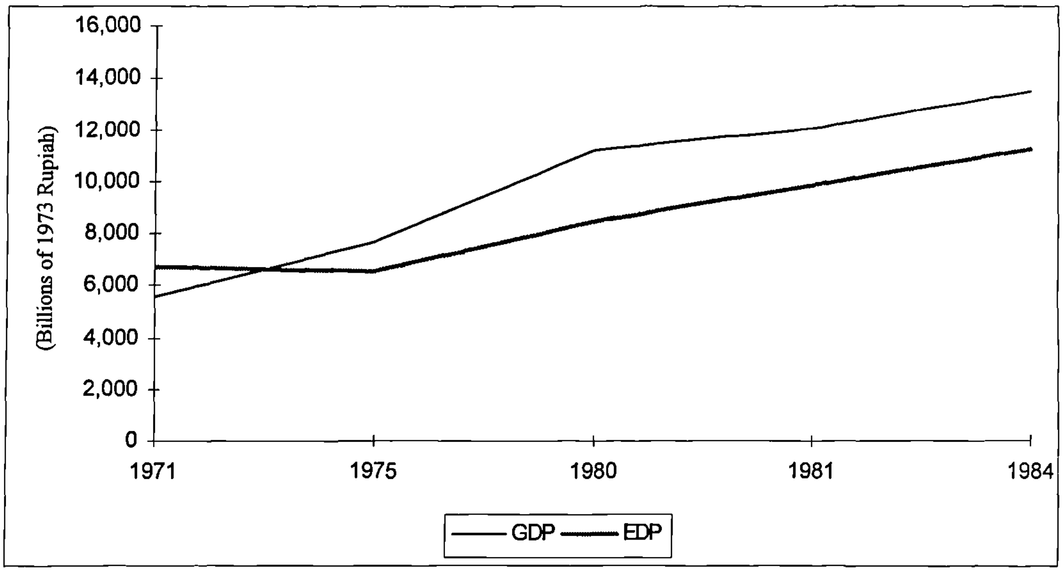
Finally, the UK is now working on establishing its integrated System of Environmental and Economic Accounts (SEEA) in line with the Revised System of National Accounts, which was published by the UN in 1993[1]. The UK government Strategy for Sustainable Development (as noted in Lynch and Brown, 1994; Vaze and Stephen, 1996) states that resource and environmental accounts will be important in monitoring sustainable growth. Such green accounts could provide one of a number of indicators of the benefits and damage to the environment associated with economic change. While environmental accounts could provide objective, comprehensive and systematic information which is necessary if consideration of the environment is to become a central element in decision-making in government and industry, there are however no plans to aim for a single environmental indicator or index.

2.2 Experience in Developing Countries

Within the last few years, governments in developing countries, in recognising their natural resource dependence, have also realised the need for an adequate accounting framework. In particular policy-makers recognise the need for a planning tool that more effectively integrates economic and ecological considerations. The World Resource Institute (WRI) has taken the lead here, collaborating with government institutions and statistical agencies on pilot studies in Indonesia and Costa Rica. For the former Repetto et al (1989) carried out a study to calculate the contribution of the environment in the current income of Indonesia using the depreciation approach, which will be explained in Chapter Four and applied for Egypt in Chapter Five, in order to calculate the depletion of petroleum, forest and soil.

[1] SEEA framework is explained and discussed in great details in Appendix 3.1

Figure 3.1: Indonesian GDP, EDP, 1971-84 (Billions of 1973 Rupiah)



The most important result of Repetto's finding was that, over the period 1971 to 1984, the estimated average annual growth rate of environmentally adjusted GDP was 4% and not 7.1% as calculated conventionally. This means that the contribution of the environment was about 3% (nearly half of the average growth rate). This shows that the liquidation of natural assets was included in the traditional GDP estimates, hence providing a false picture for the sustainability of the growth and development of the economy. It should also be noted from Table 3.1 and Figure 3.1 that in 1971 EDP exceeded GDP. This is explained by the fact that in this year the net changes in the stock of natural assets were positive (new discoveries were higher than extraction for petroleum resource). Therefore the country's policies for issues such as consumption and investment should have been based on using EDP and not GDP.

Table 3.1: Comparison of Indonesian GDP and EDP, 1971- 84.

Year	GDP	Petroleum	Forestry	Soil	Net change	EDP
1971	5,545	1,527	-312	-89	1,126	6,671
1975	7,681	-787	-249	-85	-1,121	6,560
1980	11,169	-1,663	-965	-65	-2,693	8,476
1981	12,055	-1,552	-595	-68	-2,215	9,840
1984	13,520	-1,765	-493	-76	-2,334	11,186
Average annual growth	7.1%					4.0%

A similar study, following roughly the same methodology, was performed for Costa Rica (Solorzano et al., 1991), to estimate the depreciation of forest (deforestation), soil (soil erosion), and fisheries (over-fishing). The results of this study are in line with the Indonesian findings, though not so dramatically. Natural capital loss averaged roughly five percent of GDP annually. For the period 1970 to 1989, natural resource depletion adjustments lowered the growth rate of the net domestic product from an average of 4.9 to 4.7 percent (Table 3.2 and Figure 3.2). In addition, over the study period (1970-1989), natural resource depreciation, which is the difference between Net Capital Formation (NCF) and Adjusted Net capital Formation (ANCF) (Table 2.2) grew at an average rate of 6.4% per annum. It was initially smaller in value than the estimated capital consumption allowance of produced capital (buildings and equipment,...etc.), but by 1989 natural resource depreciation had become three times as large. It grew from 5-6% of GDP in the early years to about 8-9% in the late 1980s.

Figure 3.2: Costa Rica's GDP, NDP, and EDP, 1970-89 (millions of 1984 Colones)

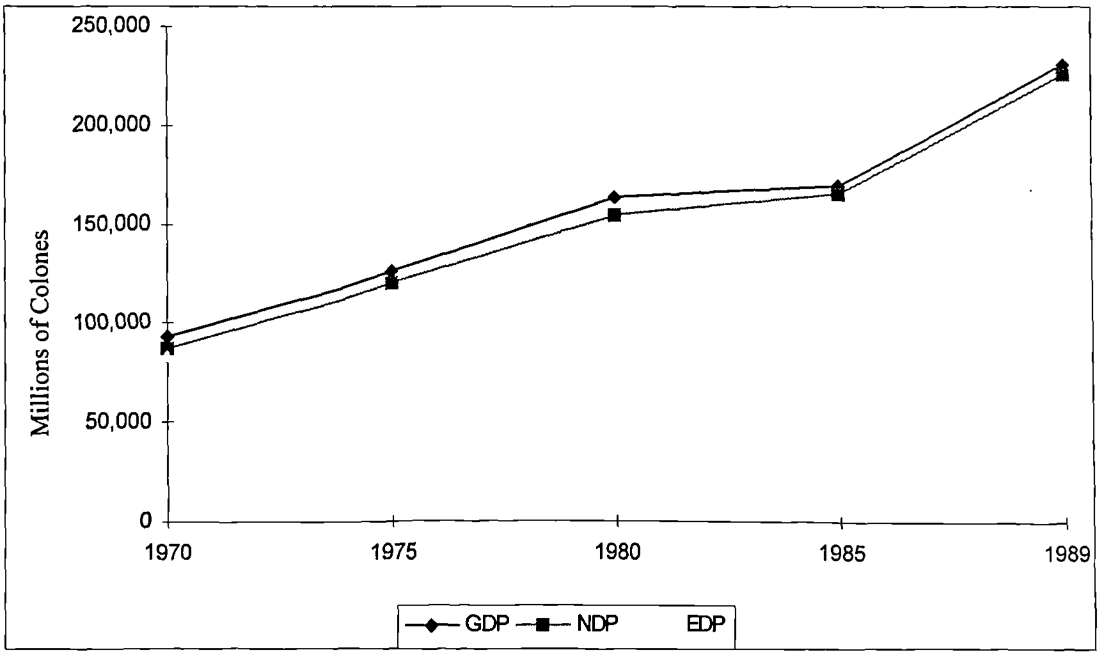


Table 3.2: Gross, net domestic product and environmentally-adjusted net domestic product (EDP) Costa Rica, 1970 - 89

Year	*GDP*	*NDP*	*NCF*	*DEP*	*EDP*	*ANCF*
1970	93,446	87,495	13,240	4,982	82,513	8,258
1975	125,393	118,738	20,481	7,583	111,155	12,898
1980	161,894	153,365	34,846	8,233	145,132	26,613
1985	169,299	164,605	39,136	11,231	153,374	27,905
1989	231,289	225,966	n.a	20,604	205,362	n.a

In terms of GDP growth, Thailand has often been described as an economic success story. These impressive growth rates have been achieved through a run-down of natural assets, although whether or not this is sustainable is open to question. Sadoff (1992) attempts to show how an adjusted national accounting framework can be used to analyze this proposition and the effects of Thailand's logging ban of 1989 in response to major flooding in 1988. Making the appropriate adjustments for the user cost and net price approaches, which will be explained in Chapter Four, Sadoff found that the resulting average adjusted aggregates are 1.5% and 2.2% of GDP respectively over the period 1970 to 1990.[2]

Van Tongeren et al (1993) and Bartelmus et al (1993) in collaboration with governments officials of Mexico and Papua New Guinea have applied the SEEA method proposed by the UN in SNA93. The main objective of these two case studies was to test the model and to explain how a different perspective can be given to policy-makers after incorporating the use of natural resources and environmental assets. This correction is useful for resource-dependent countries or those that have environmental problems (e.g., soil erosion, water and air pollution). In the case of Mexico, a relatively advanced developing country with severe environmental problems, the environmentally adjusted net domestic product (EDP) for 1985 was estimated as 87 % of NDP and net capital accumulation decreased from 11% of NDP to –15% of EDP (Table 3.3). However, in the case of Papua New Guinea, a country at a relatively low stage of development with a large extractive industry sector, the EDP was 90-98 % of NDP for the period 1986-90 (Van Tongeren et al.,1993; Bartelmus et al., 1993).

Table 3.3: Net domestic product and environmentally-adjusted net domestic product, Mexico 1985.

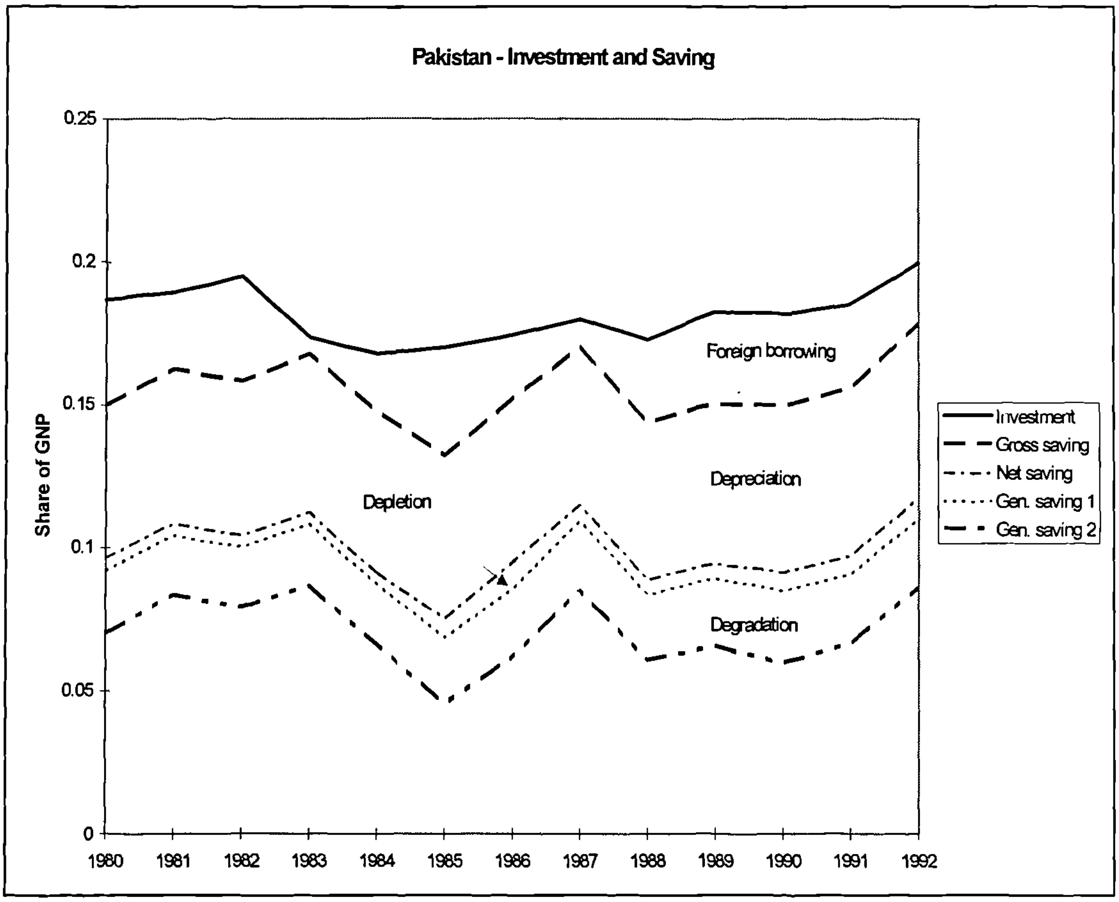
		In million pesos			*Index*
Net Domestic Product (NDP)			42060		100
Mines Resource Depletion					
	Oil	1470			3.5
	Timber	164			0.4
	Land use change	764			1.8
			2398		
Equals EDP1				39662	94.3
Mines Resource Degradation					
	Soil erosion	449			1.1
	Solid wastes	197			0.5
	Ground water use	191			0.5
	Water pollution	662			1.6
	Air pollution	1656			3.9
			3155		
Equals EDP2				36507	86.7

[2] Deductions are made from GDP. No account is taken of the depreciation of man-made capital.

Seroa Da Motta and Fernandes Mendes (1993) have carried out a study for individual natural resources: minerals, forests, urban water and air pollution for Brazil (Seroa Da Motta and Fernandes Mendes, 1993 quoted in Hamilton and Lutz, 1996; Georgiou et al., 1997). The theoretical foundation is the accounting system proposed by Peskin (1989), which was intended to derive environmentally adjusted aggregate product measures. It was assumed that the rents from mineral and forest resource depletion are already included in the profits or royalties received from these activities. The air and water pollution costs were calculated in terms of the environmental loss of services provided by air and water. These losses were calculated using estimates of lost production due to premature death, loss of days of work, and medical expenditures, caused by water-borne and respiratory diseases for the period 1970-1989. No attempt was made to estimate the loss in human well-being caused by air and water pollution in terms of discomfort or pain suffered by city residents. As a consequence of being a pilot project which did not cover all issues relevant to an environmental accounting exercise, the results were not aggregated into one measure of Brazilian "green" GDP. Instead, the results of each case resource were compared to the corresponding national figure: gross mineral production for mineral depletion, gross agricultural production for forest depletion, and value added of industrial sector for air and water pollution.

Brandon (1996) has estimated the cost of environmental degradation (soil erosion, and air and water pollution) for Pakistan, by following almost the same methodology that has been used in case of Brazil. However, Hamilton and Lutz (1996) have used Brandon's estimates in order to calculate the rate of genuine saving for Pakistan for a thirteen year period (1980-1992) (see Figure 3.3). The underlying accounting is straightforward: gross saving equals gross investment less foreign borrowing, while net saving subtracts the value of depreciation of produced assets; the two genuine savings measures deduct the depletion of natural resources and the value of degradation of the environment (in this case soil erosion and health damage attributable to pollution) in succession. From the policy-maker's perspective, the interesting question concerns what policies affect the levels of the individual curves. The gross saving curve anchors all others, in the sense that the macroeconomic policies that affect savings effort will shift all the other curves upward or downward. The level of foreign borrowing then determines gross investment. Depreciation of assets is largely a physical phenomenon, representing the value of ordinary wear and tear on the stock of produced capital, and so is not altered by policy. Policies concerning natural resource exploitation and environmental management then affect the size of the remaining deductions.

Figure 3.3: Pakistan-investment and saving as a % of GNP (1980-1992)



Source: Adopted from Hamilton and Lutz, 1996

2.3 International Organizations

International organisations have to varying degrees attempted to provide leadership and guidance to countries on their resource and environmental accounting efforts. The United Nations has a direct interest in the topic because the SNA is based on UN standards and guidelines. The World Bank has funded research jointly with the UN

Statistical Office, on the application of new satellite accounting techniques (these studies, for Mexico and Papua New Guinea, are reviewed in the section on empirical experience above). The OECD group on the state of the environment has had natural resource accounting as part of its work programme at least since 1986. And the United Nations Environment Program (UNEP) started in 1993 a research programme in this domain. What follows is a brief description of these efforts by international organizations.

The United Nations, in conjunction with Eurostat, the IMF, OECD and the World Bank, is in the midst of the revision of the System of National Accounts, the first major one since 1968. Although the work to date has included major clarifications of concepts and classifications that impinge particularly on the treatment of commercial natural resources in the accounts, there is no intention to bring the environment and natural resources directly into the accounts, leading to the alteration of national accounts aggregates –in particular, only produced assets are explicitly accounted for in the measurement of net income and product. As noted earlier, the provisional draft of Chapter XXI of the revised SNA (SNA, 1993) includes a succinct description of the guidelines on a satellite System of Environmental and Economic Accounts (SEEA) (United Nations, 1990). However, this draft chapter states explicitly that the description "... is included to guide countries in responding effectively to the current emphases in policy making and analysis on environmentally sound and sustainable economic growth and development and to help national accountants in elaborating environmental satellite studies which take the national accounts as a point of departure". The SEEA is not formally a part of the SNA, but rather a point of departure". The SEEA is not formally a part of the SNA, but rather an example satellite account under the heading "Satellite Analysis and Accounts".

Appendix 3.1 (Table 3.5) gives an outline of the structure of the SEEA, along with some basic definitions of terms. The salient characteristics of the system are: (i) economic assets are split between produced and non-produced (natural) assets; (ii) the environment appears explicitly as a source of non-produced (but non-economic) natural assets; (iii) specific account is taken of the use of non-produced assets in arriving at a revised net product measure (see below); and (iv) the transfer of natural assets from environmental (non-economic) to economic non-produced assets is explicitly accounted for. The new net product measure is termed "environmentally adjusted net domestic product" (EDP) and is measured as follows:

EDP = consumption

+ gross capital formation (produced)

- consumption of fixed capital (produced)

- depletion of non-produced economic assets

- degradation of environmental assets

+ net exports.

An important point to note is that the SEEA does not provide definitive guidelines for valuation. For the depletion of commercial natural resources (i.e., economic non-produced assets) it suggests using either the El Serafy (1989) or Repetto et al (1989) approaches; for the value of degradation of the environment it suggests using either a cost-based method (the cost of returning the environment to its state at the beginning of the accounting period) or contingent valuation of changes in the environment. The inclusion of environment and resource accounting in Agenda 21 of the United Nations Conference on Environment and Development (as noted in the introduction to this study) has given new impetus to the development of the SEEA.

2.4 Summary

Table 3.4 is the summary of the current natural resource and environmental accounting experiences and approaches which have been seen so far. From the review of the contribution, we conclude that there is a real need for a great deal more empirical work, especially in developing countries, in the area of environmental and natural resource accounting. To construct a complete environmental accounting system requires data-intensive procedures, and is time-consuming. The country case studies reveal that a wide variety of approaches to natural resource and environmental accounting are currently being developed. This variety reflects different endowments, environmental concerns and, to some extent, systems of political economy in the countries studied.

Table 3.4: Environmental accounting approaches and case studies and their main concerns

Developed Countries	***Environmental concerns***	***Main emphasis***
Canada	Natural resources.	Physical accounting based on STRESS data base.
France	Environmental & natural resources.	Physical and monetary accounting "patrimony accounts; physical geographical, agents accounts".
Netherlands	Environmental losses & damage.	Physical accounting.
Norway	Natural resources.	Physical accounting.
USA	Pollution abatements expenditures.	Environmental accounting
UK	Environmental & natural resources.	Physical and monetary accounting
Developing Countries	***Environmental concerns***	***Main emphasis***
Indonesia	• Forests, petroleum, soils.	
Costa Rica	• Fisheries, forests, soil.	• Depreciation of natural resources, economic performance or adjusted GDP.
Brazil	• Minerals, forests, air and water.	• Economic performance or adjusted GDP by sectors
Pakistan	• Soil, air and water.	• Environmental degradation and Genuine Savings as sustainability indicator
Mexico	• Land, forests, petroleum, water, air.	• Depletion of natural resources environmental degradation based on new SNA, i.e., SEEA
Papua New Guinea	• Mine, fisheries, forests, energy.	• New economic performance.

Notes:

1. *STRESS[3] (Stress Response Environmental Statistical System).*
2. *SEEA (System of integrated Environmental and Economic Accounting).*

[3] STRESS are physical accounts designed to be used as data-bases for model-building and analysis, and not to be used for valuation purposes. But SEEA is a combination of physical and monetary accounts and therefore they allow for incorporating natural resources depletion and degradation into SNA framework in order to produce the environmentally adjusted indicators such as EDP.

It can also be concluded from the above analysis and discussion that, for resource base economies in general and those of developing countries in particular, the evaluation of economic performance and estimates of macroeconomic relationships may be seriously distorted by failure to account for natural resource depreciation. However, different countries have responded to perceived inadequacies in conventional accounting systems in different ways. In some cases this is because of differences in the scale of objectives (limited in the US but ambitious in France). Also important are differences in the cost and effort involved in gathering data and differences in the interests of individuals responsible for the development of different techniques.

Probably the chief factor, however, is the view taken about the two main functions of conventional national accounts--i.e. whether to assist in performance measurement or to provide a more general data system for the management of a modern economy. In the former case conventional accounts mis-state income, and perhaps growth, because of their neglect of environmental deterioration and the depletion of natural resources. In the latter case the function of national accounts is to provide a coherent database to support economic policy, research, and modelling. This function can not be adequately performed without information that will better reflect environmental economic interactions. The various approaches differ in the degree to which they emphasise each of these two broad functions. Thus, for example, the responsible government agencies in Norway and US have so far shown little interest in producing better GDP estimates. Instead they have concentrated on developing better databases for policy analysis and economic modelling. In contrast, in developing countries such as Indonesia and Costa Rica (Repetto, 1989 and Solorzano, 1991) they have concentrated on the correction of conventional income indicators to reflect the real growth rate of economic performance.

The approaches also differ significantly in their complexity and coverage. The US approach is narrowly focused on expenditure data, whereas the French approach covers a wide range of data reflecting environmental-economic interaction and resource depletion. On the other hand, the Indonesian and Costa Rican approaches fall between the two extremes. The differences in complexity and coverage reflect not only the particular degree of emphasis on the two major functions of national accounts but also different policy objectives. The Norwegian system is well suited to support the Norwegian desire to manage their resources of petroleum, timber, hydrocarbon, and fish. The US approach, with its emphasis on expenditure data, supports the analysis of the macroeconomic effects of environmental policy. The Repetto approach in Indonesia addresses sustainability issues in developing countries, which is mostly needed in developing countries.

The Statistical Office of the United Nations, which sets guidelines for the standard system of National Accounts, has produced satellite accounts that can be presented with the conventional accounts, showing economic performance relative to a variety of environmental indicators. The United Nations has attached these modifications to the Input-Output (I/O) tables framework. I/O tables show the flows from sectors into other sectors (rows) and the inputs into sectors from the other sectors in the economy (columns). I/O tables tend to be about five years or more out-of-date, because the availability of data on inter-sectoral flows tends to lag behind the availability of national aggregate data, such that are found in conventional National Accounts, by several years. It is conceptually easy but empirically difficult to link environmental/resource flows to the economic flows. The fact that the United Nations is looking to input/output analysis as the key framework to address the environmental dimensions means that realistically this method will probably not be ready for application in developing countries for several years.

Finally, however, although these approaches may have different structures in accordance with their different concerns and policy objectives, their data requirements are often quite similar. Thus the Norwegian and the Repetto frameworks appear to differ substantially on the surface. Yet similar data could be used for them. This means that efforts at implementation in developing countries could begin before a final decision is taken as to which approach will better suit country needs. And since the conditions for success in resource and environmental accounting are likely to be country-specific, there is little point in waiting for broader experience in developed countries before a developing country decides to embark on its own studies. Given the relative severity of resource and environmental problems in the developing countries and therefore the relative seriousness of the deficiencies in the ability of standard economic accounts to reflect these problems, a productive strategy for developing nations might be to initiate their own, low cost, pilot studies.

3. ALTERNATIVE APPROACHES IN ENVIRONMENTAL ACCOUNTING

Including the environment in national income accounting of developing countries requires some questions to be answered, such as: Should they start with the aggregated or disaggregated approach? Should they prepare their accounts using the physical or monetary measures? Should they aim at full accounting for the depletion and degradation of environmental and natural resources, or start now with their available data-base? Finally, should they focus on integrating the environmental costs with SNA aggregates or should it be attached as a supplement to the systems in satellite accounts? These questions need to be explored and discussed in order to decide the most appropriate approach before launching any environmental accounting exercise in the developing world.

This section examines all the approaches that have been designed or used to improve the effectiveness of conventional national income accounting by including environmental impacts and natural resource depletion and degradation. These approaches could be categorised in four main groups of alternative approaches. These are: (1) the aggregated and disaggregated approach; (2) the physical and monetary approach; (3) the full and partial approach; and finally, the satellite and the integrated approach. These approaches, as seen from Section 2, have been practised in some countries.

3.1 The Aggregated and Disaggregated Approach

The first problem in launching any environmental accounting exercise is to determine the desirable degree of aggregation in wealth and sustainable income measurements, especially when these concepts must account for the separate dimensions of reproducible and environmental capital. Aggregation, which sacrifices information by reducing the dimensions of measurement, is appropriate when the use of the aggregates rather than more detailed information would make little difference to the analysis (Richter, 1994). The benefit of more detailed information is then not worth the cost of interpreting it. Money is the tool for aggregation, and for monetary aggregation to be appropriate, prices of final goods and services yielding income flows must truly reflect the values of those goods and services. Meaningful prices require perfect knowledge by consumers or the researcher in the case of consumer ignorance. Monetary measurement may be a problem especially in the case of environmental services and damage. The practical problems of valuing non-marketable natural resources are significant, and these problems are accentuated by the possibility of large losses due to incomplete valuation or lack of recognition of critical natural resources. These problems have encouraged some analysts, in the developed world, to recommend disaggregated accounting frameworks which do not monetize the value of all non-marketable environmental capital.

However, one may say that, if there is a possibility of large loss due to incorrectly estimating monetary environmental values, then a more disaggregated approach may be necessary. The appropriate degree of monetary aggregation is dependent on the feasibility of operationalizing concepts such as Environmentally-adjusted net Domestic Product (EDP) and Environmentally-adjusted net Domestic Investment (EDI) that have been calculated in the case studies of Indonesia, Costa Rica, Mexico and Papua New Guinea. In addition, the aggregated approach, even with less accurate results, is much more appropriate for developing countries for a variety of reasons: (1) its results could be simply attached to gross aggregates which should be the main interest of developing countries; (2) the data reliability and availability at sector and resource levels are much weaker than at macro level; (3) the results of the aggregated level could be improved in future, which has been seen from the Indonesian and

Costa Rican experiences; (4) and finally, applying the aggregated approach means less cost compared to the dissaggregated approach, which is an encouraging point for developing countries to launch their own studies.

3.2 The Physical and Monetary Approach

Two main approaches in environmental accounting which are complementary and overlap each other are: (i) physical terms approach[4]; (ii) monetary terms approach[5]. Environmental accounting in physical terms focuses on physical assets balance (i.e., opening, closing stocks and changes therein) of materials, energy and natural resources. Where applicable (for selected pollutants), it may also include changes in environmental quality of natural assets in terms of environmental (quality) indices. There are several examples, developed by individual countries such as Norway, USA, and France.

In many instances, physical indicators of environmental change have been invaluable, leading especially to a cleaner environment. But resort to physical indicators will not be sufficient for addressing natural resource deterioration and its implication for economic policies especially for the less developed countries. Physical indicators for deforestation, loss of fish stock, declining mineral deposits, soil erosion and the like are certainly necessary for drawing attention to environmental decline, and can serve as a basis for monetary valuation of environmental losses, but clearly their economic

[4] Physical measurements may take three forms: (1) measuring of the state of the natural environment, air, water and soil, by monitoring of the changes occurring in that state. Such measures have been made for a long time, especially in monitoring quality of air, as a normal function of public health administration; (2) measuring of the quantities of discharge of substances regarded as pollutants; (3) measuring the consequences of pollution for human health, for animal or bird life, and for plant contamination.

[5] Efforts to collect or impute data, in money terms, also fall into four broad classes: (1) statistics of actual expenditures on the control of pollution. The data usually exist, but they are not necessary identified separately in the records of enterprises and public authorities (cost of preventing damage); (2) estimates of the hypothetical costs of achieving given levels of purity in air, water, and soil (cost of avoiding damage); (3) estimates of various kinds of damage caused by or resulting as consequences of pollution (cost of reducing damage); (4) estimates by using the individuals willingness to pay (WTP) to prevent the loss or to improve the environment, or their willingness to accept (WTA) compensation for the environmental loss.

role would be vastly enhanced if incorporated in an adjusted set macroeconomic measurements (El Serafy, 1997).

Monetary environmental accounting is generally more limited in coverage of environmental concerns than physical resource accounting. Experience with monetary environmental accounting is much more recent, and much controversy still surrounds this approach, particularly with regard to valuation. Due to these valuation problems, many analysts believe that SNA aggregates should be simply linked with supplementary information provided in the form of a series of physical, chemical, and biological indicators on the state of the environment. This technique, which abandons conventional aggregated monetary income measures in favor of a multidimensional income measure to assess sustainability, runs the risk of being ignored by policy-makers when making economic decisions that seriously affect the environment. Although it may not be possible to implement an accounting framework as comprehensively as necessary to include all environmental services and damage in monetary terms, it does seem vital to develop meaningful monetary links between environmental phenomena and conventional economic income measures such as GDP and NDP.

Therefore, monetary estimates of environmental damage are an important and useful tool in the development and implementation of environmental accounting and policy analysis. They should not be regarded as an exclusive or perfect tool but, in the absence of a perfect tool, they are a useful way of organising and summarising information on environmental effects in a way which can facilitate more rational decisions. Moreover, even when monetary estimates of environmental damage are not precise, they may remain useful and their use should be encouraged. At present, no estimate of environmental damage is perfect. Most often, estimates of damage are available for only one or two poorly defined levels of environmental quality. This imperfect situation is often due to the fact that the knowledge and measure of physical damage associated with the change in environmental quality is unknown or highly speculative. In addition, there may be some difficulties in attaching monetary values or price tags to physical damage. At most, the monetary damage estimate can help provide a rational basis for a policy choice, even if the monetary estimate is far from perfect ones. As will be indicated, imperfect estimates, particularly underestimates, can in some circumstances be as valuable as perfect ones. On the other hand, at worst, attempts to estimate monetary damage may force some additional degree of rationality on to the decision making process and may yield some additional information which will aid this process.

Monetary environmental accounting in this sense includes the sort of environmental adjustments that have been developed and carried out in several projects in resource-oriented developing countries such as Indonesia, Costa Rica and Mexico, among others. In these case studies, GDP has been adjusted for selected environmental costs, including the cost of oil depletion, deforestation, depletion of fish stock, soil erosion and the cost of air and water pollution. While these studies are based on detailed analyses in physical terms, distinguishing between a variety of species of timber, fish and different types of soil, based on geographical location and agricultural use, the ultimate focus; however, was on the adjustment of GDP and NDP.

3.3 The Full and Partial Approach

Although, as has been stressed earlier, conventional accounting systems have been criticized for their severe shortcomings from the environmental perspective, many new interesting approaches have been proposed. Conceptually, there are two main streams to these proposals. One prefers to have the whole system of national accounts revised. The other prefers to leave the standard system as it is, but incorporate specific areas of social concerns, especially the value of resource development and impacts on environmental quality, by creating new structures within the overall accounting system. These structures can then be used for many sectors until the conventional accounts are eventually capable of use as if the whole system was completely revised.

For the time being, the likelihood of changing the whole system of national accounting seems remote as the national accounts are so prominent in terms of economic planning. A completely new system would need to be accepted and understood by a wide audience before it could have an effect on policy. Therefore, a better strategy is to adjust the accounts in one way or another, in order to reflect links to the natural environment. The partial approach requires to taking advantage of the Satellite Accounts so that partial adjustments to income can be made. It requires gradual adjustments for the depletion and degradation of natural assets one at a time. The United Nations Handbook on Integrating Environmental and Economic Accounts (1993) recommends that the integration should proceed step by step. The first step is to analyse and to reformat the existing system of national accounts and to accommodate environmentally relevant information that is already included in conventional national accounts. It also recommends some priorities for the implementation of SEEA for developing and developed countries (see Table 3.6 in Appendix 3.2).

Partial adjustment in national income accounts should be able to deal, at least, with the depletion of natural resources and some of the environmental impacts which will be outlined in the next chapter, especially the aspects that reflect concerns with sustainability. In other words, the revision of the whole accounting system is unforeseeable in the near future, so that adjustments need to be made to focus attention on a particular sector, resource, or a policy purpose. In the current thesis, agriculture (land losses and soil erosion), mining (oil and gas depletion) and industry (air and water pollution) have been selected as they provide particular insight into sustainability and other policy issues for Egypt, and the refinement of the accounting methods for these activities will provide a useful guide to apply the appropriate approach and valuation techniques to other resources and sectors.

3.4 The Satellite and Integrated Approach

There have been numerous efforts to design an appropriate mechanism to measure and value the resources counted into a nation's production. For example, the United Nations statistical office in collaboration with some international organizations such as WB and FAO, have recently proposed a major revision in the way that economic activity is recorded -its integrated system for environmental and economic account (SEEA) - in the integrated Environmental and Economic Accounting handbook. This handbook presents a framework, a satellite account outside the core of the economic accounting system, to measure the stock and chart the flows of a nation's resources. In contrast, some economists, such as Robert Repetto of World Resources Institute, argue for recording resource use in the core of national accounts. However, the debate continues as to the most appropriate methodology to value resources and the mechanism to incorporate that valuation into the core of accounts.

Satellite accounts provide countries with supplementary accounts and indicators for natural resources and the environment. However, some believe that the revised SNA leaves too many issues unresolved. For instance, the problem of the coverage remains: which environmental degradation and natural capital depletion should be incorporated? Failing to expand the production boundary of the SNA, the revised SNA continues to exclude phenomena that exist principally within the environment, such as the loss of biological diversity or damage to the ozone layer. Another important criticism of the satellite accounts is their emphasis upon a physical, rather than monetary, approach to natural resources. Robert Repetto notes that a physical accounting approach by itself has considerable shortcomings. First, it does not lend itself to useful aggregation. Aggregating timber from various species of trees in physical units (cubic meters) obscures wide differences in stumpage value. Likewise, aggregating mineral reserves in physical units (tons) obscures vast differences in mineral deposits due to grade and recovery costs. Moreover, maintaining disaggregated physical accounts results in a mountain of statistics that are not easily summarised or used. Finally, summaries expressed in physical units do not enable policymakers to understand the impact of economic policies on natural resources and the environment-presumably, the main point of the exercise (Repetto et al., 1989).

Seeking to address the inadequacies of the SNA, two approaches to constructing integrated accounts have been proposed. Natural resource accounting corrects national accounts for the depletion and degradation of natural capital through expansion of the asset boundary. Environmental accounting, on the other hand, has a broader focus and includes more complex issues through expansion of the production boundary. Supporters of environmental accounting suggest deducting a monetary value from GDP[6] to account for environmental degradation. The value of environmental degradation is defined as the cost of returning the environment to its original state at the beginning of the accounting period. However, the empirical means of accounting for the loss of non-market environmental services is usually conducted by applying the indirect valuation techniques that normally capture only the direct loss of resources services; thus the environmental accounting exercise is more difficult and time-consuming.

Proponents of natural resource and environmental accounting, for developing countries, are in agreement that countries should focus upon those resources and environmental problems that are most important for the economy, acknowledging that the sum-total of the adjustment is only partial. El Serafy suggests, "Let us adjust income gradually for degradation of petroleum, forestry, fisheries, water and air quality, soil erosions, one at a time and as our methodologies firm up and the physical basis of our calculations improves, leaving economic valuation of thorny areas such as biodiversity to the last" (El Serafy, 1993b). As seen in Section 2, investigations of this type have been carried out in Indonesia and Costa Rica, Papua New Guinea and Mexico, Pakistan, and Brazil either by international organisations or by independent researchers. For the purposes of this thesis, integrated accounts for Egypt will be limited to: (1) the depletion of non-renewable natural resources (oil and gas); (2) the depletion and degradation of renewable resources (agriculture land losses, soil erosion, and water and air pollution).

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[6] The foregoing argument for including the resources and the environment in the national accounts faces some difficulty. Should the adjustment in the change affect both GDP and NDP, or merely change NDP? Current answers are political rather than economic. Some economists argue that because the media and politicians focus on one number, GDP, any framework for incorporating the environment must affect the gross figure to reflect environmental damage. Others, citing that welfare and sustainable income are better measured by net income, argue for an adjustment in NDP.

From the above analysis and discussion one may conclude for developing countries that, first, the aggregated approach is far more appropriate than the disaggregated one for various reasons: (1) it is not difficult to apply; (2) it does not require detailed data and much expense. Second, monetary estimates and integrated approaches are also more important than the physical and satellite approaches because: (1) money estimates are the tool for aggregation and focusing the policymakers' attention on the seriousness of the environmental issues and problems, especially if we know the priorities of the policymakers in the developing world are different form those in the developed world; (2) monetary estimates for the environmental costs will be attached to economic aggregates, which are the main base of countries' planning and policy analysis. Finally, the partial approach is much more appropriate for developing countries than the full approach because: (1) their data bases are limited; (2) the valuation techniques are new and sometimes controversial; (3) and finally, the partial approach means to start as soon as possible with the most critical environmental issues and problems. The following analysis of Egypt's System of National Accounts in this study is very much in this spirit. It focuses on aggiegate rather than disaggregate data, monetary rather than physical measurements, integrated accounts rather than satellite accounts, and only considers: (1) the depletion of oil and, gas, and agriculture land; (2) the degradation of soil, air, and water.

4. POLICY IMPLICATIONS OF ENVIRONMENTAL ACCOUNTING[7]

The new emphasis that governments have placed on sustainable development is a main source of criticism of the traditional national accounts. Measures such as Net Domestic Product NDP, while better than GDP for measuring sustainability, account only for the depreciation of produced assets, ignoring the value of the depletion and

[7] Because of the strong potential for resource and environmental accounting to influence policies, in developing countries, the World Bank has become an active participant. Efforts are underway to carry out country-level case studies and to introduce more widely green accounting aggregates into the work of the Bank. In 1995 and 1997 the Bank published *Monitoring Environmental Progress*, which presented crude preliminary estimates of the rates of genuine savings (as a result of cross-country estimations for resource depletion and environmental degradation).

degradation of natural resources and environmental assets. They can not serve, therefore, as guides for policies aimed at achieving sustainable development. Greener aggregates, it is hoped, can. There is strong potential for resource and environmental accounting to influence policies in developing countries. Genuine saving, that accounts for natural resource depletion and degradation, could be used as an indicator for sustainability. The main goal of this section is to show some of the actual and potential policy uses for greener national accounts aggregates, such as Eco-Domestic Product and Genuine Saving.

4.1 The Policy Implications of Environmental Accounting at the Macro Level

Because SNA fails to consider natural capital depletion or environmental degradation, NDP - and to a greater extent, GDP -does not represent Hicksian income. The two measurements of economic performance are distorted because undesirable outputs are overlooked and natural resource inputs are implicitly valued at zero (Lutz, 1993). Because linkages between the economy and the environment are not considered, the national accounts may provide potentially misleading measures of economic progress: El Serafy writes "....where an economy derives significant parts of its prosperity from natural resource exploitation and where the resource depletion fails to be reflected properly in the national accounts, including the balance of payments, then (a) income will be overestimated; (b) savings and investment exaggerated; (c) the fiscal deficits (if natural resource exploitation is carried out in the public sector as it often is in developing countries) underestimated; (d) and if natural resources are exported, the current account in reality may be deficit, but papered over by unsustainable exports of assets" (El Serafy, 1993a and 1996).

Therefore, macroeconomic indicators derived from conventional SNA could portray significant economic progress while the nation's total resource base is in a process of steady decline. Consequently, policy prescriptions based on erroneous indicators may be quite inappropriate. In conclusion, measures of national income must be comprehensive if they are to serve as a useful guide to macroeconomic policy. They are inadequate if significant depletion of natural capital takes place without being reflected in national income estimates. Not all countries need adjustment of their national income estimates; however, where countries are highly dependent upon resource depletion, and where the stocks of such resources are small relative to extraction rate, the necessary adjustments may be considerable (El Serafy, 1995).

Incorporating natural capital depletion and degradation into national income accounts gives policymakers the ability to identify Hicksian income (sustainable income). In short, natural resource and environmental accounting permits the calculation of an environmentally adjusted net domestic product (EDP). Such an income serves as a better measure of prudent behavior than GDP or NDP. Economic growth based upon resource extraction and pollution is frequently unsustainable in the long run. Unless gross capital formation is larger than the sum of man-made capital and natural capital depletion and degradation, the economy's capital stock is in a continual state of decline. However, development strategies are based upon resource extraction and environmental pollution throughout the developing world. Through the calculation of EDP, countries may find themselves poorer than conventional SNA estimates indicate and economic growth rates may be significantly different. Indeed, economic growth rates could be negative where positive growth had been indicated by conventional measures. Other issues highlighted by integrated accounts include the following: (1) Is the saving/investment effort adequate? (2) Is the economy sufficiently diversified to avoid over-dependence upon dwindling natural capital? (3) Is the current account of the balance of payments in surplus or deficit?

Net savings measures the rate of change of wealth, and thus provides an indicator of the effect of economic policy on long-run development prospects. If the savings rate is positive after adjusting for natural capital depletion and degradation, then development is considered to be sustainable. If gross domestic investment is less than the combined value of fixed capital depreciation and natural capital depletion, then the country is drawing down its capital base to finance current consumption. Countries must devote a portion of current income to capital maintenance in order to sustain existing national income levels; likewise, countries must expand the capital stock through domestic savings or foreign borrowing if an increase in income is desired. The net addition to capital is their main avenue for generating a higher level of future income (El Serafy, 1993a). However, if revenues from natural capital depletion and degradation are consumed and if capital formation falls short of the combined value of fixed capital depreciation and natural capital depletion, the integrated accounts will indicate the level of disinvestment which has occurred (El Serafy, 1995).

Savings and investment play a central role in the economics of development, but the traditional measures in the national accounts ignore depletion and degradation of environmental assets. To correct this, genuine saving is defined as net saving less the value of resource depletion and the value of environmental degradation[8]. The policy implications of measuring genuine saving[9] are quite direct: sustained negative genuine savings must lead, eventually, to declining welfare. Moreover, the consideration of the determinants of genuine saving provides an essential linkage between the interests of ministries of natural resources, environment, finance, and planning.

Hamilton (1994) and Hamilton and Lutz (1996), for example, have criticized National Environmental Action Plans (NEAPs) for misleading policymakers because these policy frameworks read as if they were written by the resource and environmental ministries for the resource and environmental ministries, with no links to the interest of economic ministries such as finance and planning. Hamilton and

[8] See for example, Pearce and Atkinson (1993); Hamilton (1994); World Bank (1995 and 1997).

[9] Standard national accounting defines savings as a residual, production minus consumption, both public and private. The notion of genuine savings is given by the following basic accounting identities: $S_g = GNP - C - D_r - D_n = I - NFB - D_r - D_n$. Here D_r is the depreciation of fixed capital, D_n is depletion and degradation of natural capital, I is gross investment, NFB is net foreign borrowing. The right hand side of the equation can be interpreted as explaining how produced assets are financed: Investment is financed by the sum of net foreign borrowing, depreciation allowance (broadly defined), and genuine savings. Negative genuine savings is an indication that the net assets position of the country is deteriorating.

Lutz write "...these three players in government policy, the economic, the resource sector and the environmental ministries, all have a role in achieving sustainable development. Unfortunately, all three have generally had narrow views of their roles and full integration or even communication has often been lacking. Resource and environmental accounting can not solve institutional problems, but it can provide the informational basis for better integration of economic, natural resource and environmental policies. The valuation exercises that underlie monetized environmental accounts can provide high-level indicators of sustainable development".

Countries that are liquidating natural resources rapidly and consuming the proceeds will show up clearly in this analysis (the World Bank's Monitoring Environmental Progress, for instance, shows many countries with negative genuine saving rates). Secondly, a new view of the growth-environment trade-off emerges, because the damage from pollution emissions is deducted from genuine savings as in case study of Pakistan, mentioned earlier. Countries that choose to grow and worry about the environment later will therefore be highlighted by the savings analysis, because the effect of this policy will be to depress genuine savings – some of the accumulation of capital is offset by the cumulative effects of pollution. If these countries maintain persistently negative rates of genuine saving, the welfare of their populations will decline.

Finally, integrated accounts allow policymakers to discern whether the current account is being propped up by inflows of foreign exchange derived from the export of natural capital. Some researchers note that the value of natural capital exports should be placed in the capital account -reflecting the export of capital- while the current account is adjusted to reveal its true position. Such a procedure may show the current account to be in serious deficit with only the inflow of foreign exchange earned by unsustainable natural capital exports, such as oil, allowing it to appear in less deficit or surplus (El Serafy, 1993a; Hamilton, 1994; and Hamilton and Lutz, 1996).

Greener measures of national income, what the SEEA terms Eco-Domestic Product (EDP), will also have an influence on policy. However, Hamilton and Lutz (1996) have argued that the improved accounting for the environment and producing green measures such as EDP will have an indirect more than direct effect on policies. For example, environmental accounting, by working toward valuing depletion and degradation, can help prioritize the relative importance of environmental issues. In addition, environmental accounting efforts, as part of or in parallel with environmental action plans (which have tended to be more descriptive in nature), should be valuable in setting priorities. It should be mentioned in this context that there have been data-gathering efforts in the past, related to or unrelated to natural resources, where bodies of data were generated, but not profitably utilized in subsequent analyses. To avoid such situations, it is important to bring a cost-benefit perspective to data-gathering efforts, comparing the costs of obtaining additional data to the potential uses and benefits (Hamilton and Lutz, 1996).

In conclusion, better estimates should encourage policymakers and politicians to focus on EDP rather than GDP, and should heighten environmental awareness among staff in central banks, economic ministries, and elsewhere. Integrated environmental and economic accounting, by monetizing natural resource and environmental effects, extends the range of data available to macro economists and can alert them to the relative economic importance of key natural resource and environmental areas. Measuring EDP will create a 'more enabling environment' and may provide better environmental and macroeconomic policies.

4.2 The Policy Implications of Environmental Accounting on Sectoral Level

On the national and sectoral levels, economic devices, such as the quite popular incremental capital output ratio (essentially a capital/value added ratio) which indicates capital productivity can give misleading readings if the accounts are not suitably adjusted to separate capital liquidation from value added. At the project level also, not allowing for the depreciation or user cost of natural resources in cost-benefit calculations, the expected yield from projects exploiting natural resources is exaggerated, thus accelerating their depletion. Development may therefore be misdirected towards natural resource-dependent activities whose true rates of return are much lower than those indicated by mistaken accounting.

For sectoral accounts, 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. In addition, 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 in turn will be reflected in distorted national measures of productivity. Productivity comparisons between resource-rich and resource-poor countries therefore are affected by this gap. Moreover, incorporating the value for natural resource depletion and degradation in the sectoral accounts will show the relevant sectors accountable for their liquidation of an important component of national wealth, and this could used to re-evaluate the sectoral productivity and performance.

Finally, it can be concluded that, once national accounts have been adjusted to reflect environmental changes, the adjusted accounts can provide a formidable platform from which macroeconomic policies can be reassessed in the service of future development. Not only will they tell us whether an economy is progressing or merely liquidating its natural assets and living on unsustainable proceeds from the sale of natural assets, but they will offer an improved view of the true level of the economy's income. Correct income measurements are crucial for guiding the whole gamut of economic policies. It is not a coincidence that national income (GDP or GNP) is used as reference point to which are compared important economic aggregates such as the fiscal deficit, the balance of payments deficit on current account, savings and investment, the supply of money, national and foreign debt, etc. Reckoning national income incorrectly where significant adjustment needs to be made to reflect environmental deterioration, will misguide policies purporting to help economic management.

5. CONCLUSION

As can be seen from the above discussions and analysis there is a difference in the environmental issues confronted by developed and developing countries. Advanced countries have reached a level of industrial and agricultural growth where they have to worry about problems such as pollution risks and the conservation of the natural environment. Developing countries, however, are caught in a web of poverty, unemployment and low productivity. The principal problem for them is that of keeping the environmental and natural resource base intact. Important resources are arable land, forests, genetic diversity, life support systems and water quantity and quality. Primary sectors are generally the major sectors in these economies with a predominantly non-market nature of activity. In view of this, it is important for developing countries to develop their tools, approaches, and valuation methods that reflect both the country's social characteristics and its social objectives. Sustainable economic growth –one of the more important social objectives- must be *translated* into concepts that lend themselves to measurement and valuation if this objective is to be reflected in the expanded accounting system. Indeed, it may not be possible to develop valuation schemes that fully measure the degree of sustainability. Yet, it is important to point out that the accounting framework, even without complete or perfect monetary valuations, can provide a data system that can be of tremendous use to those responsible for making sustainable development policy.

For developing countries, the adjustments to standard national accounting aggregates that result from resource and environmental accounting can be sizable. This is obviously true for the most resource-dependent economies, but it is also likely to be of growing importance for those countries that are rapidly industrializing and urbanizing. For these countries, the growth in damage from pollution emissions, in terms of human health in particular, is of mounting concern[10]. However, as explored above, it is not a useful investment of scarce intellectual resources, in developing countries, to attempt the full integration of environmental impacts into the national accounting system. This view is supported by Markandya and Richardson (1992) and El Serafy (1991).

From examining the country's experiences of environmental accounting, one can conclude that environmental accounting will not be a uniform process across countries. Many developed countries have sophisticated models that permit the integration of resource and environmental information into macroeconomic analysis. For these countries the usefulness of adjusting national accounts aggregates may be limited, largely because policy simulations can be carried out directly. The physical natural resource and environmental accounts described above can support the implementation of these models. However, building complex policy models may be an expensive luxury in many developing countries. For these countries, rapid assessments of resource depletion and the value of environmental degradation, placed in the savings and wealth framework as well as SNA aggregates presented above, will guide policy-makers aiming for sustainable development.

Also, from examining the variety of approaches in previous efforts of environmental accounting, one may argue that environmental accounting exercises in developing countries must proceed in stages. It has to be aggregated, monetary, integrated, and gradual. It calls also for an interdisciplinary approach. Normally available data is inadequate and patchy, and sometimes is not uniform in high quality. Therefore, information has to be collated from various sources to progress the work. Once again, the following analysis of Egypt's National Accounts is very much in this spirit. It focuses on aggregate rather than disaggregate data, monetary rather than physical

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[10] Therefore, pollution costs should be counted in addition to the depletion costs. As evidence, Faber and Proops (1994) write that "many authors, especially economists, see pollution as the lesser of these two evils. This is because one may view pollution as an "externality" where its non-market nature leads to its over-production. If, somehow, one were to internalise this externality then pollution would cease to be a problem".

measurements, integrated rather than satellite accounts and only considers: (1) the depletion of oil, gas and agriculture land; (2) the degradation of air, water and soil.

The current System of National Accounts in Egypt, as discussed and explored in Chapter One, is an implementation of the UNSNA (1968), thus, it ignores the contribution of the natural resources and environment in the current estimates of income. As a result, there is no treatment of the depletion and degradation of natural assets in analogy to the depreciation treatment of man-made capital. Although several policies were formulated for the sustainable development of Egypt, none of these policies have addressed the need for an adequate and accurate National Accounting System. Egypt , as been explored in Chapter Two, is a country with limited reserves of depletable resources (i.e., oil and gas) and with serious environmental problems such as air and water pollution, and land degradation. If sustainable development in Egypt is to be achieved, the depreciation and the degradation costs of these resources should be incorporated into the System of National Accounting to arrive at sustainable income (long-term income), which will be useful for policy analysis and long-run planning. This is the task of the following Chapters.

CHAPTER FOUR

ENVIRONMENTAL ACCOUNTING: METHODOLOGY

There is a dangerous asymmetry today in the way we measure, and hence, the way we think about, the value of natural resources. Man-made assets – buildings and equipment, for example- are valued as productive capital and are written off against the value of production as they depreciate. This practice recognises that a consumption level maintained by drawing down the stock of capital exceeds the sustainable level of income. Natural resource assets are not so valued, and their loss entails no debit charge against current income that would account for the decrease in potential future production. A country could exhaust its mineral resources, cut down its forests, erode its soils, pollute its aquifers, and hunt its wildlife to extinction, but measured income would not be affected as these assets disappeared (Repetto et al., 1989).

1.INTRODUCTION

Accounting for natural resource use does not normally take place in the process of economic activities because the costs of environmental degradation and resource depletion are not borne by the economic actors who cause them. The effects of environmental resource depletion is normally outside the profit and loss account of a firm. The effects are not, however, outside these accounts of the society or the nation or mankind. A firm may not bear the burden of pollution, congestion and degradation, but other members of the society surely do. Natural resource accounting is worth doing if only to keep one reminded of the environmental consequences of economic activities. Such accounting can alter our perception of what kind of development is desirable and in turn the policy choices we make. A natural resource account should provide an inventory of major natural resources of the country. The inventories should indicate the quantities, qualities and values of the resources at the beginning and changes in them over the year. The important steps in this are definition of natural resources, their measurement and their valuation. To quantify the value of a natural resource, we need to define the principle of measurement and also characterize the process of measurement.

Preparation of national resource accounts and their regular publication can bring much needed accountability to public policy. It will tell how much is the real income of the nation, how much the nation borrows from nature, how much this generation borrows from the future as well how much some members of the society gain at the cost of others. What would be a broad outline of such an account? What kind of concepts do we need to value natural resources? How do we go about setting up such a system? If the natural resource accounts can be integrated with the standard national (economic) accounts, it will serve a number of useful purposes. First of all, valuation is a very economical way of presenting information contained in masses of physical data. Secondly, they would be understood and appreciated by the general public who will be asked to compare like for like. Thirdly, and most importantly, it will make it considerably easier to bring environmental considerations into decision-making.

The purpose of this chapter is to develop an environmental accounting model for a developing country, Egypt, which will be subsequently operationalized in order to calculate Egyptian sustainable income (long-term income). The structure of this chapter is as follows. Sections Two and Three discuss the main issues which should be considered when applying environmental accounting for a developing country. In the fourth and fifth sections of this chapter we discuss a range of valuation techniques, focusing on both the depletion and the degradation of natural resources, as well as on some of the criticism of environmental valuation as currently practiced in economics and discussing some issues arising therefrom. The sixth and final section presents a developed environmental accounting model for Egypt. This model is designed to deal with accounting for the depletion of non-renewable resources first; accounting for the depletion and degradation of renewable natural resources second; incorporating the depletion and degradation costs into the Egyptian SNA in order to establish the Egyptian environmental macro and sectoral accounts third; and finally analyzing both the environmental macro and sectoral accounts to draw some of the policy implications from environmental macro and sectoral accounts.

2. ECONOMIC VALUATION AND SUSTAINABLE DEVELOPMENT

The literature on Environmental Accounting tends to suggest that the clues to sustainability lie in the quantity and quality of a nation's capital stock. Part of the intuition here is that nations are like corporations[1]. No corporation would regard itself as sustainable if it used up its capital resources to fund its sales and profits expansion. As long as capital assets are at least intact, and preferably growing, any profit or income earned can be regarded as 'sustainable'. Similarly at a national level, sustainable growth and development cannot be achieved if capital assets are declining. Indeed, some economic growth models suggest strongly that if capital assets are kept intact, one concept of intergenerational equity– that of equalizing real consumption per capita over time – can be achieved providing population growth does not outstrip the rate of technological change (Solow, 1986). (This is a big caveat since it is likely to be met in rich countries but not in poor countries).

As argued in chapter Two defining and measuring natural capital should become part of the national accounting processes. The primary condition for sustainable development would then be that the aggregate stock of capital should not decline. Put another way, depreciation on the capital stock should not exceed the rate of new investment in capital assets. If securing sustainable development depends on monitoring and measuring aggregate capital stocks and not allowing them to decline, there need be no particular role for environmental protection in sustainable development. Environmental assets could decline in quantity as long as depreciation in these assets was offset by investment in other man-made assets or human capital. But even if this view of sustainability is accepted, valuation is still central to the process. For it is not possible to know whether sufficient offsetting investment has

[1] This study is focused mainly on adjusting the accounts on macro and sectoral levels; however, these accounts are based on data and information obtained from, among other sources, units level accounts. Therefore, accounting practices on the firm level will require some adjustments, in parallel with macro and sectoral levels, in order to support preparing successful environmental accounting (see for example, Gray, 1994; Schaltegger, 1996).

taken place unless there is some measure of the rate of depreciation on natural assets and their forgone economic rate of return. Of course one may still make a special case for the environment. The acceptability of 'running down' environmental assets provided other assets are built up will depend on relative valuations and judgments based on other measures of sustainability, as well as moral views about destroying the environment.

3. ECONOMIC VALUATION AND THE MODIFICATION OF NATIONAL ACCOUNTS

Macroeconomic management makes extensive use of the national economic accounts which record monetary flows and transactions within the economy. The primary purpose of the accounts is to record economic activity, rather than to attempt to measure aggregate well-being in the nation. Nonetheless, national accounts are widely used to indicate well-being and rates of change in national aggregates such as GDP are widely construed as measures of 'development'. Whether the accounts are designed to record economic activity or measure well-being, or both, they are deficient in respect of their treatment of the environment. Economic activity involves the use of materials and energy resources, which having been transformed into goods and services, sooner or later they become waste products. Any measure of economic activity which ignores these materials and energy flows will fail to record important activities which affect the sustainability of the economic activity. In the same way, any measure of well-being which ignores the resource and energy flows will fail to measure 'sustainable well-being'. For these reasons, there is now widespread consensus that national accounts need to be modified at least with respect to the way in which environmental 'stocks' and 'flows' are recorded. Materials and energy flows begin at the point of extraction, harvest or use of natural resources. They terminate at the point where goods and resources become waste products, that is emissions to air, discharges to water, or solid waste to land or sea. Logically, then, GDP needs to be modified to account for:

1. any depreciation of natural capital stocks, in the same way that net national income is gross domestic income less estimated depreciation on man-made

capital. This is a measure of the 'draw down' of natural capital; and

2. any losses accruing to human well-being from the extraction, processing and disposal of materials and energy to receiving environments.

Both adjustments involve economic valuation. The first adjustment involves a valuation of the natural capital stock; the second involves valuation of such things as health impairment, pollution damage to buildings, crops and trees, aesthetic and recreational losses and other forms of 'psychic' damage. National accountants have not agreed how best to make the appropriate adjustments. Depreciation of stocks of natural capital is relevant when one is interested in some measure of sustainable income, that is the income that a nation can receive without running down its capital base. In the conventional accounts this is partly accounted for by estimating net domestic product (NDP) which is defined as:

$$NDP = GDP - D_k \qquad (3.1)$$

Where:

D_k is the depreciation on man-made capital (machines, roads, buildings, and so on). The further adjustment that is required is:

$$NDP = GDP - D_k - D_n \qquad (3.2)$$

Where:

D_n is the depreciation of environmental assets.

There is a clear role for economic valuation for both the depletion and the degradation of natural capital in establishing modified national income accounts. This in turn will produce a modified economic gross aggregates that could considered as better measures of economic welfare than the conventional ones.

4. VALUATION OF THE DEPLETION OF NATURAL RESOURCES

There are two main approaches which address resource depletion directly in the national income accounts; they are the "Depreciation" (Landefeld and Hines, 1985; Repetto et al. 1989) and the "User-Cost" Approaches (El Serafy, 1989). Both attempt to redress the asymmetrical treatment of natural and man-made capital in the current calculation of national income, and incorporate the environmental depletion into economic indicators. However, the two approaches address this issue in quite dissimilar ways. While both attempt to develop a new definition of national income compatible with Hicksian definition, the Depreciation Approach focuses on net natural resource flows, whereas the User-Cost approach concentrates upon natural capital stock.

Man-made capital is depreciated in the national income accounts, and the maintenance, management, and operating costs of machinery and facilities are netted out of an activity's value-added as intermediate costs. In this way the loss of or damage to assets is charged against current income to account for the resulting decrease in potential future earnings. In the case of natural capital, asset stock accounts are not compiled and no depreciation is deducted to reflect capital consumption.

Both the depreciation and user-cost approaches claim that national income indicators, as they are currently constructed, are deceptively overstated and likely to inappropriately encourage increased consumption of resources and environmental services. Current accounting procedures ensure that the greater the exploitation of the environment, the more profitable an activity will appear, thus creating incentives to expand ecologically costly production. Unfortunately, what appears to be remarkable growth and profits may, in fact, be irreversible environmental dis-investment.

4.1 Depreciation Approach

Robert Repetto claims that the economic techniques used to value the decline of productivity of fixed capital may be applied in a straightforward manner to the depletion of renewable and non-renewable resources. However, because geological and ecological information on natural capital depletion comes in physical units, such data must be converted into monetary units prior to adjusting national income accounts. For mineral resources, information on stock changes due to discovery, extraction, extensions, and net revisions are required first. Then, income accounts are developed directly from the physical accounts by assigning an appropriate monetary value to stock changes.

The Depreciation Approach values each unit of natural capital at its net price, namely, its real value as an input in the production process minus the marginal cost incurred (including a normal profit) in extracting the resource. Under certain conditions (perfect competitions and optimizing behavior), this net price reflects the present value of future income generating capacity of the resource (Bartelmus et al., 1993). This method was developed by Landefeld and Hines (1985) and adjusted by Repetto and his colleagues for implementation in Indonesia in order to calculate the Indonesian GDP after subtracting soil erosion, oil and forest depletion. Also, it has been widely applied by Van Tongeren et al (1993) for Mexico, Bartelmus et al (1993) for Papua New Guinea, Landefeld and Carson (1994b) for the USA, Vaze (1996) for the UK, and Common and Sanyal (1998) for Australia. In Repetto's approach, the net profits from the natural resource are simply deducted from GDP. In this method:

$$GR = TR - COE \quad (4.1.1)$$

$$RR = GR - (rNS + Dep) \quad (4.1.2)$$

$$\delta = RR / QE \quad (4.1.3)$$

$$DEPL = \delta (QE) \quad (4.1.4)$$

$$VR = \delta (QRES) \quad (4.1.5)$$

Where:

GR = gross rent,

TR = total revenue,

COE[2] = average variable cost of extraction, including compensation of employees, materials consumed, etc.,

RR = resource rent,

r = interest rate, discount rate,

NS = net stock of capital employed in mineral extraction valued at current replacement cost,

[2] Theoretically COE is the marginal cost; however the average cost is usually used instead because of the difficulty in estimating the marginal cost.

Dep = depreciation of net stock,

δ = resource rent per unit (net profit),

QE = quantity of resource extracted during the year,

DEPL = value of the annual depletion,

VR = value of the resource stock,

QRES = stock of resources

In equation (4.1.4) natural resource depletion equals the resource rent per unit (δ) times the quantity of resource extracted during the year (QE). But Repetto modifies equation (4.1.4) by adding the discovery of new resources to income in the year of discovery; this method is known in the literature as NPII.

$$DEPL = \delta\,(QE - ND) \qquad (4.1.6)$$

Where:

ND = discoveries during the year

The depreciation method, as developed by Repetto in equation (4.1.6), has several drawbacks which should be noted. First, Repetto suggested that discoveries should be counted at the full rental rate even though economic production has not taken place. Accounting for the discovery of new reserves in this manner will open up the economic system to non economic process. This runs against the basic principles of the SNA, in which national income and output depend exclusively on production. Therefore, United Nations SNA 1993 adopted equation (4.1.4), which is known in the literature as NPI, and treated new discoveries as other volume changes in the balance sheet to overcome this problem, to avoid the volatility new discoveries may bring to income calculations. Second, the calculation of net rent, used in the valuation process, is likewise problematic; Hartwick points out: "the principle problem of implementing the accounting rule above is obtaining marginal extraction cost for minerals extracted. As long as marginal extraction costs are increasing, using average costs in place of marginal will overestimate true economic depreciation" (Hartwick, 1990). In short, using average cost instead of *marginal* costs may overestimate natural capital depreciation. Third and most important, the Depreciation Approach is criticised for stripping countries of a marketable resource endowment. Nations with considerable natural capital are better off than those which lack natural capital, and they may enjoy a higher standard of living than the latter by virtue of their resource endowment. For example, consider two nations identical in all aspects except for the fact that one has vast oil reserves while the other has none. Assuming the extreme case, where the first derives a hundred *percent of national income from* oil production while the second produces only agriculture goods, then the Depreciation method would indicate that the net income of the oil-producing nation is zero while that of the agriculture nation is positive (El Serafy, 1989).

4.2 User-Cost Approach

El Serafy criticized the previous approach as unrealistic and ad hoc. He emphasized that the depletion or destruction of natural resources may be counted as the liquidation of assets. El Serafy's method is a simple version of present value. He deals with the calculation of income from non-renewable resources such as oil and minerals. He argues that following the Hick's definition of income, a portion of mining receipts should be counted as value added. In order to identify that portion, he tried to divide the net revenue from mining into an income and capital component. The first should count in GDP and is not earned at the expense of resource depletion. It is value added or a Keyensian version of "user-cost"[3]. The second component is capital consumption, which is earned at the expense of using the value of mining.

The calculation of economic depreciation is made based on the equation (4.2.1) below, which equates the finite capitalized value R at discount rate r to the capitalized value at the same discount rate of the infinite series X.

$$R_t + a^2 R_{(t+2)} + ... + a^n R_{(n+t)} = X + aX + a^2 X + ... + a^n X + a^{(n+1)} X + ... \qquad (4.2.1)$$

By assuming that the yearly revenue is constant every year, he simplified the left hand side equation as[4]:

[3] Keynes defined the user-cost as "reduction in the value of the equipment due to using it as compared with not using it, after allowing for the maintenance and improvement cost" (Hartwick and Hageman, 1991).

[4] In the following formulation, it is assumed that the receipts R accrue at the beginning of each accounting period. If alternatively they accrue at the end of the accounting period, the fraction X/R in equation (3.2.4) would be $X/R = 1 - 1/(1+r)^n$.

$$R\left(\frac{(1+r)^{n+1}-1}{r(1+r)^n}\right) \qquad (4.2.2)$$

and the right hand side as:

$$X\frac{(1+r)}{r} \qquad (4.2.3)$$

Then the ratio of true income to receipts, is given as:

$$\frac{X}{R}=1-\frac{1}{(1+r)^{(n+1)}} \qquad (4.2.4)$$

or

$$R-X=R\left(\frac{1}{(1+r)^{n+1}}\right) \qquad (4.2.5)$$

From this equation be computed "user-cost" R-X. The value of user-cost is just that amount which must be invested in some alternative activity at a given discount rate that will generate a steady income flow equal to that earned from the mine. On the other hand, Table (4.1) below, which is drawn from El Serafy 1981, shows the ratio X/R (income portion) for a number of different discount rates and oil reserve life expectancies. For example, if net revenues of oil reserves increase by £100, and the country has a 20 year life expectancy of oil reserves and 5% discount rate, the sustainable income (X/R) from the reserve is £62. The capital consumption allowance (User-Cost portion) would be £38. This amount could be invested elsewhere at a return r to ensure generating the level of income after the resource is exhausted.

Table 4.1: Proportion of receipts from oil sales that should be considered income.

Life Expectancy (years)	*Real Interest Rate (% per annum)*			
	1	2	5	10
15	15	27	52	78
20	19	34	62	86
30	27	46	77	95
40	34	56	86	98
50	40	64	91	99

However, there is a need to choose a discount rate r. El Serafy proposes a 5 percent discount rate. Determining the discount rate has a very significant impact on the formula. On the other hand, technical change, inflation, population growth, and price changes cannot be easily reflected in the formula. The second problem is new discoveries cannot yield capital value appreciation. Discoveries can only affect El Serafy's depreciation method by changing the estimate of the remaining years in the life of the resource. Third, Peter Bartelmus of the United Nations Statistical Commissions states that: El Serafy is not specific about how the capital component should be invested and whether the capital must be reinvested in a perfect or near substitute form (Bartelmus, 1992). Lastly, he is not concerned with valuing total reserves, but the fraction of the resources being liquidated in the current accounting period, which is valued at current prices.

Repetto's Depreciation Approach focuses on those resources which obtain their economic value through marketed natural products such as timber and petroleum. Repetto excludes the non-marketed environmental services. On the other hand, the User-Cost Approach is principally a means to account for the depletion of exhaustible resources. However it addresses renewable natural resources. El Serafy writes: "the treatment of income from renewable natural resources such as forests, which have to be maintained through replanting, or fisheries, which have to be restocked, is more straightforward. Where such replanting or restocking is effected at technologically acceptable rates that would keep capital intact, these activities could be charged against the gross returns from the natural resource to obtain the net value added generated; this is similar to the capital consumption in national accounts" (El Serafy, 1989).

5. VALUATION OF THE DEGRADATION OF NATURAL RESOURCES

Together with the direct valuation techniques analyzed before, in estimating costs indirect monetary values need to be attached for non-priced services provided by natural resources and the environment. 'Environmental valuation' is a very active, rapidly expanding field. It is also somewhat controversial. Many non-economists regard putting prices on environmental services as totally misconceived, if not wicked. While most economists accept the desirability of environmental valuation, there is disagreement over the prospects for actually doing it in a satisfactory way.

The original, and still the principal, motivation for environmental valuation was to enable environmental impacts to be included in cost benefit analysis. Impacts can be favourable or unfavorable. Taking the latter first, suppose that there is proposed some development –a mine or a tourist resort- in a wilderness area. The argument for valuing the services provided by the wilderness area, which would be reduced, and perhaps totally lost, if the development goes ahead, is that only then can they be compared with the standard costs and benefits of the project so that a proper decision on it can be made. Therefore, it is necessary to have a monetary measure of the variation of pollution reduction benefits with the level of reduction. Environmental valuation for cost benefit analysis has a history of some 30 years. In the last few years there have emerged two further sources of demand for environmental valuations. The first in the USA, since the late 1980s, economists' valuations of environmental damage are now admissible evidence in fixing the compensation to be paid by those the courts hold responsible for the damage. Second, is the perceived need to take account of environmental damage in measuring economic performance (Perman et al, 1999).

Environmental degradation/damage imposes costs to nations. Some of these costs produce impacts on GDP: GDP is lowered as a result of environmental damage. Other costs are not currently recorded as part of GDP, but would be if GDP accounts were modified to reflect comprehensive measures of aggregate well-being rather than concentrating on economic activity. Focusing on costs that are currently recorded as part of GDP, evidence is now available to show that environmental degradation results in appreciable losses of GDP. The kinds of impacts that give rise to such costs include:

1. forgone crop output due to soil erosion and air and water pollution;
2. forgone forestry output due to air pollution damage, soil contamination and soil erosion;
3. impairment of human health and consequent loss of labour productivity; and

4. diversion of labour and resources from high productivity uses to low productivity uses such as maintenance of buildings damaged by pollution.

National environmental damage cost estimates can play a useful role in assessing development priorities. Because environmental damage costs do not show up explicitly in measures of national product, planners have no obvious incentive to treat environmental damage as a priority in development plans. Increasingly, however, the environment is entering into development plans as the GDP costs of degradation are being shown to be significant and sometimes very substantial. Therefore, economic valuation of degradation costs is particularly appropriate at the levels of macroeconomic and sectoral management of the economy: it may be more important that the Ministry of Finance as well as Ministry of Planning appreciate the costs of environmental degradation than that the Ministry of the Environment does.

The monetary measure of a change in an individual's well-being due to a change in environmental quality is called the total economic value (TEV) of the change. It is important to understand that it is not environmental quality itself that is being measured, but people's preferences for that quality. Valuation is therefore anthropocentric in that it relates to preferences held by people, and the economic value of something is established by an actual or hypothetical exchange transaction.

The TEV of a resource can be disaggregated into use value (UV) and non-use value (NUV), also called 'passive use value'. Use values can be direct use values (DUV), indirect use value (IUV) and option value (OV). Direct use values are derived when an individual makes actual use of a facility, for example visiting a recreation area to go fishing. Indirect use values arise from the natural functioning of ecosystems, such as storm protection provided by trees. Option value is an individual's WTP for the option of using an asset at some future date. NUV has proved to be both difficult to define and measure. It can be subdivided into existence value (XV), which measures WTP for a resource for some "moral", altruistic or other reason and is unrelated to current or future use; and bequest value (BV), which measures an individual's WTP to ensure that his or her heirs will be able to use a resource in the future. So,

$$TEV = UV + NUV = (DUV + IUV + OV) + (XV + BV) \quad (5.1)$$

A variety of valuation techniques may be used to quantify the above concepts of value. The basic concept of economic valuation underlying all these techniques is the willingness to pay (WTP) of individuals for an environmental service or resource, i.e., the area under the compensated or Hicksian demand curve. As shown in Table 4.2, valuation methods can be categorised, on the one hand, according to which type of market they rely on, and on the other hand, by considering how they make use of actual or potential behaviour (Munasinghe and Lutz, 1993).

Table 4.2: An economic taxonomy for environmental resource valuation

	Conventional market	*Implicit market*	*Constructed market*
Based on actual behavior	• Change of productivity • Loss of earnings • Defensive expenditure	• Travel cost • Wage differences • Property values	• Artificial market
Based on potential behavior	• Replacement cost • Shadow project		• Contingent valuation

The valuation techniques presented in Table 4.2 are grouped according to analytical method. Under specific conditions, such as when the environmental impact leads to a marginal change in the supply of a good or service that is bought on a competitive market, the WTP can be estimated directly in terms of changes valued at prevailing market prices. If the market is not fully competitive, then the market valuation will be a partial measure, and shadow price corrections may need to be made. The foregoing comments apply to change of productivity. Often, the result of the impact cannot be directly related to a market activity. In some of these cases, the WTP could be estimated at conventional market value by using a closely related proxy. This approach applies to the following techniques: loss of earnings, defensive expenditure, replacement cost, and shadow project.

In certain cases the WTP can be estimated through derivation of a demand function for the environmental asset through analysis of actual behavior. Examples of this approach (also called surrogate market techniques) include travel cost, wage differential, and property valuation. The WTP can also be elicited through a controlled experiment or direct interviews, using the artificial market and contingent valuation. Next, we discuss each of the above listed valuation techniques in Table 4.2 in great detail.

5.1 Valuation Techniques Based on Conventional Markets

The primary feature of the methods considered in this section is that they are directly based on market prices or productivity. This is possible where a change in environmental quality affects actual production or productive capability.

Change in Productivity

Development projects can affect production and productivity positively or negatively. The incremental output can be valued by using standard economic prices. There are examples of this in the following case studies. In the study on soil conservation in Lesotho, the increased production from conserved land is estimated. In the valuation of one hectare of Peruvian rainforest, the values of different production schemes are compared. Other examples include impacts on tropical wetlands (Barbier and Markandya, 1989 cited in Convery, 1993) and the effects of sedimentation on coral diversity and ultimately on fish production (Dixon, 1989).

Loss of Earnings

Changes in environmental quality can have significant effects on human health. Ideally, the monetary value of health impacts should be determined by the willingness to pay, of individuals, for improved health. In practice, one may have to resort to "second best" techniques such as using foregone earnings in cases of premature death, sickness, or absenteeism (and increased medical expenditures, which may be considered a type of defensive expenditure or replacement costs).

The "value-of-human life" approach is often questioned on ethical grounds. It is argued that it dehumanzies life, which is considered to have infinite value. In practice, however, society implicitly places finite values on human life and health in policy and project decisions that affect environmental quality, workers' safety, or health. If this was not so, we would be justified in spending all of GDP on health improvements. In the case of an increase or a reduction in the probability of numbers of deaths, an approximate estimate of value is the loss in estimated future earnings of the individuals involved (also called the human capital approach). Loss of earnings approach has been applied in Brazil and Ghana, to value health care costs and productivity losses (in the form of morbidity and mortality) associated with air and water pollution. The authors concluded that their estimates of the related health costs of air and water pollution are necessary for setting priorities among various environmental problems in both countries (see Tuto, 1995; and Georgiou et al., 1997).

Defensive Expenditures

Individuals, firms, and governments undertake a variety of "defensive expenditures" in order to avoid or reduce unwanted environmental effects. Environmental damages are often difficult to assess, but information on defensive expenditures may be available or can be obtained at lesser cost than direct valuations of the environmental good in question. Such actual expenditures indicate that individuals, firms, or governments judge the resultant benefits to be greater than the costs. The defensive expenditures can then be interpreted as a minimum valuation of benefits.[5] However, caution is advisable with this approach, especially in cases where defensive expenditures are arbitrarily mandated by governments, with little or no consideration given to market forces or free choices by informed economic agents.

Replacement Cost

This technique looks at the cost of replacing or restoring a damaged asset to its original state and uses this cost as a measure of the benefit of restoration. The

[5] As discussed in the previous chapter, such defensive expenditures by firms are treated in the current system of national accounts as intermediate costs and are therefore not part of value added or final output. Defensive expenditures by households and governments, on the other hand, are treated as final expenditures and included in GDP. Present research seeks to address this and other issues and inconsistencies in the SNA.

approach is widely used because it is often easy to find estimates of such costs. Under this approach, the costs that would have to be incurred in order to replace a damaged asset are estimated. The estimate is not a measure of benefit of avoiding the damage in the first place, since the damage costs may be higher or lower than the replacement cost. However, it is an appropriate technique if there is some compelling reason as to why the damage should be restored, or certainty that this will occur.

The replacement cost approach has been applied to protecting groundwater resources in the Philippines, by determining the cost of developing alternative water sources (Munasinghe, 1993). A second type of application involves estimating erosion prevention benefits by calculating the value of fertilizer needed to replace the nutrients lost through soil erosion, as in Costa Rica (1991) and Ghana (1993) case studies. The method is only relevant if, in the absence of erosion control measures, the fertilizer would actually be applied. Another example would be the cost of an artificial fish nursery to estimate the value of wetlands that might be impaired by a project. The same technique of estimating potential ex-post mitigation expenditures represented by the increased costs of health care, is used in the Brazil case study.

5.2 Valuation Techniques Based on Implicit (or Surrogate) Markets

The methods and techniques described in this section use market information indirectly. The approaches discussed here include travel cost, property value, wage differential, and marketed goods as surrogates for non-marketed goods. Each technique has its particular advantages and disadvantages as well as its specific requirements for data and resources. The task of the analyst is to determine which of the techniques might be applicable to a particular situation.

5.2.1 Travel Cost Method

Often connected with recreational analysis in industrial countries, the travel cost method measures the benefits produced by recreation sites (parks, lakes, forests, wilderness). A related method can also be used to value "travel time" in projects dealing with fuelwood and water collection[6]. In this method, the area surrounding a

[6] For examples (see Hanley 1988; 1989a and 1989b).

site is divided into concentric zones of increasing distance. A survey of users, conducted at the site, determines the zone of origin, visitation rates, travel costs, and various socio-economic characteristics. Users close to the site would be expected to make more use of it, because its implicit price, as measured by travel costs, is lower than that for more distant users. Analysis of the questionnaires enables a demand curve to be constructed (based on the willingness to pay for entry to the site, costs of getting to the site, and foregone earnings or opportunity cost of time spent) and an associated consumers' surplus to be determined. This surplus represents an estimate of the value of the environmental good in question. Many case studies have applied the travel cost method. For example, the travel cost for domestic trips to a forest reserve in Costa Rica is used. In the second study, on the value of elephants in Kenya, the travel cost of tourists from Europe and North America is used as one estimate of consumer surplus (see Munasinghe, 1993).

5.2.2 Property Value

Also referred to as a "hedonic price" technique, the property value method is based on the general land value approach. The objective is to determine the implicit prices of certain characteristics of properties. In the environmental area, for instance, the aim of the method is to place a value on the benefits of environmental quality improvements, or to estimate the costs of a deterioration (for example, the effects of air pollution in certain areas). The property value approach has been used to analyze the effects of air pollution in certain areas. Where pollution is localized, the method compares prices of houses in affected areas with houses of equal size and similar neighborhood characteristics elsewhere in the same metropolitan area. The approach is based on the assumption of a competitive real estate market, and its demands on information and statistical analysis are significant. Its applicability to developing countries is, therefore, limited.

5.2.3 Wage Differential

This method is based on the theory that in a competitive market the demand for labor equals the value of the marginal product and that the supply of labor varies with working and living conditions in an area. A higher wage is therefore necessary to attract workers to locate in polluted areas or to undertake more risky occupations. Again, as in the case of property value, the wage differential can only be used if the labor market is very competitive. Other considerations are that this method relies on private valuation of health risks, not necessarily social ones. In this context, the level of information concerning occupational hazards must be high in order for private individuals to make meaningful tradeoffs between health risks and remuneration. Finally, the effects of all factors other than environment (for example, skill level, job responsibility, and so forth) that might influence wages must be eliminated, to isolate the impacts of environment.

5.2.4 Marketed Goods as Proxies for Non-Marketed Goods

In situations where environmental goods have close substitutes that are marketed, the value of the environmental good in question can be approximated by the observed market price of its substitutes. For example, the value of a non-marketed fish variety can be valued at the price of the most similar fish being sold in local markets (Georgiou et al, 1997).

5.3 Valuation Techniques Based on Constructed Markets

5.3.1 Contingent Valuation

When people's preferences as revealed in markets do not exist, the contingent valuation method tries to obtain information on consumers' preferences by posing direct questions about willingness to pay. It basically asks people what they are willing to pay fort a benefit, or what they are willing to accept by way of compensation to tolerate a cost (or both). This process of asking may be either through a direct questionnaire/survey, or by experimental techniques in which subjects respond to various stimuli in "laboratory" conditions. What is sought are personal valuations of the respondent for increases or decreases in the quantity of some good, contingent upon a hypothetical market. Willingness to pay is constrained by the income level of the respondent, whereas willingness to accept payment for a loss is not constrained. Estimates of willingness to accept tend to be significantly higher than willingness-to-pay estimates.

Pearce and Markandya (1989) compared the contingent valuation method with other, more market-based methods. In seven studies conducted in industrial countries they found that the overlap of estimates is complete, if accuracy is expressed as plus or minus 60 percent of the estimates computed. This result provides some reassurance that a rigorously applied contingent valuation method, while not being very precise, nevertheless can produce valuations that are of the right order of magnitude and that may be sufficient to rule out certain alternative projects or favour others. The contingent valuation method has certain shortcomings, including problems of designing, implementing, and interpreting questionnaires.[7] While its applicability may be limited, there is now considerable experience in applying this survey-based approach in developing countries, for example, to evaluate the quality of supply of potable water and electricity services (for examples of contingent valuation studies, see the case studies on Haiti and Kenya in Munasinghe and Lutz, 1993).

5.3.2 Artificial Market

Such markets could be constructed for experimental purposes, to determine consumer willingness to pay for a good or service. For example, a home water purification kit might be marketed at various price levels or access to a game reserve might be offered on the basis of different admission fees, thereby facilitating the estimation of the value placed by individuals on water purity or on the use of a recreational facility, respectively.

From the above discussions, it could be summarized that *total economic value* refers to the whole class of values that have a basis in human preferences and so are amenable to analysis within an economics framework. Total economic value is the sum of current use and non-use values. A summary of the most commonly used methods for estimating current use value, because of the difficulty surrounding measuring non-use value, of environmental assets is given in Table 4.3 below. From this Table the following should be noted: first, if market prices exist for specific

[7] See for example several papers appearing in The Energy Journal, December 1988.

impacts, then the change in market price following an impact (or compared to an environment which is broadly identical apart from the impact) represents a valid basis for calculating the loss in use value, although as already emphasized, account should be taken of price distortions in imperfect markets; second, if market prices do not exist, indirect valuation methods must be applied. The applicability of some of the principal methods is considered in the table 4.3 below, that synthesis the proposed and applied valuation techniques for valuing environmental degradation in the literature.

Table 4.3: List of principal methods currently applied to value environmental damage

Method	Summary Description	Strengths	Weaknesses
Methods based on Conventional Market:			
Changes in ecosystem productivity	Measures the value of changes in marketed output	Direct use of market prices facilitates clear monetary valuations	Only applicable where the causal relationships between defined activities and productivity changes can be unambiguously established
Loss of earnings	Measures the value of lost earnings as a result of damage to health	Uses "value of life' and "value of time" techniques which are well developed	As above, reliability depends on establishing clear cause-and-effect relationships
Opportunity cost	Measures the income or output for a resource in an alternative use	Can be applied where a resource is destroyed or reduced by a particular activity	Most useful for local effects; difficult to apply where impacts are uncertain or extend beyond a specified area
Defensive expenditures	Calculates the costs of adopting measures to prevent environmental damage	A useful measure where it is a real cost	Less useful where it is a hypothetical cost which individuals state they might be willing to pay to avoid damage
Health measures	Measures the impact of pollution etc. on health	Similar to "loss of earnings"	Similar to "loss of earnings"
Materials corrosion	Measures the impact of pollution etc. on the built environment	Values can be calculated using property values or remediation costs	As with other "dose response" techniques, its reliability depends on establishing clear cause- & -effect relationships
Crop damage	Measures the impact of pollution etc. on the vegetation	Direct use of market prices facilities clear monetary valuations	As for materials corrosion

Replacement costs	Estimates costs of replacing productive assets destroyed by a particular activity	Transparent and reasonably objective	Relies on accurate estimates of the magnitude of damage, calculation of replacement costs & identification of secondary benefits
Methods Based on Implicit or "Surrogate" Market			
Property value	Measures differences in property values in areas affected by negative environmental impacts	Uses directly observed values	Reliability depends on efficient markets, high correlation, and absence of other factors which may affect values
Wage differentials	Measures differences in wage rates	Uses directly observed values	Same weaknesses as for hedonic pricing
Travel cost	Calculates value of time & money spent by individuals travelling to an environmental amenity	Useful proxy of value of assets such as national parks	Of limited applicability to other types of environmental asset
Revealed Preference Techniques:			
Willingness to pay	Uses surveys or "bidding games" to establish how much people are willing to pay avoid environmental damage	Can be used to develop demand curves for environmental goods & bads	Relies on subjective perceptions of damage & results are related to ability to pay
Compensation claims	Identifies how much in compensation individuals require to concede some change in their environment	Is the basis for actual "trades" made for environmental assets based on strict civil liability & the "polluter pays" principle	Inevitable upward bias in initial demand for compensation

6. METHODOLOGY FOR EGYPT

To develop an environmental accounting framework for a developing country, Egypt, it has to be a reflection of the country's characteristics, which were explored in great detail in the previous Chapter (3). These characteristics, briefly, are: (1) a large, populous, developing country that needs economic development; (2) a country where agriculture is dominant and in its middle stage of industrialisation; (3) a country in which much economic activity is in the small and informal sector; (4) a country in which millions of poor depend on natural resources for their subsistence; (5) and finally a country with a large ecological diversity. The resources we emphasise and the priorities we give in preparing environmental accounting would have to reflect these characteristics.

We will extend the current Egyptian national accounts in many ways for our purpose. First of all, we will consider the environmental deterioration resulting from various emissions and effluents associated with the various economic activities of production and consumption. Second, we will build the sectoral detail accounts for the resources of interest. The environmental consequences of the various economic activities affect the different natural resources, their qualities as well as their amounts. Our objective is to calculate quantitatively the changes that are brought about in the various natural assets. The main natural assets of interest to us are the following: (1) exhaustible resources such as oil and gas; (2) renewable resources such as land, water, and air.

6.1 Accounting for the Depletion of Natural Resources

6.1.1 Oil and Gas

In order to modify the Egyptian National Accounts for the depletion of natural resources, two main approaches will be used to illustrate differences in opinion: the User-cost Approach, and the Depreciation Approach (both Net-Price I and Net-Price II). These approaches have been widely applied in Indonesia, Mexico, Papua New Guinea, Australia, USA and in the UK.

6.1.2 Agriculture Land Losses

The valuation techniques discussed at Section 4 above were developed mainly to value depletion of non-renewable resources (oil and gas). However, the net present value method could also be used to value the depletion of renewable natural capital. It is necessary to value them in order to include net depletion of their capital stocks in income accounts. For example, the United Nations guidelines suggest that the value (of fish extraction, land losses, and timber tracts) should be based on market prices where available. These capital assets prices should reflect the present value of future income flows. If there have been insufficient market transactions to provide a base for estimation, agriculture land losses, for example, could be valued by discounting the future net revenues of a hectare of land at current prices after deducting management and operation costs (United Nations, 1977). Therefore, Net Present

Value (NPV) will be used to estimate the value of agriculture land losses due to urban and industrial expansion. This method will be explained in great detail in Chapter Six Section 5.

6.2 Accounting for the Degradation of Natural Resources

As discussed in great detail in the previous chapters, the most urgent environmental problems in Egypt are water and air pollution and soil erosion. These type of resources are non-marketed ones. Therefore the indirect valuation techniques will be utilized in order to estimate the use value (Capital Consumption Allowance) for these resources. For example, as will be explained in greater detail in Chapter Six, the value of commercial fertilizers that have been used to replace the nutrients loss from soil is used as a proxy for estimating the cost of soil erosion. However, the implicit assumption in using indirect valuation methods is that the market for these proxies are perfectly competitive. In the case of fertilizers, for example, this is certainly not the case, as these prices were subsidized by the government. This fact may introduce a distortion in our estimates. However, as long as this distortion is on the side of underestimating the real cost of degradation it will not have a negative effect on the overall results.

6.2.1 Air and Water Pollution

Air and water pollution inflicts its damaging effects on Human Capital (morbidity and mortality), Physical Capital, and Vegetation. For Human Capital, sickness and absenteeism (morbidity), the most commonly used approaches rely on information on loss of earnings and medical care costs. Local data on these costs can be collected, and can also be presented to decision makers to focus their attention on the economic and social costs of pollution. On the other hand, one widely known approach to estimate the "value" of a human life is the human capital approach. This approach is based on foregone earnings and treats a life as a productive capital and estimates the production lost from premature death. This approach is full of methodological and moral problems; however it offers probably the most feasible and acceptable method of estimating the value of human life in developing countries. The alternative approach is based on information on the willingness to pay of individuals to avoid premature death. Contingent valuation techniques based on individuals' willingness to pay to avoid environmental damage may represent the best available valuation method in many cases. However, in common with other techniques, it is potentially subject to bias as a consequence of unrepresentative sample selection, poorly structured questionnaires incorporating leading questions, upward bias in hypothetical bids for environmental assets, etc. Consequently, estimates such as those derived from the human capital approach are more applicable and appropriate for developing countries than those derived from willingness to pay.

Loss of earnings

This method is most commonly used in evaluating the losses in net output that result from sickness and premature death. Environment-related health diseases are the most significant effects of air and water pollution, responsible for human capital productivity losses in Egypt. These losses comprising the aggregate value of estimated earnings foregone as a consequence of environment-induced illness (morbidity) in addition to the imputation value for the productivity lost as a consequence of the premature deaths resulting from environment-induced illness (mortality). The principles which are followed in case of mortality are the same as in the case of morbidity: the years of productive life lost are estimated and then valued using a proposed human capital accounting model.

Preventive or Defensive Expenditures

Defensive expenditures are outlays that are required to counter or mitigate the damage imposed by environmental degradation. In the case of Egypt, in addition to the estimate of loss of earnings induced by environment-related illness, the productive resources foregone as a result of defensive expenditures such as medical and staff costs, were also estimated. On the other hand, the effects of air pollution on physical capital, particularly buildings damage, are measured by an indicator of WTP to avoid the damages- the costs of extra painting, cleaning and the like. Finally, the cost of crop damages resulting from air and water pollution have not been accounted for because it was not significant compared to human and physical capital effects; in addition the available data were incomplete and inaccurate.

6.2.2 Soil Erosion

Replacement Costs

We attempted to use change in land value as a means of approximating the losses induced by erosion, but failed because markets for land and property are insufficiently developed to allow credible use of this method. The position, however, is likely to improve over time. Therefore, the "second best" has been used, the costs of replacing the losses. This may be a relatively poor measure of willingness to pay, because it only estimates the costs of replacement, not whether anyone would be willing to incur these costs. When all else fails, however, replacement costs do give an approximate estimate of the willingness to pay. The gross On-site and Off-site costs of replacement of nutrient losses in Egypt were estimated because it proved impossible to derive productivity losses.

6.3 Environmental Accounting Model for Egypt

The general structure of the Egyptian environmental accounting model, developed for this study, consists of three main modules- the SNA module, depletion module, and the degradation module. The SNA module is the core of the environmental accounting model. The major linkages of the three modules are shown in Figure 4.1; however the detailed structure of the degradation module is presented separately in Figure 4.2. Figures (4.1) and (4.2), which present a block diagram model of the study, show the objectives, the methodology, the main steps, and the relationship between the main steps of the study.

The developed environmental accounting model for Egypt, shown in Figures (4.1) and (4.2), is designed to deal with the most urgent environmental problems in Egypt, namely: (1) the depletion of natural resources such as oil and gas, and agriculture land losses due to urban expansion; (2) the degradation of natural capital such as water and air pollution and soil erosion. However, the model's framework is flexible in such a way that it can be enlarged to cover more resources as our knowledge improves. Second, the accuracy of the results could be improved when the methods of calculations improves. Third, it performs the two main functions of accounting science, which are: (1) measuring the environmental cost (depletion and degradation); (2) reporting and disclosure in the accounting final statements (modified national accounts) for SNA users. Fourth, the modified aggregated and disaggregated environmental accounting could show a totally different picture for the whole economy, which may indicate the distortion in the country's planning and policy analysis on both macro and sectoral levels. Fifth, when comparing the model's outputs with its inputs (feedback process), some important issues will arise such as the lacks and the gaps in environmental and economic data which need to be completed, and the actions which need to be taken either to reduce or to stop the environmental deterioration on macro and sectoral levels. Finally, this model is specifically built for Egypt; however it could be modified and applied in other developing countries which may have quite similar or different environmental problems.

The rest of the study is structured on the basis of this model: the depletion of non-renewable natural resources (oil and gas) will be accounted for first, (Chapter Five); the depletion and degradation of renewable natural resources (i.e. land loss, air and water pollution, soil erosion) will be accounted for second, (Chapter Six). Third, both the depletion and degradation costs will be incorporated into the conventional SNA framework in order to establish the Egyptian environmental macro and sectoral accounts (Chapter Seven). This will be followed by presenting the policy implications of Egyptian environmental macro and sectoral accounts (Chapter Eight).

FIGURE 4.1: ENVIRONMENTAL ACCOUNTING MODEL FOR EGYPT

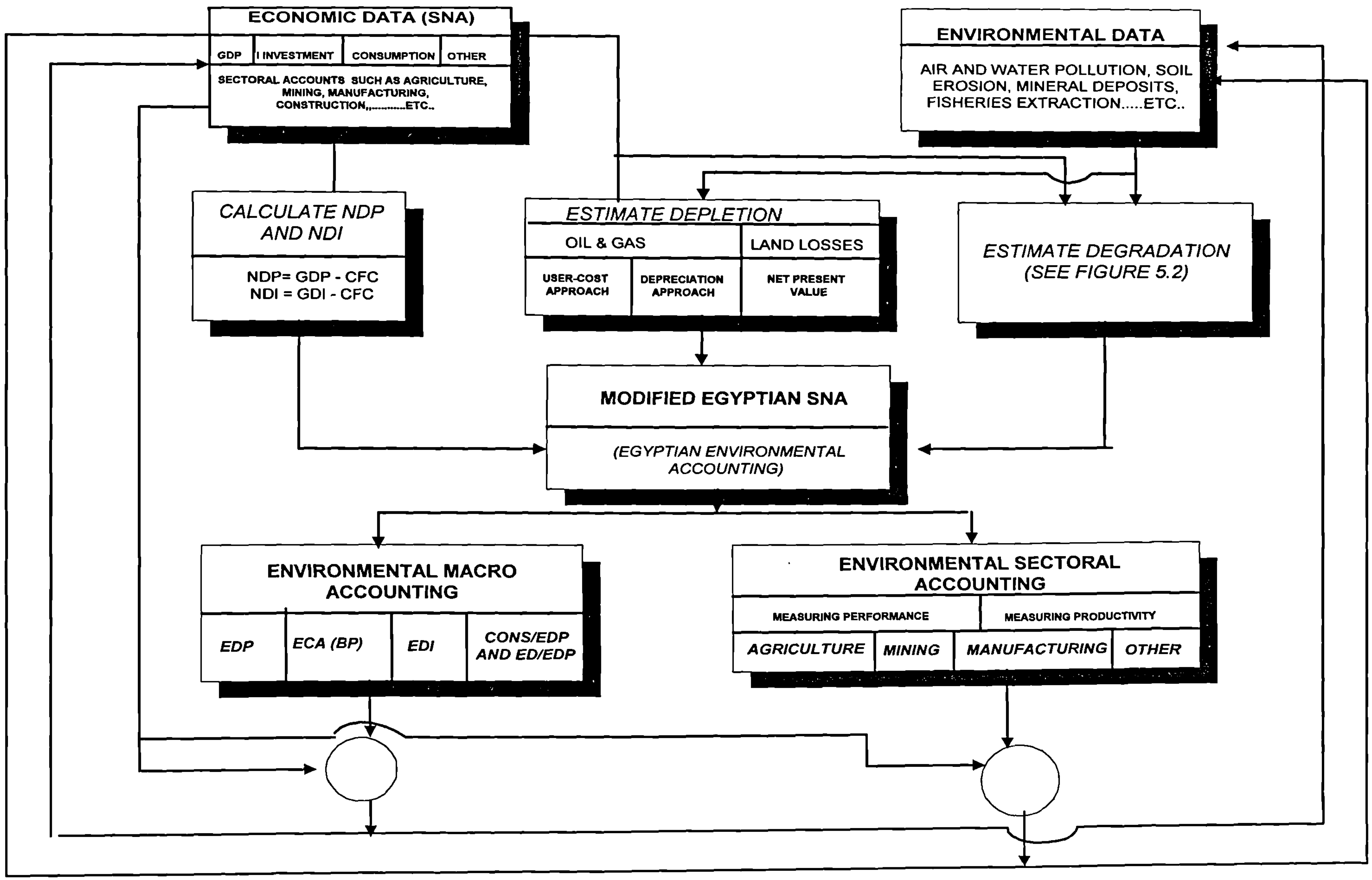
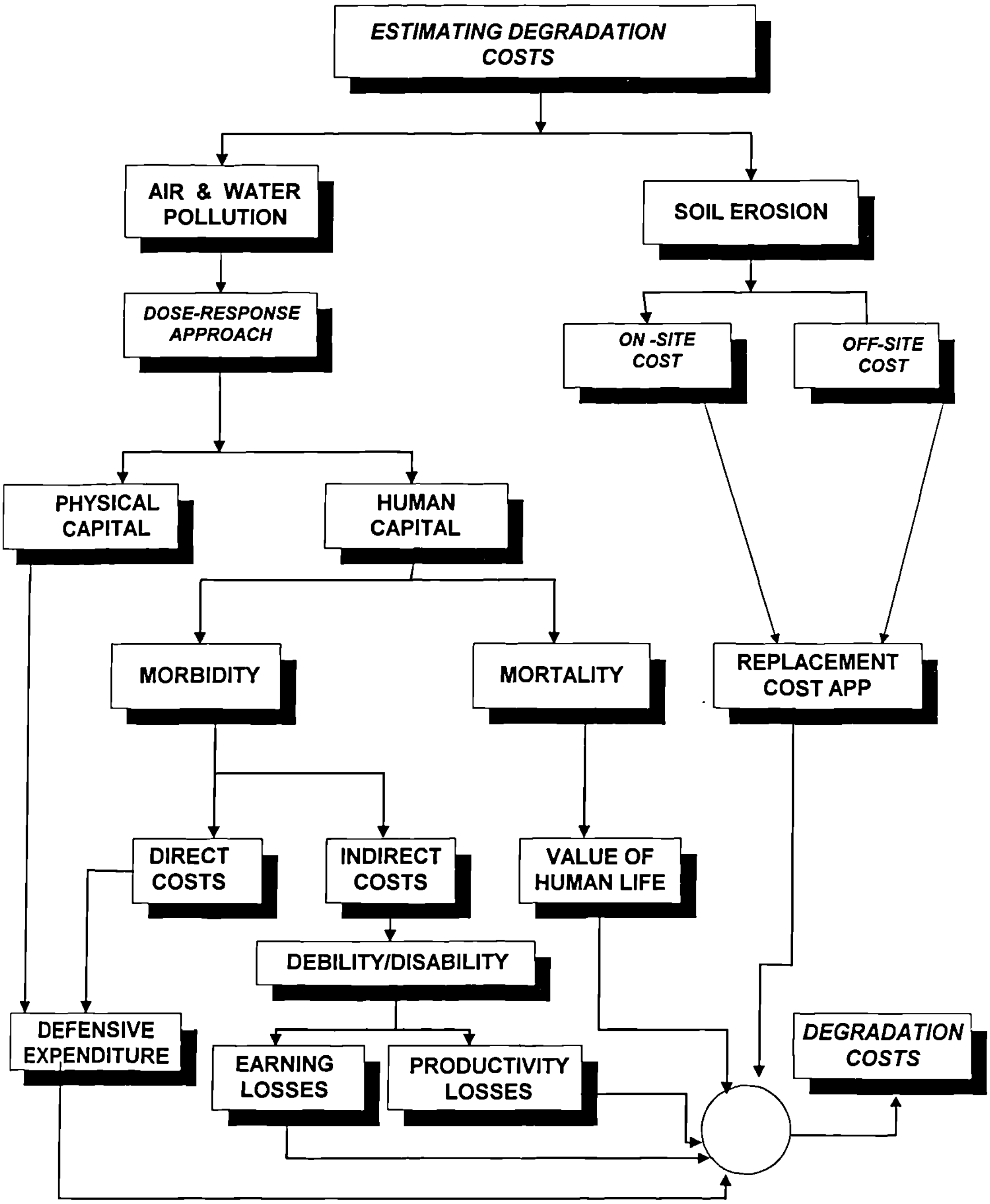


FIGURE 4.2: ENVIRONMENTAL DEGRADATION MODULE



PART C

ESTIMATING ENVIRONMENTALLY ADJUSTED NET DOMESTIC PRODUCT (EDP)

CHAPTER FIVE

ACCOUNTING FOR THE DEPLETION OF NON-RENEWABLE NATURAL RESOURCES

1. INTRODUCTION

An important component of environmental accounting is the attempt to include measures of depletion and degradation of natural resources into the system of national accounting so as to provide better measures of sustainable income, that will be useful for decision-making and long-term planning. As has been stressed earlier this study is an attempt to develop an SNA framework for a developing country, Egypt, that could be operationalized to calculate sustainable income. To achieve this objective two steps have to be taken: the first is to account for the depreciation (depletion) of non-renewable natural resources, such as oil and gas; the second is to account for the depletion and degradation of renewable natural resources such as air and water pollution and soil erosion, to estimate the pollution costs which could be considered as a minimum social value of capital consumption allowance for these environmental assets. This chapter focuses mainly on the first problem, i.e. accounting for the depletion of non-renewable natural resources. The second problem will be assessed in the following chapter (Chapter Six).

The rationale for including depletion of non-renewable natural resources in national income measures depends on the recognition that such resources are capital. It does not depend on whether produced-capital can be substituted for natural resources. There is extensive substitution among different types of produced-capital, but net domestic product still accounts for annual changes in the value of the entire produced-capital stock. Similarly, even if there is extensive substitution of produced-capital for exhaustible resources, income measures still account for annual changes in the value of the entire stock of produced and environmental-capital. The real annual change in the capital stock can be determined if the depletion of natural resource capital is accounted for in the national income accounts as is currently done for produced-capital when calculating NDP.

In Egypt non-renewable natural resources, such as oil and gas, are of concern because they constitute an important part of the country's capital stock and their use can be consistent with Egyptian sustainable development if some of the returns from extraction are used for investment in produced capital (machines, buildings) rather than consumption. However, in the Egyptian national accounts, as in most countries, there are no entries for the value of depletion and new discoveries for oil and gas corresponding to those for gross investment and depreciation of produced capital. Thus the current national accounts, while useful for short to medium-term demand management and stabilization policies, may mislead policy-makers interested in long-term planning. In this sense the study argues that the Egyptian national income is inflated by the failure to account for the depletion of exhaustible resources. Such inflated income measures may encourage high levels of current consumption that may be hard to sustain in the future.

There are two main approaches for determining depletion allowances for non-renewable natural resources: the depreciation and user-cost approaches. The depreciation approach is analogous to treatment of produced-capital depreciation. The user-cost approach divides the net receipts from the depletable resource into income and user-cost percentages. As been discussed in Chapter Four the user-cost and income percentages are chosen by determining the perpetuity value of the present value of the finite stream of net receipts from the depletable resource extraction. This chapter implements both approaches to determine the value of annual depletion of oil and gas in Egypt over the 1972-90 period. This chapter accounts for only one part of a complete environmental accounting which considers all environmental costs, non-renewable resources depletion. Accounts for losses of renewable resources (non-marketed) such as air, water, and land are treated in the next chapter.

The rest of this chapter is divided into five sections: the second discusses the controversial issues surrounding the inclusion of non-renewable natural resources into national income accounts; the third gives an overview for the Egyptian oil and gas industry; the fourth examines the conceptual basis for the main approaches, depreciation and user-cost approaches, that are used in estimating non-renewable natural resources depletion; the fifth applies both approaches to Egyptian NDP to construct an environmentally-adjusted measures which include the depletion of oil and gas. This is our first Environmentally-adjusted measure for the Egyptian net Domestic Product (EDP1); and finally section six presents the conclusions.

2. THE INCLUSION OF NON-RENEWABLE RESOURCES IN SNA

The national income accounting treatment of non-renewable resources revolves around some questions such as: should non-renewable natural resources be treated as inventories or as fixed capital? Should addition to and subtraction from the stock of reserves be treated symmetrically in measures of an environmentally adjusted net domestic product (EDP)? Should proved or probable reserves be accounted for when estimating the depletion allowance? Finally, should it be assumed that the unit values of these resources stays constant over time?

2.1 Fixed Capital Versus Inventory Treatment

There are two primary forms of capital concepts used in the national income accounts: fixed capital and inventories. Even when economic theorists have agreed about treating natural resources as a type of capital, they have disagreed about whether it should be treated as fixed capital or as an inventory. Landefeld and Carson (1994) from BEA in their recent estimates for mineral depletion for the USA used the fixed capital analogy. El Serafy (1989; 1993b), on the other hand, has advocated treating mineral resources as an inventory. The UN's Handbook of

Integrated Environmental and Economic Accounting (1993) has also proposed the option that mineral resources and timber be treated as inventories. This was obvious when they recommended using the user-cost approach as an alternative for estimating the depletion allowance for non-renewable natural resources.

If depletion is viewed as a decline in inventories, and the change in business inventories is a component of both GDP and NDP, it would result in a subtraction from both GDP and NDP. Harrison and El Serafy, among others, argue that minerals should be viewed as inventories because the depreciation approach can not apply to assets that can not be replaced since receipts from selling these assets can not be used to recreate these minerals. On the other hand, if natural resources are treated as fixed capital, depletion would be treated as depreciation. As NDP is defined as GDP less depreciation, with this treatment, any depletion charges would affect only NDP.

Do natural resources resemble fixed capital or inventories? The different characteristics of fixed versus inventory capital are the answer to this question. The first characteristic of fixed capital is that it is not physically used up in production the way inventories are. Second, fixed capital goods are generally not resold and virtually all of them are held for periods of several years. Third, fixed capital requires large initial expenditures, which yield revenues over a long period of many years. Fourth, the income to owners of fixed capital comprises the reduction in the value of the asset due to its use, i.e. depreciation, and a return that could be earned if invested elsewhere. Finally, fixed capital can be thought of as yielding a rent. As a result, if mineral reserves were treated like fixed capital, it would be reasonable to attribute a part of profits to economic rent accruing to natural resources.

On the other hand, the characteristics of inventories are different. First, raw materials and semi-finished goods inventories are physically used up in further stages of production, typically within the accounting period. The primary purpose of inventories of finished goods, however, is to avoid stock-outs associated with swings in demand for less than a year. Second, goods in inventories are usually resold to others. Third, there is the question of whether inventories can be thought of as yielding a rent. A price increase of the goods in inventory resulting in an increase in the value of the inventory is viewed as a capital gain. Capital goods earn rents because they yield services over a long period of time, and one invests in capital assets to do just that. The purpose of holding inventories is not to yield services over several periods, but to be used as inputs of production or consumed in the current year or at maximum in the next year.

Which of these characteristics are fitting for mineral resources? As demonstrated by Katz (1993), if one takes the view that the unit of capital is an oil field, then one would intuitively conceive of it as being fixed capital. On the other hand, if one views the unit of analysis as, say, a barrel of oil, then one would view minerals as an inventory. The distinguishing feature of a fixed asset, however, is not that it is durable in some physical sense, but that it may be used repeatedly in production over many years. Seen in this way, an oil field is a capital asset- included in gross fixed capital- which with the application of additional labour and materials yields its services in the form of barrels of oil. Additional capital expenditures, can be made to maintain or augment the capacity and the expected service life of the oil field. In this way, development of an existing field is viewed not as production of an oil inventory *in situ*, but as significantly changing the characteristics of the fixed asset.[1]

The fixed capital treatment is based on the fact that to create oil reserves requires enormous expenditures which are spread over several years for the development of a single entire oil deposit. Once established, these assets are held over a considerable number of years before they are exhausted. Oil fields contribute to production over several accounting periods and the fundamental accounting principle of "matching"[2] dictates that their costs be allocated to those periods, over which the production occurs, necessitating their treatment as fixed capital. Inventories are divisible and can be sold whole or in part without effecting the other units in stock. On the other

[1] The SNA states that capital expenditures must bring about significant changes in some of the characteristics of the fixed assets, i.e. change the size, shape, performance, productive capacity or extend the previously expected service life of the asset (UN, 1993).

[2] In accounting, matching refers to assigning expenses to the accounting period in which they were used to produce revenue. Hence, any expenditure that will benefit several accounting periods is considered a capital expenditure.

hand, oil and gas while measured and reported in barrels or thousand cubic feet (mcf), are produced using the fixed capital invested in the field. One cannot extract a unit from reserve "inventory" without a concomitant reduction in the value of the oil field's remaining associated capital.

In summary, the length of asset life, the nature of producing that asset, and the manner in which the capital services of the asset are derived, make the case for treating non-renewable natural resources as fixed capital consistent with other forms of fixed capital.[3] On the other hand, those that favour the inventory approach tend to stress the influence depletion has on GDP because of its frequent use in policy analysis rather than NDP for some empirical reasons[4]. From the above discussions, one may conclude that there is no clear cut answer for whether oil and gas should be treated as fixed capital or inventory. Therefore, in this study, the two approaches, user-cost and depreciation, which are derived from these two different views will be applied in calculating the depletion allowance for the Egyptian oil and gas sector. This is explained in Section 5 below.

2.2 Treatment of Additions to Reserves

The need to adjust NDP for the depletion of natural resources has been widely accepted. However, the question of whether NDP should be similarly adjusted for additions to the stock of natural resources has remained controversial. There is a proposal that additions and subtractions from the stock of natural resources should be treated asymmetrically, that is, NDP should be adjusted for depletion but not for

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[3] However, as argued by Proops and Faber (1991), there are obvious differences between the two kinds of assets (fixed and non-renewable), which are inputs to the production process. Thus, unlike fixed capital, non-renewable resources can not be produced. Another important difference is that the scarcity of non-renewable resource is necessarily increased with its extraction and consequence use in the production process, or its direct use as a consumption good. A third difference is that, in general, the extraction costs of non-renewable resources rise with the amount of resources already extracted, for a given technology.

[4] For example, the applied accounting principles that are used to estimate depreciation allowances for fixed capital vary from one asset and country to another. Therefore, analysts prefer to use GDP which results from consensus principles as a result of applying SNA framework.

discoveries of natural resources. The UN (1993) has mentioned two reasons why an asymmetrical treatment might be adopted: first, the depletion estimate gives a measure of sustainability that shows how a fixed stock is used up. Second, the value of additions is volatile, uncertain and sometimes extreme. However, one could argue that there are a number of good reasons for treating additions and subtractions from the capital stock symmetrically. The most important one is that an asymmetric treatment runs counter to the practice of good bookkeeping: what comes off the books must have gone on the books. In addition, Levin (1991) notes that strict Hicksian definition of income as consumption plus changes in net worth demands symmetry between additions to wealth and subtractions from wealth. Moreover, Hartwick (1990) views discoveries of new stock as increments to known supplies and should, therefore, be incorporated in a figure for net changes in the size and value.

The symmetric treatment of additions to and subtractions from the stock of natural resources is consistent with the notion of sustainable income. If discoveries and depletion are equal so that the stock value of natural resources is maintained, then the measure of net capital formation in natural resources is zero. If discoveries exceed depletion, net natural resource capital formation[5] is positive and increases EDP. If depletion exceeds discoveries, net natural resource capital formation is negative and EDP decreases.

Economic theory, supports the use of a symmetric treatment to additions and subtractions. In calculating EDP, net national investment in plant and equipment is added to net national investment in natural resources. The validity of this aggregation rests on the premise that the sustainability of income is unaffected if natural resource wealth is replaced with man-made wealth of an equal value. In other words, human-made wealth in the form of equipment and structures is considered to be a substitute for new reserves of natural resources. However, from the empirical view, Landefeld and Hines (1985) were not optimistic about including natural resource net depletion (discoveries minus extraction) in the core of national accounts, mainly due to the

[5] It has to be noted that one of the SEEA features is introducing the concept of net capital accumulation instead of net capital formation. The first is wider than the second because it includes both net capital formations for natural and man-made assets.

volatility it may bring to income measures. Foy (1991) arrived at the same conclusion when comparing the results of net price method (NPII) to user-cost method. Finally, the UN (1993) and its Handbook of Integrated System of Environmental and Economic Accounts have adopted a new version of net price method (NPI). In addition, they have recommended the use of the user-cost method as an alternative approach. In this study all these views and methods will be applied to examine the differences in results and opinions.

2.3 Proved Versus Probable Reserves

The amount of mineral resources that can be recovered, given current economic conditions, is not known with certainty. Reserves are classified by the degree of certainty attached to the estimates. For example, proved petroleum reserves are estimates based upon engineering data, to be recoverable under existing technology and economic conditions. Other reserves whose recovery at current prices and costs are uncertain are classified as either "probable" or "possible." Another way of classifying reserves is that proven reserves have a better chance (more than 90 percent) to be extracted under existing technical conditions, while probable reserves have only a 50 percent chance; and possible reserves have less than 50 percent chance of being produced (Vaze, 1996). As a result, there is a question about which set of estimates should be used in natural resource and environmental accounting. Should the accounts be concerned only with proved reserves or should they also account for probable or even undiscovered reserves?

Those in the oil and gas industry have noted that for every barrel of oil listed as proved, several more will eventually be extracted. The ratio of the amount of oil that will eventually be recovered from a given field to the amount that was initially listed as proved has been termed as "stretch factor."[6] It must be noted, however, that these extensions of reserves are not free. Reserves are stretched by massive doses of investment in development. Both the reserves and the investment that create them

[6] For example, Adelman et al (1991) have estimated this stretch factor to be about 3.5 in the United States.

will be booked at a latter date. The UN (1993) [7] estimates have ignored this stretch factor and only accounted for proved resources. As a result, the valuation made here (in this study) is only for proved reserves.

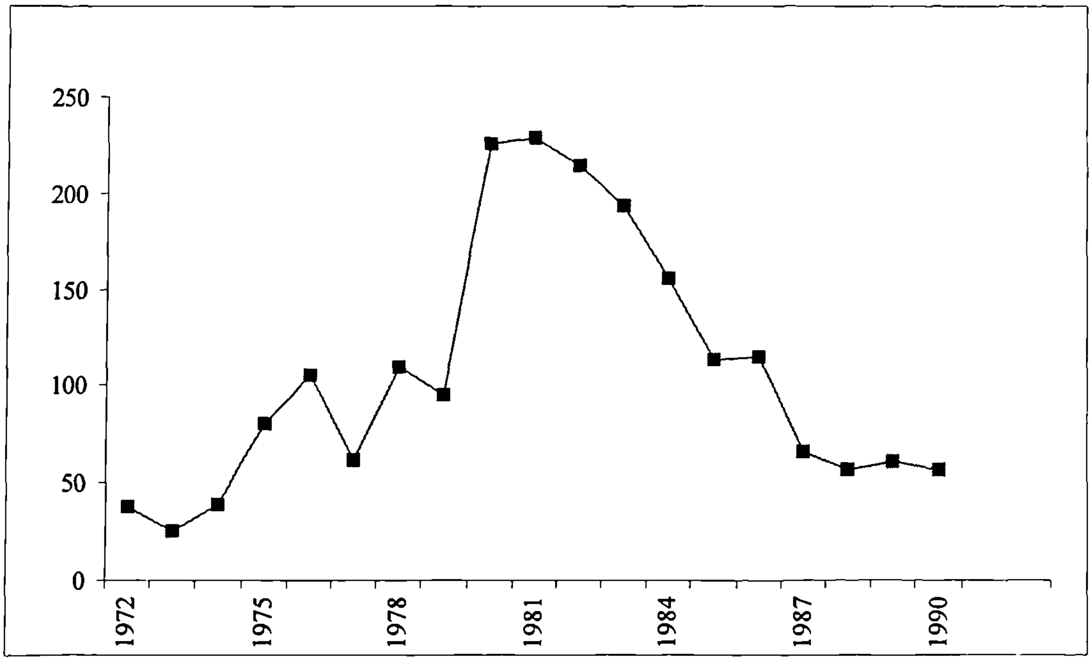
2.4 Future Values of Economic Rent

The Hotelling model of non-renewable resources describes the economic response to limited reserves of natural resources. The Hotelling rule[8] states that the net price or unit rent of the resource must grow at a rate equal to the rate of interest given an efficient extraction path and in competitive resource industry in equilibrium. The net price is equal to the price of extracted resource minus the marginal cost of extraction. However, all empirical analysis has used the average cost because of the difficulty of acquiring the marginal cost. However, empirical confirmation of time path implied by the Hotelling rule is difficult to find. For example, Adelman (1986) shows that since the 1980s the production of high cost US oil has risen and that of low cost Saudi oil has fallen in contradiction to Hotelling type behaviour.

[7] Note that, in both the 1993 SNA (1993) and in its handbook on Integrated Environmental and Economic Accounting (1993), the UN has recommended that only proved reserves be valued.

[8] The Hotelling model makes forecasting prices, discounting future revenues, and the future time path of production irrelevant because net returns rise with the interest rate: value of reserves in the current period is simply the sum of all future (undiscounted) net returns.

Figure 5.1: Real rent per ton of oil equivalent, Egyptian production, 1972-1992 (£E 1990)[9].



There are a number of reasons explaining why rents in the Egyptian oil and gas sector did not follow the Hotelling rule within the study period (1972-1990). First, the government has entered into different types of contracts, as shown in Figure 5.7 in Appendix 5.1, such as 50-50% joint ventures, Production Sharing Contracts (PSCs) and Profit Sharing Agreements (PSAs) with foreign companies within the last three decades. Second, the high percentage of tax rate that could reach to 40% of the total profit. Third, the unpredictable changes in world oil prices that were a result of supply increase. For example, the adverse developments in international petroleum markets in the mid-1980s in terms of collapse of oil prices (especially in 1986) had a significant effect on the petroleum industry in Egypt and on the Egyptian government policy toward foreign companies such as: the fall of the value of both the profit and cost of oil that reduces the foreign company's share of the resource rents; and the lack of large discoveries.

[9] The methodology which is used for estimating the net rent per unit will be explained later on in Section 5.

3. DEPRECIATION AND USER-COST APPROACHES

As mentioned above, two principal approaches have been proposed for incorporating the depletion of non-renewable resources as a cost into production accounts. El Serafy (1981) has proposed a "user-cost" approach to distinguish between the true (that is, sustainable) income component of the sales revenues of minerals and its capital component, which is to be deducted from the gross production value as a user-cost. In contrast, Repetto and his colleagues (1989) have applied a "depreciation" approach. Gross value added is not affected by this method, in that the consumption and increase of natural resources are treated as produced-capital. This makes it possible to obtain further modified (in addition to the depreciation of produced fixed assets) estimates for net value added of the oil and gas sector and for the whole economy.

3.1 Depreciation Approach

As has been discussed in Chapter Four Section 4.1, there are two proposed and widely applied, models of current net price method for estimating the depletion allowance under the depreciation approach. The first model of estimating the depletion allowance, Net-Price II (NPII), is proposed and applied by Landefeld and Hines for the US oil and gas for the period 1941-1978, Repetto et al for Indonesia (1989), Vaze (1996) for the UK, and Common and Sanyal (1998) for Australia. The second model of the net price method, Net-Price I (NPI), is suggested and applied by the United Nations (1993). NPI proposes that new discoveries from the NPII model be recorded in balance sheets, and not in the flow accounts, under other volume changes. This is to avoid the volatility it may bring to income measures. Another view is that depletion allowance is a transaction between agents (from non-produced to economic assets) and can legitimately be brought into the income account which is not the case for discoveries (Bartelmus et al., 1994; and Tongern et al., 1993). Proponents of the depreciation approach maintain that depletion allowance of natural resources entry should be placed in the level of NDP with depreciation of man-made assets, as discussed above.

3.2 User-Cost Approach

The handbook of Integrated Environmental and Economic Accounting (United Nations 1993), or SEEA, mentions two concepts or analogies for viewing natural resources: fixed capital and inventory. The SEEA presents two approaches for valuing the depletion (or depreciation) of natural resources: the net price method and the El Serafy "user-cost" approach. The net price method has already been discussed. In 1981, El Serafy presented his method for dividing the proceeds from the sale of an exhaustible asset, such as an oil reserve, into a portion that could be consumed and a portion to be reinvested. The El Serafy method calculates the proportion of true, perpetual or "sustainable" income to the proceeds from the extraction of a natural resource from a fixed stock.

The El Serafy method of calculating "proper income", as he called it, has become an important approach to estimate the depletion allowance of non-renewable natural resources. For example, Vaze (1996), Common (1998), and Foy (1991) have applied the user-cost approach when they calculated the depletion allowance using the possible valuation approaches. Most importantly, the El Serafy approach is presented by the SEEA, the satellite counterpart to the System of National Accounts, as a valid alternative to the net price approach. Stocks of natural resources can be easily treated as inventories in both physical and monetary terms. Conceptualising natural resources as inventories gives rise to the possibility of, if not the preference for, using the El Serafy method. In fact, the El Serafy method avoids the application of negative net prices by subdividing the actual operating surplus into two parts: depletion or user-costs which should be invested to achieve a constant flow of income in the future, even after the complete exploitation of the natural resources, and a remaining true income element (UN, 1993).

As has been discussed in Chapter Four Section 4.2, the user-cost approach results in a lower deduction from[10], or in addition to, GDP than the value of depletion resulted from NPII or NPI. For example, NPII adds the total value of new discoveries to GDP whereas user-cost approach only adds a percentage of its total present value. Therefore, El Serafy depletion allowance would not be less than zero. But NPII gives negative depletion allowance if new discoveries are greater than extraction. However, NPI gives a higher estimate for the depletion allowance and lower estimates for income adjusted measures because it does not account for new discoveries.

The user-cost approach is a better approximation of sustainable income because it only deducts from exhaustible resource revenues an amount necessary to maintain a constant real income after the resource is depleted. This methodology directly follows the Hicksian income concept. If depletion is negative (new discoveries are greater than depletion), the method of NPII will not deduct an amount from the new discoveries that is necessary to maintain a constant real income after the resource is exhausted. If depletion is positive, the method of NPII and NPI will deduct depletion allowance that is less or larger than needed to maintain a constant real income after the resource is exhausted. Only part of the value of net depletion needs to be reinvested elsewhere in order to achieve a constant stream of income after the resource is exhausted. The core of the sustainable income concept is a constant level of purchasing power over time. However, due to new mineral discoveries, price and interest rate changes over time, and uncertainties in the calculation of depletion times, there would be wide swings in the income from mineral resources using either User-Cost (UC) method or depreciation approaches.[11] Hence all the methods of natural resource valuation and inclusion in the accounts will lead to increased volatility in the GDP time series. However, the basic difference between UC and NPI position and that of NPII is that UC and NPI appear more willing to tolerate the

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[10] Recall that the net price approach subtracts all current production expenditures, depreciation and a normal return to capital from the year's market price to derive net price. On the other hand, user-cost approach does not consider the rate of return as a cost when calculating the net revenues.

[11] Although price changes will not affect El Serafy's X/R ratio, price changes will still cause the absolute measures of income to change from period to period.

greater swings in value due to inclusion of natural resource depletion in the income accounts.

4. EGYPTIAN OIL AND GAS SECTOR

4.1 Oil and Gas in The Egyptian Economy

As discussed in Chapter Two, the oil and gas industry is one of the most important sectors of the Egyptian economy. Over the 1972-1990 period, the share of oil and gas extraction in Egyptian real GDP was 5.2 percent in 1973, 18.8 percent in 1980, and 7.2 percent in 1992, with an average share of 10.41 percent over the study period. The economic importance of the oil and gas extraction industry has been matched by its importance as one of the four main sources (workers remittances, Suez Canal revenue, oil exports, and tourism) of foreign exchange earnings. Egypt began exporting crude oil in 1976. The growth potential of these exports is constrained by the continuing increase in domestic consumption, however, and by the persistent weakness of international oil prices. Between the 1987 and 1993 fiscal years, the value of petroleum exports fluctuated between $1.2 billion and almost $2 billion, representing approximately 40-50 percent of total export revenues (CBE, 1993).

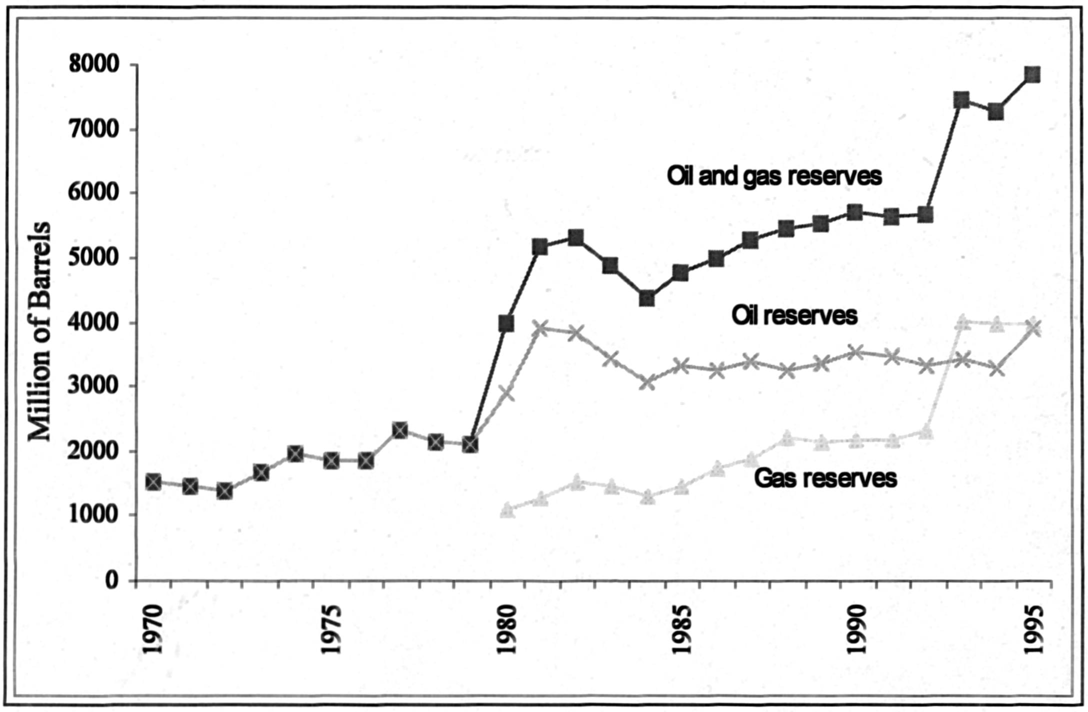
The mining industry is dominated by the extraction of crude oil. While Egypt's reserves are small by Middle Eastern standards, they amounted to about 4.5 billion barrels at the end of 1991, or about 0.42 percent of total world reserves. (BP, 1992; DTI, 1991). Production of crude oil has risen significantly in the past decade, rising from an average of 725,000 barrels per day (b/d) in 1983 to 925,000 b/d at the end of 1990 (see Figure 5.7 in Appendix 5.1). Natural gas output has shown an even more dramatic increase, reaching 8.2 million tones of oil equivalent (MTOE) at the end of 1990 compared to only 2.4 MTOE in 1983. At 1991 production levels, Egypt had enough petroleum to last another 13.5 years, and natural gas to provide supplies for just under 39 years. Government policies are encouraging the use of gas, rather than oil, in power stations and industry, as a result of which about 59 percent of total gas output is used to generate electricity, 40 percent as a fuel source for industry and 1 percent for domestic fuel.

4.2 Developments of Oil and Gas Reserves

Commercial production of hydrocarbons in Egypt began in 1912 but the first petroleum legislation was not enacted until 1948. This legislation provided for royalty payments on oil production and only Egyptian companies were allowed to obtain oil production licenses. Restrictions on foreign oil companies resulted in many of them leaving Egypt, and by 1950 oil production had declined. In 1954, new legislation provided foreign oil companies with a more favorable environment and allowed them to own 51% of Egyptian companies developing hydrocarbons. The first contract under the new legislation, containing a concession agreement with relinquishment clauses, was signed between the government and a foreign oil company in 1954. In 1957 the government created the state oil company and in 1963 it ruled that foreign oil companies operating in Egypt were required to work with the state oil company as joint ventures (see Figure 5.7 in Appendix 5.1).

Commercially viable deposits of crude oil discovered in Egypt in the early 1970s, transforming Egypt into a crude-oil exporting country in 1976, resulted in PSAs being introduced specifying that foreign oil companies had to take all related risks. In the case of commercial hydrocarbon development, the first 30 to 40 percent of the oil produced was set aside to reimburse the oil company for exploration and development costs. The balance of the production was split in proportions ranging from 60/40 to 90/10 in favor of the state oil company (Abdin, 1985; IEA, 1996). Therefore, the existing joint ventures contracts were converted to the new PSAs at a time when the crude oil price was increasing. From the oil company's perspective, the rise in prices coupled with more favorable terms implied that the profit potential from crude oil development in Egypt was greatly improved. The result was an increase in drilling activity and an increase in production (see Figure 5.2 below).

Figure 5.2:Egypt oil and gas reserves, 1970-1995[12]



Up to the late 1970s no efforts were made to develop the natural gas sector in Egypt due to two factors. The first was the nature of natural gas as a non-traded resource where a large sunk cost is required for exporting projects especially in cases of commercial discoveries that are not large enough to be considered for long exporting projects. The second was the lack of incentives to utilize natural gas resulting from the limited and distorted domestic markets arising from significant government intervention to subsidize domestic energy product prices that weakens the incentives to utilize these reserves domestically. However, the government has started to pay more attention to the utilization of natural gas resource as a substitute for crude oil and oil products for domestic uses as well. This is designed to reduce consumption and to increase exports of crude for foreign exchange earnings.

At the beginning of the 1980s the Egyptian General Petroleum Corporation (EGPC), the state company, started to offer more incentives to encourage foreign companies in the search for and utilization of gas as fuel and to feed the existing stock. EGPC has offered differentiated terms such as increased gas prices and larger areas to attract

[12] See later discussion in this section.

exploration in less explored areas (EGPC, 1987). These differentiated terms were to compensate interested companies for either the lower expected values or for the low level of information regarding these areas. All these actions resulted in increasing oil and gas reserves until the mid-1980s, which consequently declined as a response to the fall in world oil prices in the late 1980s. However, new gas clauses were introduced that applied the terms of oil contracts to gas discoveries. This has provided an incentive for more participation by foreign companies due to expected profits. For example, the 1989 figures show that foreign companies are committed to spending over $700 million on drilling some 212 exploration wells under 50 new agreements (Abdallah, 1996). The high number of contracts in 1989 was a result of the more favorable terms associated with the new gas clause for the foreign companies.

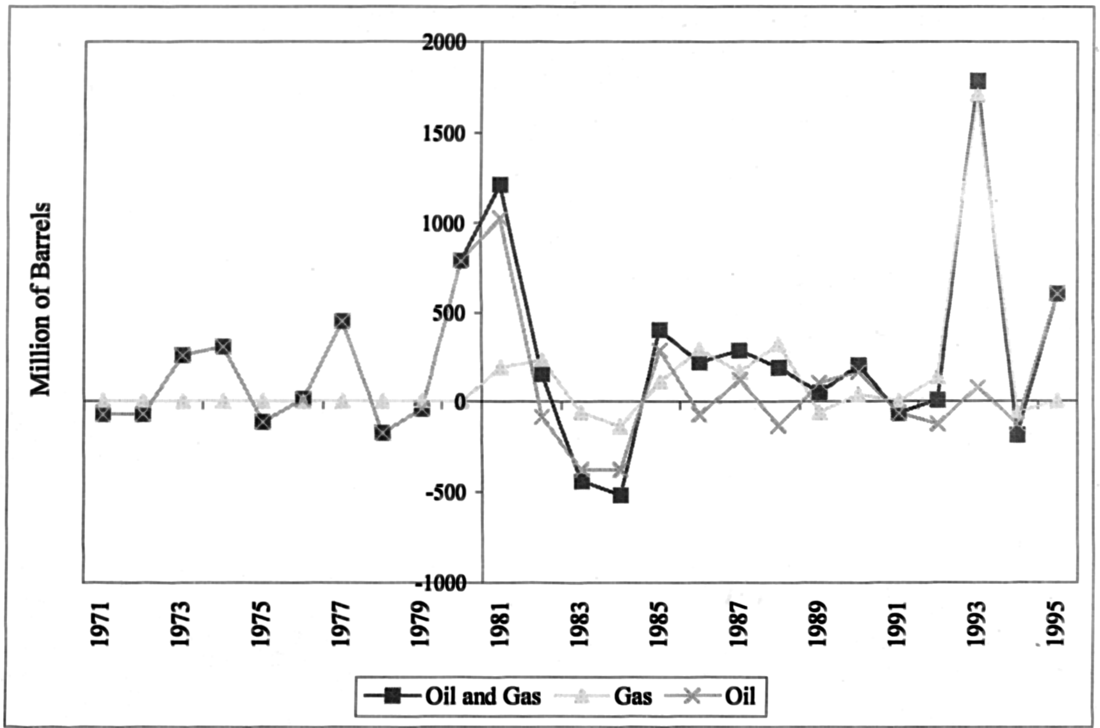
Before 1989, no single company had ever drilled only for gas in Egypt. All gas discoveries were made while drilling for crude oil. The government's new clauses have provided a significant incentive to attract foreign companies to explore for petroleum resources by increasing the expected profit from exploration of oil discoveries and shares to natural gas discoveries. Therefore, the exploration for petroleum resources in Egypt showed a significant increase in the late 1980s and at the beginning of the 1990s (see Figure 5.3 below). Finally, in the 1990s a new model of concession agreements was introduced that made all aspects of the agreement negotiable.

4.3 Physical Accounts

Both published and unpublished data have been used in this study. For example, proven oil and gas reserves were obtained from EGPC (unpublished data); annual oil and gas extraction were obtained from EGPC annual report. New discoveries were obtained indirectly from annual deposits and extraction, and presented in Table 5.5 in Appendix 5.1. It has to be admitted that oil and gas stock estimates are treated with confidentiality by EGPC because of their sensitivity. Therefore, the flow accounts results are more reliable than stock accounts.

The annual net change in oil and gas reserves over the period 1972-1994, that is the total additions minus extraction, is shown in Figure. 5.3. The net change is a determinant of judging if the country on balance has depleted its stock of non-renewable resources. Figure 5.3 below shows that the net change for the 1972-1979 period was generally decreasing. This was followed by an increase until the mid 1980s, as a result of introducing new incentives for foreign companies for gas discoveries. The reserves then show a decrease up to 1989. However, at the beginning of the 1990s, the reserves increased again as a result of applying the oil terms for gas contracts that encouraged the foreign companies to drill searching for gas, which was not the case prior to 1990. Therefore, several new oil fields have been brought on stream since 1992[13].

Figure 5.3: Net changes of Egyptian oil and gas reserves, 1970-1995



[13] For example, new fields in the Gulf of Suez such as the Asharfi field came into 22kb/d in 1992. Also, the Warda and North Geisum fields came on stream in 1994 for a total of about 30kb/d, and in Western Desert several smaller fields have been discovered in the south Umbaraka acreage (IEA, 1996).

Table 5.5 in Appendix 5.1 shows how the physical accounts could be established as a first step in preparing monetary accounts, which assures the complementarity between the physical and monetary approaches. New discoveries have been recorded under other volume change as was proposed by the UNSNA 93. On the other hand, only depletion allowance is recorded in the flow accounts. Treating the depletion of limited natural resources as current income rather than asset depreciation has a serious effect on the Egyptian economic performance in general and oil and gas sector in particular. This is explained in the next section.

5. CONSTRUCTION OF EGYPTIAN ENVIRONMENTALLY-ADJUSTED NET DOMESTIC PRODUCT (EDP1)

This section presents some results for Egypt, based on published and unpublished data. The first source is the national income accounts, which can be used to derive an estimate of the depreciation of non-renewable resources (i.e., oil and gas). These depreciation estimates are based on an estimate of the rent that is earned in the oil and gas sector. The issues of Egyptian National Accounts published by CAPMS have been used to calculate the total rent for oil and gas sector in applying depreciation and user-cost approaches calculated for the period 1972-1990[14].

Oil and gas reserves are often measured in barrels of oil equivalent (the thermal equivalent of one thousand cubic feet of natural gas to one barrel of oil) because economic measures of oil and gas extraction are aggregated into one industry category in the NA statistics. In this chapter, we have aggregated oil and gas production and reserves using a conversion factor of 0.1772 barrels of oil for one mcf of natural gas. This is the heat value, not a market value (IEA, 1996).

[14] As discussed in Chapter One, the first publication of Egyptian NA according to SNA 1968 framework was in 1971/72. On the other hand, the latest publication of Egyptian NA in 1997 was for 1991/92 (fiscal year).Therefore, it could be pointed out that in many developing countries national accounts are of a limited relevance for short term planning because of its long delay in publication. However, this may not be the case for long-term planning. For example, the fourth Egyptian five-year plan (1997-2002) is based on national income accounts data up to 1991/92.

5.1 Depreciation Approach

This study applies both models of current net price method to estimate the depletion allowance resulting from applying the depreciation approach. The following steps have been followed in estimating the depletion allowance for the two versions of the net-price method.

a. Estimating gross operating surplus for the oil and gas sector from the National Accounts by subtracting compensation of employees, indirect business taxes less subsidies (net subsidies), and capital consumption allowance for produced capital from oil and gas gross domestic product. This yields an estimate for the total annual rent of the oil and gas sector.

b. Estimating the rent per unit, that results from dividing the total annual rent by the annual oil and gas extracted. This rent, then, is converted into 1990 prices.

c. Obtaining an estimate of the value of oil and gas reserves as a result of multiplying rent per unit by total reserves.

d. Estimating the natural resource component of total oil and gas reserves. This is calculated by subtracting the replacement cost value of oil and gas produced-capital, which is determined by assuming that oil and gas produced-capital is equal to the oil and gas sector share in the country's gross domestic product (Dervis, 1984; Mira, 1997), from the total value of oil and gas reserves.

e. Calculating the real net price per unit which results from dividing the previous calculated natural resource component by reserves. The net price multiplied by the annual extraction or net physical change in reserves yields NPI and NPII estimates, respectively.

5.2 User-Cost Approach

In applying the user-cost approach to estimate oil and gas depletion the following steps have been followed:

a. Calculating gross operating surplus, from NA for the 1972-1990 period, as has been explained in depreciation approach.

b. Estimating resource life expectancy, as annual reserves divided by extraction ratio.

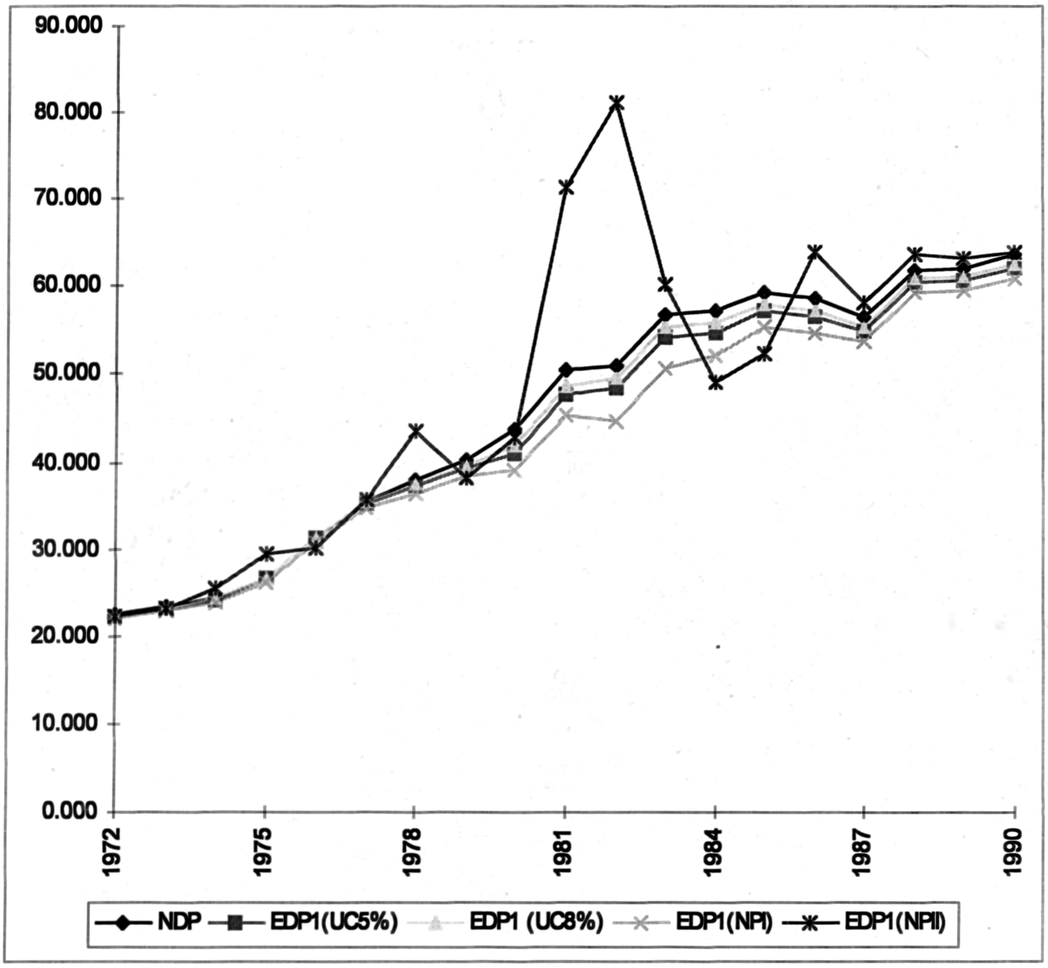
c. Choosing the discount rate. Both 5 and 8%[15] were used for user-cost estimation. But the results of 8 percent discount rate are adopted for the Egyptian economy, which is characterized, as in most developing countries, by lower income and higher level of consumption. Determining the user-cost percentage by applying equation (4.2.4) from Chapter Four. Multiplying this percentage by annual gross surplus yields the user-cost estimation that is converted to 1990 prices.

5.3 Results

Table 5.1 and Figure 5.4 show four alternative measures for Egyptian net domestic product adjusted for oil and gas depletion. The users cost adjusted measures for 5 and 8 percent are called EDP1(UC5%) and EDP1(UC8%), respectively. The adjustments for user-cost and depreciation approach were made at NDP level. The depreciation adjusted measures for net price I and net price II are called EDP1(NPI) and EDP1(NPII) respectively.

[15] 8 percent discount rate has been adopted as social discount rate for Egyptian economy in all analysis

Figure 5.4: Environmentally-adjusted measures of net domestic product, 1972-1990 (£E billion 1990)



From Table 5.1 it can be seen that EDP1(NPII), the largest alternative measure, is higher than NDP by an average of 6.42 percent over the 1972-1990 period. This average was high due to the significant additions to oil and gas reserves in the 1980s. This was, also, the result of increasing gas prices and introducing new terms in oil and gas contracts for foreign companies, especially for gas contracts. EDP1(NPII) is greater than NDP from 1980 to 1983 and from 1987 to 1990 when the net change in oil and gas reserves was positive. On the other hand, EDP1(NPI), the lowest alternative measure, is significantly lower than NDP by an average of 6.01 percent over the 1972-90 period. EDP(NPI) is lower than NDP for the entire period because additions to reserves have been recorded in the balance sheets as other volume changes which means that the total rent of the natural resource is subtracted from NDP.

Table 5.1: Environmentally-adjusted measures for Egyptian net domestic product, 1972-1990 (£E billion 1990)

Year	*NDP*	*EDP1(UC5%)*	*EDP1(UC8%)*	*EDP1(NPI)*	*EDP1(NPII)*
1972	22.50	22.17	22.27	21.97	22.19
1973	23.38	23.20	23.26	23.07	23.17
1974	24.33	24.18	24.25	23.97	25.50
1975	26.69	26.55	26.64	26.11	29.54
1976	31.42	31.28	31.37	30.76	30.04
1977	35.51	35.27	35.38	34.90	35.61
1978	37.98	37.30	37.60	36.45	43.71
1979	40.30	39.33	39.66	38.58	38.37
1980	43.95	41.04	41.93	39.28	42.84
1981	50.51	47.79	48.78	45.47	71.55
1982	50.98	48.47	49.63	44.74	81.18
1983	56.82	54.26	55.41	50.76	60.25
1984	57.20	54.85	55.82	52.15	49.26
1985	59.31	57.18	57.95	55.35	52.45
1986	58.62	56.58	57.35	54.64	63.95
1987	56.48	54.95	55.48	53.78	58.15
1988	61.94	60.50	61.00	59.41	63.80
1989	62.05	60.68	61.18	59.51	63.39
1990	63.75	62.11	62.64	60.99	64.06
AVER	45.46	44.09	44.61	42.73	48.37

EDP1(UC5%) and EDP1(UC8%) are lower than NDP by an average of 3.01 and 1.87 percent, respectively, over the 1972-1990 period. Both the users costs are significantly lower than EDP1(NPII) for two reasons. First, in user-cost approach additions to reserves means a smaller subtraction from NDP, while EDP1(NPII) is greater than NDP in the years when additions are greater than extraction. Second, in estimating the net price per unit the natural resource component has to be calculated first, which was the result of subtracting the value of produced-capital from the total value of reserves. Therefore, increases in produced-capital stock and unprofitable years in the oil and gas industry may reduce the residual natural resource value (depletion allowance). In contrast, the user-cost and incomes' portions of oil and gas operating surplus are jointly determined. Thus, the reduction in natural resource value when measuring EDP1(NPII) may be greater than the user-cost in entry when estimating EDP1(UC5%) and EDP1(UC8%). However, EDP1(UC8%) is higher than EDP1(UC5%) by an average of 1.17 percent over the 1972-90 period. This is because the user-cost portion of oil and gross operating surplus vary inversely with the discount rate. The average of user-cost percentage for EDP1(UC8%) is 26 percent compared to 41 percent for EDP1(UC5%). Hence EDP1(UC8%) is always higher than EDP1(UC5%).

Table 5.2: Annual percent change in real Egyptian net domestic product, 1973-1992

YEAR	*NDP*	*EDP1(UC5%)*	*EDP1(UC8%)*	*EDP1(NPI)*	*EDP1(NPII)*
1973	3.92	4.63	4.42	4.99	4.42
1974	4.03	4.25	4.26	3.91	10.03
1975	9.72	9.80	9.84	8.93	15.86
1976	17.72	17.79	17.76	17.78	1.68
1977	13.00	12.76	12.80	13.46	18.57
1978	6.98	5.75	6.25	4.44	22.73
1979	6.09	5.42	5.49	5.85	-12.23
1980	9.05	4.35	5.72	1.82	11.67
1981	14.93	16.46	16.33	15.75	67.00
1982	0.94	1.42	1.75	-1.61	13.47
1983	11.45	11.95	11.63	13.47	-25.78
1984	0.65	1.07	0.75	2.73	-18.24
1985	3.70	4.24	3.82	6.13	6.47
1986	-1.17	-1.04	-1.03	-1.27	21.92
1987	-3.65	-2.87	-3.27	-1.57	-9.07
1988	9.66	10.10	9.95	10.46	9.73
1989	0.19	0.29	0.30	0.17	-0.66
1990	2.73	2.35	2.39	2.48	1.06
Average	6.11	6.04	6.06	6.00	7.70

Table 5.2 shows the annual percentage change for each alternative of environmentally adjusted net domestic product (EDP1). From Table 5.2 the average growth rate of NDP is 6.11percent as compared to 6.04 percent for EDP1 (UC5%), 6.06 percent for EDP1(UC8%), 6.00 percent for EDP1(NPI), and 7.70 percent for EDP1(NPII). However, the annual changes in the growth rates for the environmentally-adjusted measures are much more important for policy analysis than the total average for the entire period. EDP1(NPII) has shown the highest average

growth rate resulting from the volatility of new discoveries for oil and gas reserves during the study period. EDP1(NPII) has shown, as well, the highest variance and coefficient of variation, 401.31 and 2.60, compared to 34.79, 0.98 for EDP1(UC5%), 34.73, 0.97 for EDP1(UC8%), and 36.71, 1.01 for EDP1(NPI). For example, EDP1(NPII) growth rate in 1983 was –25.78 percent, when reserves started to decline after noticeable increase in discoveries of gas from 1980 to 1982. On the other hand, all other measures have shown a stable average growth rate because they are not tied directly to changes in physical reserves.

In the oil and gas industry there are different shocks that could arise due to uncertainty regarding oil prices, rate of extraction, and discovery of reserves. These may have a great impact on the sector's income as well as on the total income according to the conventional SNA framework. However, this may not be the case in reality. Therefore, it would be useful to perform a second test, for both user-cost and depreciation approaches, to measure the sensitivity of the applied valuation techniques that are used in modifying GDP estimates.

Therefore, these three different shocks are simulated for the 1990-1992 period to test which of these implemented methods give the appropriate message for policy-makers interested in the sustainability of the resource rent. This, in turn, emphasises the need for estimating the sustainable income. These shocks are: (1) prices increase resulting in doubling the annual rent in 1990 and prices returning to historic level in 1991; (2) doubling in proven reserves in 1990 onwards; and (3) doubling the rate of extraction in 1990.

Table 5.3: Simulated results for net rent: oil and gas markets between 1990-1992 (£E million)

YEAR	*UC5%*	*UC8%*	*NPI*	*NPII*
Base case				
1990	1641	1106	2761	314
1991	1727	1100	3204	1652
1992	1551	1017	2742	-452
Rent doubles in 1990				
1990	3281	2212	5522	629
1991	1727	1100	3204	1652
1992	1551	1017	2742	-452
Proven reserves doubles in 1990				
1990	855	395	2761	86011
1991	850	360	3204	1652
1992	747	321	2742	-452
The rate of extraction doubles in 1990				
1990	2295	1878	5522	-2883
1991	1727	1100	3204	1652
1992	1551	1017	2742	-452

Table 5.3 shows the results of three different scenarios that represent three different shocks. First, for the price increase in 1990 that results in doubling the rent in 1990, NPII has shown a net gain to income relative to the base case. On the other hand, both UC and NPI send opposite messages from NPII. However, NPI shows more increase in the depletion allowance as compared to UC but both are still consistent with the base case. Secondly, for doubling proven reserves, NPII has shown a dramatic increase in income accounts because it credits all new *discoveries* as income. In contrast, NPI has not changed from the base case since new discoveries are recorded in balance sheets and not in income accounts. However, the UC has resulted in a lesser depletion allowance compared with the base case because new discoveries mean increasing the resource life expectancy that results from increasing the resource stocks. Finally, both NPI and UC give the same message when doubling the rate of extraction; however, although NPII gives positive depletion allowance it gives a different message from the base case.

The annual percentage change between depletion measures shows that, EDP(NPII) had the highest average growth rate because of a large increase in discoveries in the

1980s that resulted mainly from gas discoveries. This measure showed the most volatility too, as it is directly tied to changes in reserves. In contrast, the UC(5% or 10%) and NPI adjusted measures showed smooth results with NDP that appear in lower variance and coefficient of variation. This is in their favor, as an important concern about including natural resource depletion in national income accounts is the volatility they may bring to income estimates.

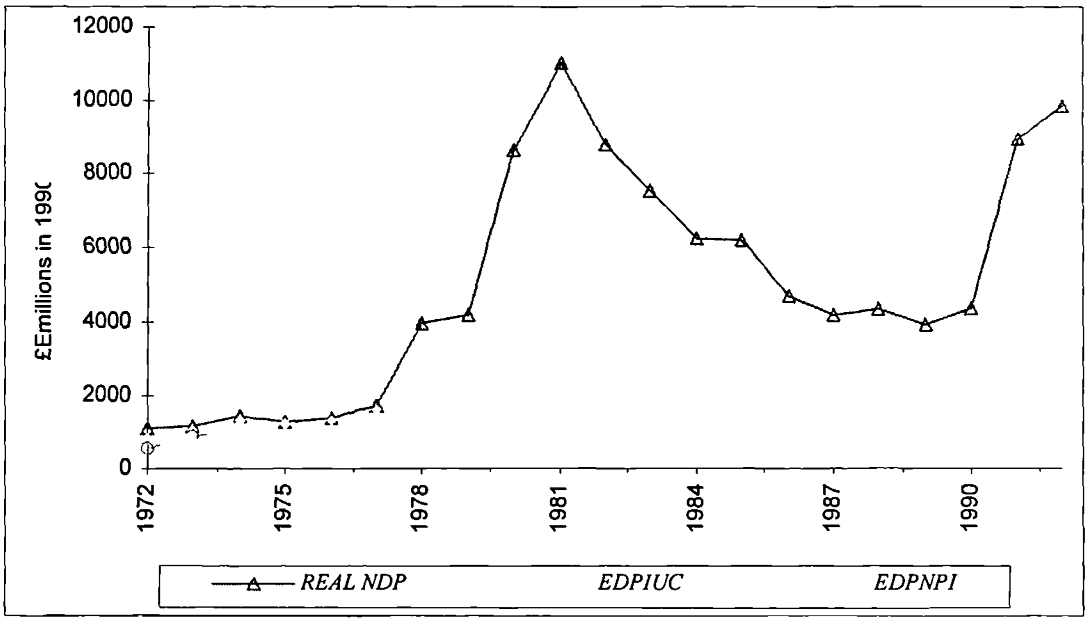
From the simulated analysis, one can conclude that both NPI and UC (5% or 10%) give an appropriate message (constant) for policy-makers for calculating sustainable income. The environmentally adjusted measures for user-cost approach as well as NPI are always lower than NDP by a percentage of or total gross operating surplus, which is already in the accounts. Consequently, for net price (NPI) and user-cost methods, one can argue that NPI gives the highest estimates while user-cost gives appropriate estimates, if the discount rate is correctly determined, for the amount that should be reinvested to keep the total capital intact. Therefore, both NPI and UC (8%) results will be used to calculate our first environmentally adjusted measure for Egyptian income (EDP1) when constructing the Egyptian environmental accounting for the 1981-90 period.

5.4 Analysis for the Depletion Allowance of Non-Renewable Natural Resources

Environmental accounting is used in this chapter to construct modified national income indicators which incorporate the cost of oil and gas depletion. The depletion of oil and gas assets as calculated above would normally be subtracted from GDP, for user-cost approach, to arrive at oil and gas adjusted GDP. However, for the purpose of comparison, depletion adjustments for user-cost and NPI have been made relative to the oil and gas sector contribution to NDP. Both the resource accounting methodologies suggest that, when resource depletion costs are incorporated, the Egyptian oil and gas sector has always produced lower incomes than what reported using the standard accounting conventions. The above calculations as well as the depletion allowance for depreciation and user-cost approaches have shown a significant effect on sectoral and macro aggregates of the Egyptian economy.

This may be explained as follows. First, for user-cost approach (8%) and NPI estimates for depreciation approach, as shown in Table 5.4 and Figure 5.5, the adjusted value added of oil and gas sector ranges from 46.44 to 76.83 percent of the original value for the period between 1972-90. As a consequence, total net domestic product is reduced by approximately 1.32 to 13.23 percent for the same period. Second, the user-cost and 8% discount rate depletion allowance in 1980, for instance, was £E2,014 million. This reduces the value added of the oil and gas sector by 23.17 percent and the overall NDP by 5.72 percent. Over the twenty-year period, the adjustment of value added of oil and gas and NDP ranged from 2.13 to 23.17 percent and from 0.21 to 5.72 percent respectively (see Table 5.4 below). The main factor that accounts for the fluctuation of the user-cost adjustments over the years is new discoveries. Discoveries extend the resource expected life span and therefore the amount that has to be retained for the development of alternative income sources decreases. This, for example, is responsible for the reduction in the user-cost in 1980 as opposed to 1986.

Figure 5.5: Conventional and modified income of oil and gas, 1972-1992



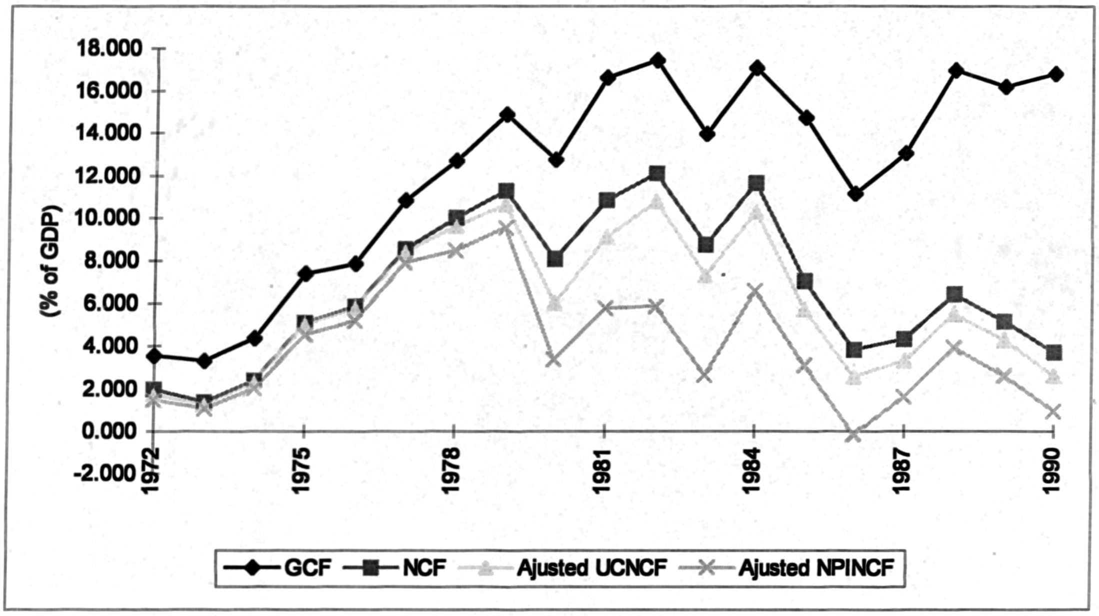
The magnitude of oil and gas depletion adjustments calculated using depreciation approach were generally larger than the comparable figures produced following the user-cost approach (see Figure 5.5). Resource depletion adjustments have indicated that the failure to account for the cost of depletion in standard measures of GDP or NDP has led to consistently overstated levels of national income in Egypt. For example, following user-cost approach, NDP adjustments for oil and gas between 1972 and 1990 yielded an average annual income that was 1.76 percent lower than the figures derived by standard calculations. On the other hand, the depreciation approach called for average downward adjustments of 5.66 percent of the standard NDP (see Table 5.4).

Table 5.4: Natural resource depletion adjustments: user-cost (UC8%) and depreciation approaches (NPI)

Year	*User-cost Adjustments (UC8%) Percent share in:*		*Depreciation Adjustments (NPI) Percent share in:*	
	NDPO&G	*Total NDP*	*NDPO&G*	*Total NDP*
1972	19.28	1.06	44.56	2.46
1973	9.72	0.53	24.27	1.32
1974	4.99	0.32	23.08	1.50
1975	2.69	0.24	28.97	2.55
1976	2.13	0.21	26.72	2.66
1977	6.57	0.45	32.79	2.22
1978	9.54	1.20	37.81	4.74
1979	14.88	1.99	40.13	5.36
1980	23.17	5.72	53.56	13.23
1981	15.58	3.43	45.38	9.98
1982	8.57	2.65	39.59	12.25
1983	9.31	2.49	39.84	10.66
1984	10.44	2.40	38.31	8.82
1985	10.89	2.30	31.71	6.68
1986	14.86	2.16	46.72	6.79
1987	13.39	1.77	36.10	4.78
1988	16.53	1.51	38.33	4.08
1989	13.94	1.41	32.51	4.10
1990	17.44	1.73	43.54	4.33
1991	15.25	2.15	44.42	7.07
1992	15.45	1.23	41.66	3.31
Average	13.41	1.76	39.71	5.66

At the same time, the adjustments indicate that the rate of Egyptian NDP growth is actually overstated. Standard NDP calculations found 6.11 percent real average annual growth between 1972 and 1990. Over the same period the user-cost adjusted income grew at a rate of 6.06 percent, while depreciation adjustment resulted in a real growth rate of 6.00 percent. The downward adjustment in income growth is the result of increasing the rate of extraction, and hence the increase in the magnitude of resource depletion adjustments since the 1970s.

Figure 5.6: Four measures of Egypt's domestic capital formation: gross, net, adjusted UC, and adjusted NPI, 1972-1990



In Egypt, the immediate losses associated with resource exploitation appear to have been a non-rational component of the country's development strategy. Case studies of Costa Rica and Indonesia, which have calculated the depreciation costs for three sectors called for downward adjustments, as well as in the growth rate of GDP[16]. Though the time periods and the scope of these studies do differ, the results are similar. These results suggest that Egypt has not made a successful transition from natural resource exploitation activities toward reproducible capital-related

[16] The Costa Rica study (1991) incorporated depreciation for forest, soil and fisheries from 1970-1988, and called for a downward adjustment in average annual GDP growth over the period from 4.9 to 4.7 percent. In Indonesia (1989) forestry, soil and petroleum depreciation adjustments lower the 1970 to 1984 average annual growth rate from 7.1 to 4.0 percent.

production. The revenues generated from natural resources have been directed to consumption, instead of investment, in such a way that this shift has given rise to non-sustainable rates of economic growth. As a result, the depletion of natural resources has had a significant effect on the country's productive capital stock. For example, from 1980 to 1983 the depletion allowance almost doubled the depreciation of produced-capital.

Clearly, this conveys a different picture of overall capital or investment efficiencies in the oil and gas sector in comparison with that conveyed by conventional capital-output ratios. On the other hand, if the decline in oil and gas assets is charged against fixed capital formation for the 1972-1990 period, the user-cost and depreciation costs would require annual downward adjustments averaging 10.23 and 32.40 percent respectively. These costs represent an additional 29.76 and 94.29 percent of the total man-made capital consumption, currently recorded as depreciation in the standard NDP calculations, for the same period. Natural resource assets depletion, calculated here for oil and gas alone, incurs a substantial cost to Egypt's economic development. A cost which policy-makers should be made aware of (see Figure 5.6). Oil and gas depletion appears to reflect a significant erosion of the total capital stock.

6. CONCLUSION

The two accounting approaches applied in this study differed in their implicit evaluations of oil and gas depletion. However, the two valuation methodologies produced oil and gas depletion adjustments of the same order of magnitude, following the same trends. Divergences occurred, however, in the size of the adjusted income series because of the way the respective depletion measures are used. The user-cost and depreciation methodologies suggested the same policy implication, apart from the size of the depletion allowance cost, with respect to Egypt's oil and gas exploitation. As evidence, both depreciation and user-cost approaches show that the average of environmentally-adjusted NDP was 6.01 percent lower when using NPI and 3.01 percent and 1.87 percent lower when using the user-cost approaches at discounted rates of 5 and 8 percent, respectively, for the 1972-1990 period. Therefore, regardless of the method applied the adjusted net domestic product measures, as shown in Table 5.4, indicate that a significant percentage of Egyptian income over 1972-1990 period was actually consumption of natural resources.

CHAPTER SIX

ACCOUNTING FOR THE DEPLETION AND DEGRADATION OF RENEWABLE RESOURCES

1. INTRODUCTION

Two major drawbacks of conventional national accounts have been stressed. National accounts have neglected: (1) the depletion of scarce natural resources that threatens the sustained productivity of the economy (this was the task of the previous chapter, accounting for the depletion of non-renewable resources); (2) the degradation of environmental quality, mainly through pollution, and consequences for human health and welfare. The research agenda here (in this chapter) is to account for the environmental degradation of environmental assets such as air, water, and land. This is the second and last major adjustment required to Egyptian GDP, in order to arrive at Environmentally-adjusted net Domestic Product (EDP2) as a better measure of economic performance. This represents the depreciation allowance for non-marketable natural resources such as air and water pollution and land degradation (i.e., soil erosion and land loss). This depreciation is attributable to the use of services of environmental capital beyond its ability to provide perpetual services.

Determination of capital consumption allowances for renewable (CCAR) natural resources is very difficult as there is no market value for the public goods and services provided by this environmental capital. Analysis of CCAR requires consideration of environmental services (ES) and environmental damages (ED). ES are of two main classes: (1) direct final services such as clean air and water; and (2) intermediate services, which are two types, (a) services to other natural systems which in turn provide final product to humans, and (b) services to economic production such as the fishing industry. ED are any reductions in the ability of the environment to yield a perpetual level of service. For example, waste disposal to air does not cause any environmental damage until the capacity of the atmosphere to yield clean air services is degraded. Future waste disposal after this point causes environmental damage. To use ES in estimating CCAR is a difficult task because of the complicated interaction between the environment and the economy. Thus, the environmental damages are our CCAR, the minimum of the social value of the environmental capital loss or the cost of replacing its services with man-made goods and services. Hence, environmental damages are subtracted, as an adjustment, from the output side of national income accounts (i.e., NDP) to yield an environmentally adjusted measure of economic performance (EDP2).

Environmentally adjusted net domestic product (EDP), resulting from the adjustment to the current Egyptian income for depletion and degradation of environmental capital in this chapter and the previous one, is an indicator of the sustainability of Egyptian income (long-term income). This indicator is very important for long-term planning, instead of using the misleading one that results from the conventional SNA framework. The question is how can the Egyptian System of National Accounting be modified to measure the Egyptian sustainable income (EDP) and what does this modification mean for policy-makers? This will be taken up in the following two chapters (Chapters Seven and Eight). This chapter aims at estimating the cost of the depletion and degradation of renewable natural resources (environmental damage) using the indirect valuation techniques as have been explored in Chapter Four.

This chapter is divided into five sections. The first and second sections deal with estimating the cost of air and water pollution, which could be considered as a minimum social value of the depreciation for these resources. The third and fourth sections will focus on estimating the depreciation of soil resource and the capital consumption allowance of agriculture land losses due to urban and industrial expansion. The final section presents a summary and highlights of the main findings.

2. THE COST OF AIR POLLUTION

The main goal of this section is to estimate some of the costs of air pollution resulting from industrial activities. This is done by measuring the economic consequences of air pollution on human health and physical capital. This section also describes the sources of the data and the procedures involved in estimating the adverse impacts that are associated with air pollutants. This section, therefore, is divided into four parts: the first discusses the problem of air pollution in Greater Cairo to set out the basic problem; the second specifies the suitable approach for estimating the cost of air pollution in the case of Egypt; the third estimates the cost of damage to human capital in terms of morbidity and mortality; the fourth estimates the cost of damage to physical capital (buildings); and the final part presents a summary and highlights of the main findings of this section.

2.1 The Air Pollution Problem in Greater Cairo

The unprecedented industrial development in Egypt during the last three decades, accompanied by a growing population, has increased the level of environmental deterioration. One of the most important problems is that the ambient level of air pollution in large cities in Egypt (especially in Cairo) has become alarming, particularly in the last three decades. Cairo is not only the political capital but also the most populated area in Egypt with the highest population density. 15% of Egypt's population live in Cairo, with a growth rate of 4 percent according to 1990 estimates. The corresponding figure for the whole country was 2.3%. Proliferation of unofficial housing has reached alarming proportions in the last three decades and the area per person of public parks is less than 1 m^2 In addition to being the most populated city in Egypt, Cairo is also the centre of industrial activities. It hosts approximately 49% of Egyptian industry and 90 percent of the country's heavy industry (see Figures 6.1 & 6.2 in Appendix 6.2). G.Cairo has 45% of the motor vehicles of different types, and consumes 41% of all the electric energy consumption of the country.

The above mentioned activities have resulted in overcrowding, unhealthy housing, a higher degree of air pollution and water pollution, soil erosion, and a large accumulation of solid waste in G.Cairo. These are the reasons for the difference in health status, agriculture production, and conditions of building and materials of inhabitants of G.Cairo and urban areas from that of the rest of Egypt. Ambient levels of air pollutants in Cairo have been monitored by the Egyptian Ministry of Health for more than 25 years. It was found that pollution levels seem to have generally increased with population, industrial activities, energy, and vehicle use through the late 1980s. Current ambient concentrations for all major air pollutants in G.Cairo and other urban cities approach and in some cases exceed the levels which threaten health, buildings, crops and household materials (Nasralla, 1993; El Gamal, 1994).

Table 6.31 in Appendix 6.2 compares the most recent data for major air pollutants in Cairo with U.S. health standards and with World Health Organisation (WHO) guidelines. It shows that sulfur dioxide concentration is above the US and WHO standards. Sulfur dioxide is an irritating gas with a pungent odour and taste which is highly soluble in water (forming sulfurous acid) and can be oxidized to sulfur trioxide (forming sulfuric acid in water). Sulfur oxides also become absorbed into particles in the air, and the resulting suspended sulfates are thought to be responsible for much of the adverse health impacts from exposures to a low or moderate ambient level of sulfur dioxide. Airborne sulfates also cause reduction in visibility, and wet or dry deposition of acidic sulfates can damage materials and cause ecological changes.

The World Development Report (1992) identified suspended particulate matter (PM) as a threat to human health. In the mid 1980s about 1.3 billion people - mostly in developing countries - lived in towns or cities that did not meet WHO standards for ambient level of suspended particulates. It has been estimated that reducing pollution to levels that meet WHO standards could prevent 300,000 to 700,000 deaths a year. Even a slight reduction from present levels would result in significant health improvement. Table 6.31 in Appendix 6.2 also indicates that the annual mean concentration of PM in Cairo is extremely high, in fact more than in any of the world's cities. The same fact has been emphasised by an OECD workshop on

Hazardous Air Pollution (OECD, 1995). PM has a strong effect in causing respiratory diseases. It is believed that as a result of the concentration of cement and heavy metals industries in and around the urban cities, the PM is responsible for the most, if not all, infectious respiratory diseases in G.Cairo and other urban areas.

2.2 Measuring the Cost of Air Pollution

An extensive literature exists on the economic cost of health damage from environmental degradation, most of it relating to the industrial world. The procedures used for valuation are often sophisticated. Those relating to morbidity tend to be different from those relating to mortality, but both tend to be part of a more general model known as dose-response model or, sometimes, the damage function approach. This model traces a pollutant from its emission to its ambient concentration, which is called the dose. The response consists of human health impact, such as respiratory illness, that shows up as days lost from work, restricted activity days, and death. The valuation exercise only takes place when the epidemiological response is estimated. Statistics on diseases related to the environment offer a first-stage measure of the potential importance of the link between environment and health. If the link can be established, the value of health damage done (its monetary cost) becomes a second-stage environmental indicator (Gerking, 1992).

At the moment, monetary estimates of national health damage are few. However, as explored in Chapter Four, morbidity might be valued as a measure of economic cost of working days lost using the ruling wage rate. Mortality requires the use of what is misleadingly known as a value of human life - these values are, in fact, measures of willingness to pay for reducing risk or willingness to accept payment for increased risk. Dose-Response relationship, or production approaches, are perhaps the most familiar valuation techniques. Essentially, a link is established between pollution level and physical response, for example, the rate at which the surface of a material decays. The decay is then valued by applying the market price (costs of repair) or by borrowing a unit valuation from non-market studies. Notable examples include the valuation of health damage. Once air pollution is linked to morbidity and morbidity is linked to days lost from work, the days lost can be valued (Adams, 1982). For example, the Council on Environmental Quality in the United States, in its second annual report (CEQ, 1971), estimated a cost figure of $16 billion, comprising health costs of $6 billion, materials and vegetation damages of $4.9 billion, and reduced property values of $5.2 billion.

The Dose-Response tends to be used particularly for two reasons. The first is when it is thought that people are unaware of the effects that pollution causes. The second is when eliciting preferences by any one of the direct methods is not possible for reasons of data, or lack of market sophistication in the population, or both. The second reason applies specially in developing countries, where price and expenditure data are generally poor and where, at least until now, the use of contingent valuation techniques has been limited because it is believed that the answers would suffer from strategic, hypothetical and operational biases.

In general, the indirect valuation approach is always applicable to environmental problems. Dose-Response based methods are of great relevance and value in developing countries where market-based methods dependent on revealed preferences are not possible. By at least trying to put money values on some aspects of environmental quality one is underlining the fact that environmental services are not free. They do have values in the same sense as marketed goods and services have value. As is known, the priorities of decision-making in the developing world differ from those in the developed world. Nevertheless it is important to bring to the attention of decision-makers in developing countries some of the environmental costs in monetary terms instead of physical terms by trying to put money values on some aspects. As mentioned above, the main objective of this section is to estimate the cost of air pollution by measuring the economic consequences (adverse impacts) of air pollution on human health and physical capital in Greater Cairo first, followed by extrapolating the total cost for Egypt second.

2.3 Costing Health Damage

The major costs of pollution-induced health effects are due to wages and productivity losses and increased costs of health care. Productivity losses and wages result from accelerated mortality rate as well as from pollution-induced morbidity. It also includes reduced productivity of an affected person who nevertheless continues his usual daily activities. Increased costs of health care include social overhead capital costs and some of the costs of the research undertaken to establish the etiology and optimal treatment of the resulting health effects. In addition, there are other financial losses due to the increased probability of ill health and death. But they are relatively minor compared with the above two. Thaler and Rosen (1975) concluded that a one-percent increase in sulfates emissions results in a 0.0002 percent increase in mortality rate. For New York city with 11.5 million capita in 1975, a one percent increase in sulfates emissions would increase the death number only by 23 cases, which is a minor cost in comparison with other costs (i.e., treatment and disability costs).

Economists at Carengie-Mellon university estimated the health damage in the United States attributable to air pollution at $2 billion in 1963. Their calculations were based on all costs associated with respiratory diseases (including doctors and hospital bills as well as forgone earnings) and an estimate of 25 percent as the proportion of respiratory disease associated with air pollution (Estes, 1973). In another study concerned with the effect of air pollution on human health, Lave and Henning (1970) in the United States attempted to estimate the economic effects of air pollution on human health. They estimated "the total annual cost that would be saved by a 50 percent reduction in air pollution levels in major urban areas, in terms of decreased morbidity and mortality, to be 2.08 billion dollars." This is not a health-related cost of air pollution, which would be greater in their estimate, but the possible savings based on the earnings lost due to sickness, disability, and early deaths attributed to air pollution. The major part of this figure comes from respiratory diseases. The amount estimated did not include health costs from smoking.

There is no doubt that air pollution is generally harmful to health especially to the respiratory system. The effects of air pollution on human health range from a slight increase of pollutants in the body through physiological changes of uncertain consequence, to the clearly pathological changes of illness and death. The economic consequences of the effects of air pollution on human health can thus be classified into two categories:

- the economic consequence of morbidity.
- the economic consequence of mortality.

These two categories for respiratory diseases for the residents of Greater Cairo will be discussed and measured below.

2.3.1 Costing Health Damage of Morbidity:

The economic consequences of morbidity include:

- Medical treatment costs.
- Wages and productivity losses.

Medical Treatment Costs

Treatment costs vary according to the type of patient, to the treatment as well as to the period of treatment either both for inpatients or outpatients. The total cost attributable to any patient during a course of hospital treatment is determined by summing the total direct and indirect costs. Direct costs include all manpower, drugs, equipment, ancillary services and other costs that are uniquely associated with individuals in the course of treatment. Thus,

$$DC = C_1 + C_2 + \dots\dots\dots + Cn \qquad (2.3.1.1)$$

Where,

DC = direct cost.

C_i = the cost of one specific item of services (i.e., manpower, drugs, equipment,..etc.).

Indirect costs include the sum of the cost per patient/day of all elements of hospital activities from which each patient benefits times the number of days the patient is hospitalised. Thus,

$$IC = Fd \times LS \qquad (2.3.1.2)$$

Where,

IC = indirect cost.

Fd = fixed cost / patient / day.

LS = the length of stay in hospital (days).

The basic feature of both direct and indirect treatment costs is that items of these costs are different and vary among patients and from one day to another. It is remarkable to note that direct treatment costs represent a high proportion of total treatment cost. The precise data relating to medical treatment costs depend upon the quality of the output of the cost accounting systems applied in hospitals (Babson, 1973). So, estimating medical treatment costs, for the purposes of determining medical treatment costs caused by pollution, depends upon the following assumption: persons suffering from a certain "disease" as a result of environmental degradation bear the same medical treatment costs as those suffering from the same diseases through other causes. Cost of medical treatment of respiratory diseases related to air pollution will be estimated as outlined below.

Estimation of medical treatment costs of a certain disease requires information about:

1. Number of patients.
2. Average length of stay in hospital.
3. Average medical treatment costs per day.

The percentage of respiratory patients in Cairo is about 18.7 percent. This percentage could be considered as an indicator of morbidity due to respiratory diseases in Greater Cairo. Also, the average percentage of respiratory diseases in Egypt is about 5.9

percent (MOH et al., 1983). Considering that G.Cairo is a highly polluted city, the percentage of respiratory diseases which may be attributable to air pollution is 12.8%. The number of patients of respiratory diseases caused by air pollution in G.Cairo can thus be estimated as shown in Table 6.1 below.

Table 6.1: Number of respiratory patients caused by air pollution among residents of Greater Cairo

Region	*Population number*	*Patients by different causes*		*Patients by air pollution*	
		%	number	%	number
G.Cairo (*)	8,666,476 (**)	18.7	620,631	12.8	207,441

(*) Population of G.Cairo includes Cairo, Giza, and Shoubra El-Kheima.
(**) From census data of Egypt, 1986.

MOH et al (1989) have estimated the average of medical treatment costs and the average length of stay for a case of respiratory diseases (inpatients) per/day to be about £E27.8 and 25 days, respectively (see Table 6.2 below).

Table 6.2: Average medical treatment costs and length of stay for inpatients with respiratory diseases

	Cost per case (*)	*Avr. cost per day*
Fees of entering hospital	£E 5.0	0.2
Consultants and medical staff/hr	£E10.0	0.4
Staying and nursing service per day	£E10.0	10
Drugs and nutrition per day	£E15.0	15
Tests and technical services per week	£E15.0	2.2
Average length of stay (day)/ Avr. cost/ day	25 days	£E27.8

£E = Egyptian Pound.
(*) Source: MOH et al. (1989).

On the basis of information given above, medical treatment costs for respiratory patients caused by air pollution could be calculated as follows:

$$MT = NP \times LS \times Avr. \qquad (2.3.1.3)$$

Where,

MT= medical treatment cost.

NP = number of patients.

LS = length of stay in hospital (days).

Avr. = average cost of treatment per day.

Using equation (2.3.1.3) medical treatment cost as it is shown in Table 6.3 is £E144.172 million

Table 6.3: Medical treatment costs of respiratory patients due to air pollution

	No. of patients	*Average length of stay (day)*	*Average cost per day (£E)*	*Total cost (000s £E)*
Greater Cairo	207,441	25	27.8	144,172

Loss of Wages and Production

From the available studies on losses from illness, two essentially divergent approaches have been used in assigning a value to each unit of labour work time. The first is to value each unit by an amount equivalent to total product per worker; the other is to use earnings as a measure of labour product per worker. The first of these assumes, as Cullis (1979) indicated, that all of the national product (income) and therefore any gains in national product are attributable to labour rather than to some combination of joint factors of production, land, labour, capital. It may be true that if there were no labour there would be no product. However, it could be argued that if there were no capital there would be very little product. The second alternative is to use earnings as a measure of the output attributable to labour. This approach would be more appropriate for the purpose of estimating labour product lost as a result of morbidity and mortality. Earnings, in this case, must be distinguished from income that includes returns on property or capital. Earnings consist only of wages and salaries. These wages and salaries are paid in direct return for productive services and correspond to the individual's contribution to production. The losses of wages and production have been calculated, for respiratory patients, to see the huge difference between the two approaches. As expected, the loss of earnings due to disability of respiratory patients of working age were about one-third of production loss. This is calculated below.

According to the Annual Statistical Yearbook of CAPMS for various years and the Socio-Economic Development Plan of the Ministry of Planning for various years, the percentage of individuals who of working age (15-60 years) was 52% of the total population of Egypt. From the same reports, the individual annual production and wage in 1990 were £E8590.6 and £E3260.2, respectively. Thus, the loss of wages of respiratory patients due to air pollution for those individuals who are of working age in G.Cairo can be estimated by using the following equation (2.3.1.4) below.

$$WL = NPW \times LS \times AVD \text{ or } (APD) \qquad (2.3.1.4)$$

Where,

WL = wage losses

NPW = number of patients of working age (52% of the total patients)

LS = length of stay in hospital (days)

AVD = average wage per day (average monthly wage / 30 days)

APD = average productivity losses per day (average annual production / 365 days)

Also the loss of production for the same patients mentioned above could be estimated using equation (2.3.1.4) and substituting APD for AVD. Calculation of lost wages and production by using equation (2.3.1.4) is presented in Table 6.4. From this Table it is clear that the loss of wages and production of individuals who are of working age is about £E24.422 million.

Table 6.4: Loss of wages and production of respiratory patients due to air pollution

	No. of patients of working age	*Average monthly wage (£E)*	*Average annual production (£E)*	*Average length of absence*	*Loss of wages (000s £E)*	*Loss of production (000s £E)*
G.Cairo	107,869	271.6	8,590.4	25	24,422	64,350

2.3.2 Costing Health Damage of Mortality

As discussed in Chapter Four the main difficulty in evaluating lives or health stems from the fact that neither life nor health is treated directly in the marketplace. Individuals can not directly purchase better health or increase their life expectancy. Under nearly all circumstances no sum of money is sufficient to compensate a person for the loss of his life. Lives can not be traded and are obviously qualitatively different from commodities produced and normally traded. However, we will try to put a rough estimation of death cases from respiratory diseases, as an example, to indicate the magnitude of the economic consequences of mortality due to air pollution. Despite these difficulties in evaluating human life, human resource accounting has made some progress in suggesting a model that could be used in estimating the value of human asset. Lev and Schwartz have proposed this model based on using a person's anticipated future earnings as a surrogate measure of his economic value (Sydenham, 1979; Flamholtz and Coff, 1994). The value of human capital embodied in a person of age p is the present value of his remaining future earnings from employment. This value for a discrete income stream is:

$$V_P = \sum_{t=p}^{T} \frac{I(t)}{(1+r)^{t-p}} \qquad (2.3.2.1)$$

Where,

V_p = the human capital value of a person p years old.

I (t) = the individual's annual earnings up to retirement.

r = discount rate.

T = retirement age.

The human resource accounting model is used in estimating the surrogate value of death cases from respiratory diseases as explained below. The study of the National Council of Services and Socio-Development (1992) has shown that the total number of deaths caused by different diseases in G.Cairo is 6,800, of which 1,227 cases are caused by respiratory diseases (i.e., 18%). The average percentage of death cases from respiratory diseases in Egypt (WHO, 1990) is about 10%. Consequently, one can arrive at the percentage of the cases which are attributable to air pollution in G.Cairo to be about 8%. The number of these death cases distributed according to their age scale can be estimated as shown in Table 6.5.

Table 6.5: Number of death cases caused by air pollution according to their age scale

Age	*Total population of Egypt (*)*	*Percentage of age*	*No. of deaths caused by different causes*	*No. of deaths caused by air pollution*
-15	19,281,187	40.0	491	38
15-	5,063,632	10.6	130	10
20-	4,247,541	8.9	109	9
25-	3,697,508	7.9	98	8
30-	2,045,324	4.4	54	4
35-	2,925,306	6.2	76	6
40-	2,127,952	4.6	56	5
45-	1,915,240	4.0	49	4
50-	1,695,676	3.6	44	4
55-	1,252,294	2.8	34	3
60+	3,002,578	7.0	86	7
Total	47,254,238	100	1227	98

(*) Census data of Egypt, 1986.

Future earnings differ according to people's age, experience, knowledge, sex, job...etc. In the absence of the above information, one can use the average annual income in calculating the capitalised future earnings based on the information from the Ministry of Manpower. These calculations are usually used to estimate workers' compensation; those who suffer a permanent disability resulting from work accidents. Based on these equations an estimation of the cost of death from respiratory diseases due to air pollution in G.Cairo is presented in Table 6.6. Calculations for each death case based on information obtained from the Ministry of Manpower is as follows:

1. Value of retirement = (Average monthly wage) x (Number of years until reaching 60 years) (2.3.2.2)
2. Value of experience lost = 3 (Average monthly wage) x (Number of years until reaching 60 years) (2.3.2.3)

It should be noted that the experience period begins from the age of 20 years old until the age of 60 years. An 8 percent discount rate is used in estimating the present value of future earnings, in applying the human resource accounting model, to calculate a surrogate value of human life as is shown in Table 6.6. Finally, the annual average of wages, as mentioned earlier, is about £E3,260.2 (CAPMS, 1992).

Table 6.6: Cost of death cases from respiratory diseases due to air pollution in G.Cairo (£E 1990)

Age	*No. of deaths caused by air pollution*	*Value of retirement*	*Value of experience lost (£E)*	*Total cost (£E)*	*Value of human capital (£E)**
-15	38	7,667,990	-	7,667,990	75,728
15-	10	1,524,013	-	1,524,013	47,744
20-	9	1,137,419	3,412,256	4,549,674	209,426
25-	8	883,416	2,650,249	3,533,666	238,998
30-	4	421,739	1,265,218	1,686,958	167,645
35-	6	495,224	1,485,673	1,980,898	289,247
40-	5	293,940	881,819	1,175,759	252,257
45-	4	191,700	575,099	766,799	241,727
50-	4	115,020	345,060	460,079	213,106
55-	3	44,730	134,190	178,920	121,770
60+	7	-	-	-	-
Total	98	12,775,192	10,749,564	23,524,756	1,857,647

(*) The discount rate is 8%.

From Table 6.6 the present value of deaths from respiratory diseases due to air pollution in G.Cairo is £E1.858 million (i.e., £E18,955.6 per death case). The economic consequences of air pollution on human health for both morbidity and mortality (for respiratory diseases) can be summarized as follows:

Table 6.7: Total cost of morbidity and mortality in G.Cairo,(£E1990)

Economic Consequences of Morbidity		
	Medical treatment costs	144,171,495
	Lost of earnings	24,421,841
Total Cost of Morbidity		168,593,336
The Cost of Mortality		1,857,647
Total Cost of Morbidity and Mortality		170,450,983

Estimating the direct and indirect costs of health damage, resulting from air pollution is an attempt to measure the loss to the nation's economy from illness, disability and premature death. This calculation gives a lower limit for the amount people would be willing to pay to lower morbidity and mortality rates. The indirect costs are calculated in terms of earnings forgone by those who are sick, disabled, or prematurely dead.

2.4 Costing Physical Capital Damage

Air pollution can cause several damaging effects for constructions and economic materials. This leads to an appreciable amount of economic loss. According to Stern et al (1978), damage due to exposure to air pollution may occur in several forms such as:

- corrosion of metals,
- rubber cracking,
- roiling and eroding of building surfaces,
- deterioration of works of art,
- fading of dyed materials, and
- loss of crop production.

It is difficult to estimate the costs of air pollution as regards to some of its damaging effects. Certain costs, such as those to agriculture, have been estimated, but many of the economic effects of pollution are indirect or hidden and thus difficult to determine. Examples would be the reduced growth of crops because of low level, but chronic, exposure to combinations of air pollutants; additional cleaning costs (how much of the dirt in the air is man-made air pollution and when is the building or shirt dirty enough to be cleaned); and damage to art work. In spite of these difficulties some estimates have been made.

This section aims at evaluating the damage effects of air pollution only on buildings. It deserves mentioning that the damaging effects of air pollution on crop production are not significant because the total cultivated area in G.Cairo is very small, about 0.1% of the total cultivated area.

Corrosive air pollutants affect building stones. In particular, limestone ($CaCo_3$) and dolomite ($CaCO_3$ and $MGCO_3$) are attacked by sulfuric acid. Staining of the stone by a combination of sulfur compounds and particulates results in additional cleaning expense. Since one of the proposed clean-up techniques for SO_2 in flue gas is to react it with $CaCO_3$, it is not surprising that the same reaction takes place, undesirably, in nature (Perkins, 1974). Paint is also affected by pollution: areas of high pollution require more frequent painting. SO2 levels that are just above the national base standard adversely affect the drying of paint. Another corrosive effect of air pollutants is evident in textiles. Both dye fading and reduced tensile strength result from several compounds including SO_2, No_x and O_3. Pollution has several types of effects on materials: it can corrode them, deteriorate them, change their color, soil them or necessitate special measures to protect them. There are several types of costs that can be classified here; the most important of which are a result of:

- the reduced longevity of a material (material and installation costs are both considered here),
- the decreased productivity or utility of a material,
- the necessity to design a satisfactory substitute material,
- the need to protect the vulnerable material from sources of pollution, and
- any additional maintenance, including the cleaning of a material, required because of pollution.

The economic loss due to air pollution has been evaluated in several countries such as the USA and the UK. The cost of material damage by air pollution in the United States was estimated to be $4.8 billion in 1968. In England, the economic loss from air pollution is of the order of $250 million per year (Stern et al., 1978). One study has compared the economic losses resulting from air pollution in a relatively heavily polluted area to those in a less polluted city. Steubenville, Ohio, with a suspended particulate level of 235 $\mu g/m^3$ was compared to Uniontown, Pennsylvania, where the particulate level was 115 $\mu g/m^3$. Table 9 shows the difference per person and the difference in total costs incurred by living in Steubenville as a result of air pollution. Therefore, the total air pollution costs per person in a polluted area were about 84 dollars per year, mainly as a result of inside and outside house maintenance (Perkins, 1974). Another study was concerned with the effect of air pollution on property values. The researchers argue that such results of air pollution as ailing shrubbery, off-color paint, sooty surfaces, hazy view, and unpleasant odors are taken into account by a home buyer in his offer price. This hypothesis was tested statistically through an analysis of residential property value in three cities- St. Louis, Kansas city, and Washington. Variations in sales prices and rents were correlated with family income, number of rooms, age and condition of property, distance from the center of the city, racial composition of neighborhood, and general educational level of neighborhood, as well as two pollution variables, sulfur dioxide and suspended particulates. Although the results, of course, differed among the three cities, a significant inverse correlation was found between air pollution and property values to the extent that a moderate decrease in air quality (five to fifteen percent) correlated with a significant decrease in property values ($300-$700 for an average property). Using these results, combined property value losses from air pollution in eighty-five United States cities were calculated at $621 million for 1965 (Ridker, 1967).

Table 6.8: Differences in cleaning costs incurred at Steubenville and at Uniontown.

Activity	*Gross cost differences (Steubenville over Uniontown) in dollars*	
	Annual	*Per capita*
Outside maintenance of houses	640,000	17
Inside maintenance of houses and apartments	1,190,000	32
Laundry and dry-cleaning	900,000	25
Hair and facial care	370,000	10
Total	$3,100,000	$84

Cleaning costs are not a corrosion effect but we may note in this section that the effect of both gaseous and particulate air pollutants is to increase markedly such cleaning costs both for buildings and individuals. A visit to the large cities in Egypt quickly demonstrates the effect of particulate matter fall-out on personal and housing cleaning costs. Some of these costs will be estimated as follows. Air pollution, as a result of PM and sulfur dioxide (SO_2) increase, in greater Cairo is above the national level by a factor of 10 and 2 times for PM and SO_2, respectively. This has a significant effect on the cost of repainting, cleaning and maintenance of inside and outside the house in comparison with the non-polluted (clean) areas. This is called comparison approach. Accordingly, we will use the comparison approach (CA) in estimating the cost of buildings damage, as a result of air pollution, in G.Cairo and other urban areas. To apply CA in estimating buildings damage, it is necessary to have data about:

1. the number of houses exposed to air pollution in the polluted area,
2. the estimation of the extra cost per house for repainting, cleaning and maintenance of the inside and outside of the house.

It is possible to estimate the number of houses in Cairo by dividing the total number of population by the average family size. The total number of population from the last census data of Egypt in 1986 for G.Cairo was about 8,666,478 capita and the average family size from the CAPMS Statistical Yearbook is about 5 persons. We could assume that an extra cost, as a result of repainting, cleaning and maintenance of the inside and outside of the house from air pollution, is 0.5% as a conservative estimate of the total annual income per capita in Cairo. This extra cost has been estimated for Steubenville, with suspended particulate level of 235 $\mu g/m^3$, as about 84 dollar per person (i.e., about 0.8% of the total annual income per capita). In contrast, the level of particulate matter in G.Cairo is about 349 $\mu g/m^3$ (see Table 6.30 in Appendix 6.2). This means that, we are underestimating the real cost of buildings damage resulting from air pollution in G.Cairo. Based on the above assumptions, and according to data availability, the cost of building damage as a result of air pollution is estimated for the period 1980-1992, as is shown in Table 6.9.

Table 6.9: An estimated cost of buildings damage from air pollution, 1980-1992.

Year	*Natural increase of population* (1)	*Population estimates* (2)	*Estimated number of houses* (3) = (2)/5	*Annual average income per capita* (4)	*Average extra cost per house (£E)* (5)= (4) x 0.5%	*Total costs of buildings damage (£E)* (6) = (3) x (5)
1980/81	2.75	7361795	1472359	854	4.27	6,286,973
1981/82	2.70	7564245	1512849	963.0	4.82	7,284,368
1982/83	2.62	7768479	1553696	1193.9	5.97	9,274,788
1983/84	2.71	7972013	1594403	1349.5	6.75	10,758,234
1984/85	2.92	8188055	1637611	1466.0	7.33	12,003,689
1985/86	2.84	8427147	1685429	1545.1	7.73	13,020,782
1986/87	2.82	8666478	1733296	1854.1	9.27	16,068,521
1987/88	2.92	8919539	1783908	2116.8	10.58	18,880,882
1988/89	2.83	9171962	1834392	2379.5	11.90	21,824,679
1989/90	2.85	9433363	1886673	2719.4	13.60	25,653,093
1990/91	2.45	9664480	1932896	3260.2	16.30	31,508,138
1991/92	2.38	9894494	1978899	3470.1	17.35	34,334,887
1992/93	2.29	10121078	2024216	3520.2	17.60	35,628,226

Note:
1. Obtained from CAPMS Statistical Yearbook, 1952-1992, Cairo, Egypt.
2. Population estimates are calculated by using 1986 census data and the natural increase in population.
3. The number of houses is estimated by using column (2) divided by the average of family size (5 persons).
4. Obtained from Economic and Social Development Plan for various years and INP (1995) Egypt: Human Development Report.
5. Column (5) =Column (4) x 0.5%.
6. Column (6) =Column (3) x Column (5).

It is worth noting that the comparison approach which has been applied in estimating the cost of buildings damage could be used in estimating the total losses of agriculture crops. However, as mentioned earlier, it requires data about the total cultivated area in the polluted city, the determination of the main crops, and the average productivity per hectare of the main crops in the polluted area in comparison to the average productivity per hectare in clean areas that are next to the polluted area, which is not readily available or difficult to estimate, in this study, for the time being. In addition, in applying the CA approach the non-polluted area should have the same characteristics of land, weather...etc., except the pollution factor. The cultivated area in G.Cairo and other urban areas of the total cultivated area is not significant and the available data are incomplete and inaccurate. Therefore, the effects of air pollution on agriculture crops will not be addressed in this study.

2.5 Summary

The cost of air pollution is estimated by measuring its damaging impact on both human and physical capital. The cost of air pollution damage to human capital in terms of morbidity and mortality, for G.Cairo in 1990, is about £E171 million. The cost of physical capital damage, for buildings, is about £E32 million for the same year. Therefore, the total cost of air pollution in 1990 for G.Cairo, the benchmark year for establishing the Egyptian environmental accounting, is £E203 million or about 1.5 percent of industrial gross domestic product. However, it is important to have in mind that this cost is only part of air pollution costs. Based on these estimates, the total cost of air pollution for urban areas in Egypt, for the 1981-1990 period, is estimated as presented in Table 6.10 below. For the details of the calculations and the methodology of estimation see Appendix 6.6 (Section 6.6.1 and Tables 6.36 & 6.37).

Table 6.10: Costs associated with air pollution for Egypt, 1981-1990 (£E million 1990)

Year	*Costs of physical capital damage for G.Cairo*	*Cost of physical capital damage for other urban areas*	*Total cost of physical capital damage 1990*	*Human capital cost for (G.Cairo)*	*Human capital costs for (rest urban)*	*Total human capital Cost 1990*	*Total cost of air pollution 1990*
1981	7.28	5.11	36.23	40.37	51.02	267.03	303.25
1982	9.27	6.50	42.52	51.40	64.85	313.34	355.86
1983	10.75	7.53	45.66	59.63	75.20	336.49	382.16
1984	12.00	8.39	45.80	66.53	83.74	337.39	383.19
1985	13.02	9.05	45.47	72.16	90.33	334.69	380.16
1986	16.06	11.12	49.65	89.06	111.01	365.27	414.92
1987	18.88	13.00	50.59	104.64	129.70	371.82	422.40
1988	21.82	14.96	50.45	120.96	149.32	370.63	421.09
1989	25.65	17.51	50.72	142.18	174.74	372.36	423.08
1990	31.50	21.57	53.08	170.45	215.19	389.82	442.90

3. THE COST OF WATER POLLUTION

"Egypt, said Herodotus, is the gift of the Nile."[1] Lack of water is one of the major constraints for economic development in Egypt. High Aswan Dam (HAD) annual releases are an average of 57.6 billion cubic meters a year (Abuzeid, 1991). There is an ongoing project with Sudan to increase Egypt's quota by 2 billion cubic meters a year (the Gonglei canal project). The Nile supplies Egypt with 98% of total agriculture, industry and domestic water consumption. However, The Nile now is in danger. One recent study has concluded that seven constituents of water have changed between 1976-1986. The constituents index has compared with its standard. These constituents were temperature, BOD, TDS, phosphate, nitrate, ammonia and fecal coliform bacteria. The study concluded that the degradation of water quality has occurred since 1977 and drinking water quality for most of Egypt's population has been contaminated (EEAA, 1992d).

The main goal of this section is to estimate some of the costs of water pollution that have resulted from economic activities. This is conducted by measuring the economic consequences of water pollution on human capital. This section is divided into three parts; the first gives a brief overview of water pollution in Egypt; the second measures the cost of water pollution damage to human capital in terms of morbidity; the third estimates human capital mortality cost; and finally the fourth presents a summary and highlights of the main findings of this section and extrapolates the water pollution costs for the 1981-1990 period.

3.1 Sources of Water Pollution

As explored in Chapter Two, there are three major sources of water pollution in Egypt: domestic, industrial and agricultural. Domestic wastewater requires at least primary treatment, and where necessary, secondary and tertiary treatment. The

[1] Herodotus was a Greek historian who visited Egypt two thousand years ago.

pollution of the Nile canals and drains, by industrial effluents, is a more complex problem compared to domestic and agriculture pollution. The Egyptian government currently owns and operates 375 industrial facilities. The Ministry of Industry is the major owner (72%), followed by the Ministry of Economics (9%), the Ministry of Supplies (8%), and the remainder (11%) is owned by the Ministry of Defense, Electricity and Agriculture (Hass, 1990). Of these industries, 35% discharge effluents directly in to the Nile through drains, 15% discharge in to the canals that are sources for irrigation as well as drinking (WHO and MOH, 1985).

Industrial water pollution is a rapidly growing problem, and in parts of Egypt water bodies are already seriously contaminated and violate WHO guidelines for drinking water (World Bank, 1992). This indicates that the industrial sector is responsible for most, if not all, of the deterioration of water quality in Egypt. Water pollution has an impact on public health. Changes in water quality have resulted in providing a suitable milieu for most, if not all, water-born diseases (e.g., cholera, malaria, bilharziasis,...etc.). Bilharziasis is the major threat for human health in Egypt, especially for the poor segments of the population in rural areas. Bilharziasis is a snail vectored trematode disease. The prevalence rate of this disease in rural areas was about 5 times higher than the urban rate in 1990 (MOH, 1992). Farmers, therefore, are more exposed to infection than others because of their direct contact with water, especially after constructing HAD and transferring to perennial irrigation (White, 1988).

The most usual effect of bilharziasis on human capital is to depress their general health and physical abilities (World Bank, 1994). The two common types of bilharziasis in Egypt are urinary (haematobium) and intestinal (mansoni). The spread of the second between the population is higher than the first (see Figure 6.3 in Appendix 6.3). In addition, the Delta governorates which are dominated by the agriculture profession have a higher percentage of infected individuals than urban and upper governorates (see Figure 6.5 and Table 6.32 in Appendix 6.3). A number of studies have linked individual worker output to health status. Some of these studies focused on the economic impact of bilharziasis. Four studies indicated that productivity declined by one-third due to bilharziasis, especially among those individuals aged between 30-60 years old (Sorkin, 1976). Therefore, morbidity costs for urban and rural areas for bilharziasis patients is estimated first by calculating medical treatment costs and wages forgone due to patients' debility. The surrogate value for human life of bilharziasis death cases is estimated second (i.e., the future earnings forgone that result from the premature death of bilharziasis patients).

3.2 Health Cost Damage Due to Morbidity

As discussed earlier in the case of air pollution, there are two main costs that have to be calculated to derive the total costs of bilharziasis disease resulting from water pollution. First, the direct cost represents the actual use of economic resources (manpower and materials). Second, the indirect cost represents the production or income forgone by impaired human resources (as a result of debility, disability, and death caused by sickness).

3.2.1 Medical Treatment Cost

Two main costs should be considered in estimating the medical treatment cost of bilharziasis; the cost of medical staff and the cost of drugs. It is important to realize that there is no indirect medical treatment[2] cost because most of the cases, if not all, are outpatients.[3] Drugs and medical staff costs have obtained from the annual report of the Ministry of Health; these costs were £E10 and £E5 per case in 1990, respectively. From the same reports, the percentages of bilharziasis infection were about 5 and 20 percent for urban and rural areas for the same year, respectively. On the basis of this information, the medical treatment cost for bilharziasis patients is calculated as shown in Table 6.11. From this table it is clear that the medical

[2] Indirect medical treatment cost such as equipment, electricity...etc. is a very small amount therefore it can be ignored. This is because this type of cost is usually shared by all types of patients.

[3] In contrast, the medical treatment cost of respiratory diseases for inpatients and outpatients have been estimated (i.e., both the direct and the indirect medical treatment costs are calculated).

treatment costs for urban and rural areas in 1990 are about £E16.395 and £E95.487 million, respectively.

Table 6.11: Medical treatment costs of bilharziasis patients due to water pollution, 1990

Category	*Population number (000s)*	*Patients number (000s)*	*Average treatment cost*	*Total cost (£E000s)*
Urban	*21,860*	*1,093*	*15*	*16,395*
Rural	31,829	6,366	15	95,487
Total	53,689	7,459	-	111,882

3.2.2 Loss of Earnings Due to Debility

Several attempts have been made to assign a quantitative value to the economic benefits that would accrue from bilharziasis control (Farooq, 1963 and 1967; Sorkin, 1976; Wright, 1988; and World Bank, 1994). Almost all these studies emphasized the benefits that would accrue from control and identified the debilitating consequences of bilharziasis infection as a key parameter in the analysis of the economic effects of bilharziasis (schistosomiasis)[4]. The hypothesis is that sustained physical effort is reduced (impose dysfunction) which therefore reduces the productivity of infected labour below what would otherwise be attained in a state of freedom from infection. All the economic analysis for bilharziasis disease is based on this assumption. A model has been proposed by Prescott (1978) to estimate the economic loss due to debility of infected individuals. The form of this model is:

$$K = N\,(e\,W) \qquad (3.2.2.1)$$

Where:

K = annual economic loss

N = number of infected individuals

W= annual average labour wage/output

e = percentage average loss of working capacity coefficient (coefficient of debility)

[4] This is the scientific name of bilharziasis disease.

Several different yardsticks of the effect of debility on worker efficiency have been used (Mushkin, 1962 and 1966; Weisbrod, 1973; and World Bank, 1994). These include:

1. Output in a plant with recorded information on number of machines in operation, before and after disease control work is instituted.
2. Wages earned on a piece-rate basis by those with the disease and those free of the disease.
3. Wages of workers in an area with high disease prevalence compared to wages of similar workers in areas free from disease.
4. Output on a farm in which a disease problem is controlled, measured against output of control group of workers.
5. Laboratory tests of work energy of groups of workers infected with the disease measured against work capacity of a normal control group.

To estimate the bilharziasis patient's debility the number of infected individuals is required first. A measure of the loss of working capacity caused by infection is required second. This is determined by the estimation of the percentage coefficient measuring the extent to which the output (wage) of infected labour falls short of the normal one. According to Ministry of Health reports, bilharziasis disease has a damaging impact on a worker's productive capacity, especially for those aged between 30-60 years old. MOH laboratory tests have estimated the coefficient of the loss in working capacity for bilharziasis patients to be about 20 percent. However, this coefficient is estimated in some other cases such as the Philippines and St. Lucia to be between 30-33% (World Bank, 1994).

According to the last data census for Egypt (1986) the percentage of persons aged between 30-60 years is about 33% of the total population of Egypt. The number of bilharziasis patients within this age category is estimated as shown in Table 6.12. The annual averages of income for urban and rural areas are £E3260.2 and £E1378.1[5],

[5] The average income in rural areas is about 42 percent of urban income. This can be explained by the characteristics of rural areas. In rural areas the dominant profession is agriculture, which includes a large proportion of unskilled labour and hidden unemployment.

respectively (Ministry of Planning follow-up reports). Thus the loss of wages of bilharziasis patients due to water pollution in Egypt, as a result of patients' debility, is estimated by using equation (3.2.2.1). Calculation of lost wages using equation (3.2.2.1) is presented in Table 6.12. This table shows that the total wages loss of infected individuals aged between 30-60 years are £E293.962 and £E723.758 million for urban and rural areas, respectively.

Table 6.12: Total wage losses due to the debility of bilharziasis patients, 1990

Category	*Patient number (000s)*	*Patient aged 30-60 (000s)*	*Annual average wage*	*Real annual average wage (£E)*	*Wage loss due to debility*	*Total wage losses (£E 000s)*
Urban	1,093	360.69	3260.0	4075.00	815.00	293,962
Rural	6,366	2100.71	1378.1	1772.63	344.53	723,758
Total	7,459	2461.4	-	-	-	1,017,720

3.3. Health Damage Costs Due to Mortality

The same human capital accounting model, applied in the case of air pollution, is used to estimate the surrogate value of deaths from bilharziasis disease. Again, this model is based on using a person's anticipated future earnings as a surrogate measure of his economic value. The form of the model is:

$$V_P = \sum_{t=p}^{T} \frac{I(t)}{(1+r)^{t-p}} \qquad (3.3.1)$$

Where:

V_p = the human capital value of a person p years old.

I (t) = the individual's annual earnings up to retirement.

r = discount rate.

T = retirement age.

The number of death cases from bilharziasis disease is obtained from CAPMS birth and death data for the last 10 years (see Figure 6.4 in Appendix 6.3). The bilharziasis death rate in 1990 was about 3.11 percent of the total population death number, which was 0.069 percent of the total population of Egypt. Therefore, urban and rural death numbers from bilharziasis are estimated by distributing the bilharziasis death number between urban and rural areas using a weighted averages of the disease prevalence rates in urban and rural areas. The number of these death cases is distributed according to the population age scale as shown in Table 6.13.

Table 6.13: Number of death cases caused by water pollution distributed according to the population age scale.

Age	*Percentage of age*	*Number of deaths in urban areas*	*Number of deaths in rural areas*	*Total number of deaths*
-15	40.0	1002	4007	5009
15-	10.6	266	1062	1328
20-	8.9	223	892	1115
25-	7.9	198	791	989
30-	4.4	110	441	551
35-	6.2	155	621	776
40-	4.6	115	461	576
45-	4.0	100	401	501
50-	3.6	90	361	451
55-	2.8	70	281	351
60+	7.0	175	701	876
Total	100	2505	10,018	12,523

An estimation of forgone future earnings of death cases due to water pollution is presented in Table 6.13 & 6.14 for urban and rural areas, respectively. These estimations are based on the earlier explained equations, mentioned in the case of air pollution, that have been used by the Ministry of Manpower to estimate permanent disability workers' compensation resulting from work accidents.

Table 6.14: Cost of death cases resulting from bilharziasis disease due to water pollution in urban areas (£E 1990)

Age	*Number of death cases*	*Value of retirement*	*Value of experience lost*	*Total cost*	*Value of human capital*
-15	1,002	196,003,224	-	196,003,224	1,935,699
15-	266	38,955,641	-	38,955,641	1,220,398
20-	223	29,073,812	87,221,435	116,295,246	5,353,179
25-	198	22,581,205	67,743,614	90,324,819	6,109,078
30-	110	10,780,177	32,340,532	43,120,709	4,285,221
35-	155	12,658,542	37,975,625	50,634,166	7,393,495
40-	115	7,513,457	22,540,371	30,053,828	6,447,995
45-	100	4,900,081	14,700,242	19,600,322	6,178,839
50-	90	2,940,048	8,820,145	11,760,193	5,447,245
55-	70	1,143,352	3,430,056	4,573,409	3,112,585
60+	175	-	-	-	-
Total	2505	326,549,538	274,772,020	601,321,558	47,483,733

Table 6.15: Cost of death cases from bilharziasis disease due to water pollution in rural areas (£E 1990)

Age	*Number of death cases*	*Value of retirement*	*Value of experience lost*	*Total cost*	*Value of human capital*
-15	4,007	331,339,339		331,339,339	3,272,259
15-	1,062	65,853,694		65,853,694	2,063,057
20-	892	49,148,669	147,446,006	196,594,675	9,049,436
25-	791	38,173,053	114,519,159	152,692,212	10,327,268
30-	441	18,223,664	54,670,991	72,894,655	7,244,076
35-	621	21,398,999	64,196,997	85,595,996	12,498,548
40-	461	12,701,341	38,104,024	50,805,365	10,900,200
45-	401	8,283,483	24,850,450	33,133,934	10,445,198
50-	361	4,970,090	14,910,270	19,880,360	9,208,453
55-	281	1,932,813	5,798,438	7,731,251	5,261,760
60+	701	-	-	-	-
Total	10,018	552,025,145	464,496,336	1,016,521,481	80,270,255

From Tables 6.14 & 6.15 one can see that the total values of human capital, for urban and rural areas, are £E47.48 and £E80.270 million, respectively. Consequently the values of one death case are about £E18,955.58 and £E8,012.603 for urban and rural areas, respectively.[6] Estimating the direct and indirect costs of health damage resulting from water pollution is an attempt to measure the loss to the nation's economy caused by illness, debility and premature death. The economic consequences of water pollution on human capital in terms of morbidity and mortality (for bilharziasis disease) for Egypt in 1990 are summarized in Table 6.16 below.

Table 6.16: Total cost of morbidity and mortality in Egypt, 1990 (£E million)

Economic Consequences of Morbidity		
	Medical treatment costs	111.88
	Loss of earnings	1017.72
Total Cost of Morbidity		1129.60
The Cost of Mortality		
	Rural death	47.48
	Urban death	80.27
Total Cost of Mortality		127.75
Total Cost of Morbidity and Mortality		*1257.35*

3.4 Summary

The above calculation for the cost of water pollution, however, only gives the lower limit for the amount that people would be willing to pay to lower the morbidity and mortality rates. The indirect costs are calculated in terms of earnings forgone for those who are sick, disabled or prematurely dead. The total cost of water pollution damage to human capital, as a result of morbidity, for both rural and urban areas is £E1129.602 million. The total mortality costs for urban and rural areas is about £E127.754 million, that is approximately one-tenth of morbidity cost. Therefore, the total cost of water pollution is £E1257.3 million, or about 4 percent of the industrial gross domestic product, that is, considering the industrial sector is responsible for water pollution as explained earlier. Based on these estimates the cost of water pollution, for the 1981-1990 period, are extrapolated as explained in great detail in

[6] The huge difference in values of human life between urban and rural areas resulted from the differences in earnings. The annual average income in rural areas is about 42 percent of the same average in urban areas.

Appendix 6.6 (Section 6.6.2 and Table 6.38). These estimates are presented in Table 6.17 below.

Table 6.17: Cost of water pollution, 1981-1990 (£E million 1990)

Year	Urban population (1)	Rural population (2)	AAIP. in urban area (3)	AAIP in rural area (£E) (4)	Total costs of urban area (£E million) (5)= (1)*(3)*0.501%	Total costs of rural (£E million) (6)=(2)* (4)*2.05%	Total cost of water pollution (1990)
1981	17,124.00	24,881.00	963.00	169.81	82.80	86.65	495.07
1982	17,569.22	25,565.23	1,193.90	209.00	105.32	109.57	579.20
1983	18,026.02	26,268.27	1,349.50	365.75	122.14	197.03	796.59
1984	18,494.70	26,990.65	1,466.00	555.16	136.14	307.28	995.57
1985	18,975.56	27,732.89	1,545.10	653.13	147.21	371.45	1,068.28
1986	19,468.93	28,495.55	1,854.10	783.75	181.25	458.00	1,167.11
1987	19,975.12	29,279.17	2,116.80	894.79	212.31	537.26	1,189.27
1988	20,494.47	30,084.35	2,379.50	1,005.82	244.86	620.53	1,186.72
1989	21,027.33	30,911.67	2,719.40	1,149.51	287.11	728.68	1,193.50
1990	21,860.00	31,829.00	3,260.20	1,378.10	357.84	899.52	1,257.36

Note: AAIP = Average Annual Income Per/capita.

4. DEPRECIATION OF SOIL RESOURCE

The central focus of this section will be to provide a systematic method of identifying and ensuring the economic cost of land degradation and more specifically that of soil erosion. The question that needs to be answered is how much should Egyptian farmers and others adversely affected by erosion be willing to pay to prevent it? The focus will be on estimating the on-site and the off-site losses. This section is divided into three parts: the first discusses the global and conceptual context and sets out the basic problem; the second reviews and examines the main approaches that could be used in estimating soil erosion; the third summarises the methodology used in estimating the on-site cost and some of the off-site cost of soil erosion and highlights the main findings of this section.

4.1 Impact of Soil erosion on Productivity

The main environmental impact associated with cropping is erosion and associated nutrient and soil loss. It is usual to distinguish between on-site losses (incurred by the farmer) and off-site losses, such as siltation of irrigation systems, harbors, and reservoirs (including hydroelectric power reservoirs); damage to fisheries; and the effects of intensified flooding. A soil's fertility depends on its slope, texture, depth, and structure as well as on precipitation, temperature, and other ecological conditions. As long as soil use does not exceed its capacity, productivity can be maintained indefinitely. If overused, the soil's productivity wanes, economic value is lost, and eventually the land is abandoned (Solorzano et al., 1991). If managed poorly the soil gradually loses productivity. Inputs have to be intensified to maintain the same yield, or farmers will be forced to switch to less intensive and profitable crops. All these problems result from nutrient loss and the deterioration of soil structure.

Soil erosion is a major form of environmental degradation in the developing world, especially the tropics (due to intense rainfall and high temperature, for example). The build-up of population pressure and the direct dependence on natural resources for livelihood further accentuates the natural process of erosion (through deforestation, overgrazing, and so forth). For developing countries there is a virtual absence of data relating soil erosion to yield losses. Notwithstanding these limitations, a study conducted by Magrath and Arens (1989) in Java established the total on-site and off-site costs of declining soil productivity at $340 million to $406 million or 0.5 percent of total GDP. More recently, Mali on-site losses from soil erosion have been estimated to be in the range of 0.5 to 3.1 percent of GDP (Bishop and Allen, 1990). Table 6.18 provides an overview of global soil degradation and excessive soil loss. Of the 4,700 million hectares of agricultural land, some 900 million (17 percent) are moderately and 300 million (6 percent) are strongly degraded (Oldeman, Hakkeling, and Sombroek, 1990). The major man-made causes are deforestation (120 million hectares between 1973 and 1988), followed by mismanagement of arable land, and overgrazing. The most frequent type of degradation is water erosion, followed by wind erosion.

Table 6.18: Soil degradation by type and cause (classified as moderately to excessively affected).

	Water	*Wind erosion*	*Chemical*	*Physical*	*Total (million hectares)*
Regions	*(in millions of hectares)*				
Africa	170	98	36	17	321
Asia	315	90	41	6	452
South America	77	16	44	1	138
North and Central America	90	37	7	5	139
Europe	93	39	18	8	158
Australia	3	-	1	2	6
Total	*748*	*280*	*147*	*39*	*1,214*
Major Causes	*(in percent)*				
Deforestation	43	8	26	2	384
Overgrazing	29	60	6	16	398
Mismanagement of arable land	24	16	58	80	339
Other	4	16	12	2	93
Total	*100*	*100*	*100*	*100*	*1,214*

Source: Adapted from ISRIC/UNEP (Oldeman, Hakkeling, and Sombreok 1990).

Egyptian soils are poor in organic matter content and available nitrogen, but contain average of phosphorus and potassium. Therefore, there is a need for relatively high fertiliser application under intensive agriculture. Present fertiliser use in the country is very high (see Table 6.33 in Appendix 6.4), and rivals average consumption in some developed countries. For example, Egyptian farmers apply an average of 319 kg/ha of basic nutrients (N, P, and K), as compared to 346 kg/ha in Holland and 377 kg/ha in Japan (world average is 28 kg/ha) (World Bank, 1993).

Farm structure distortion is the main factor that is responsible for soil erosion in Egypt. The last agriculture census, conducted in 1982 and 1990 by the Ministry of Agriculture, reported that: (1) by far the majority of farms are smallholdings of less than 5 feddans (or 2.1 hectare) and microholdings of less than 2 feddan (or 0.84 hectare) that make up 94.1% of the total number of farmers (see Figure 6.7 in Appendix 6.4); (2) plots are small in size and very scattered; (3) illiteracy rates are very high among small farmers (about 59% among those with less than 2 feddans or

0.84 hectare); (4) farmers' level of income is much lower than any other group of workers. This reported situation has the following negative consequencies: (1) it represents a handicap for the spread of new techniques among farmers; (2) most of them do not follow the agricultural annual rotation that conserves soil fertility; (3) and finally, most of them seek to cultivate the profitable crops for their own survival without considering the side effects on land sustainability (short term benefits normally result in long term costs). In addition, the land tenure system and property rights in Egypt have damaging impacts on the sustainability of land and water resources. Moreover, the distorted owner-tenant relationship for agricultural land in Egypt is another major factor that prevents farmers and owners from investing in land improvements (Hughes, 1992).

Therefore, farm structure and tenant-owner relationship distortions are the major causes of on-site cost of soil erosion in Egypt. On the other hand, HAD and its reservoir, which prevents the rich mud and organic material from settling on lands, as it was before by the annual flood, is another cause of soil erosion (off-site cost). The second cost (off-site) is normally a minor cost compared to the first (on-site). This is explained in the following section.

4.2 Approaches in Estimating Soil Depreciation

The depreciation of the soil resource can be expressed directly, by quantifying the loss of productivity, or indirectly by evaluating physical and biological properties lost through erosion. The main approaches in estimating the cost of soil erosion are:

- ***The productivity approach***: this considers the cost of production foregone due to erosion-induced productivity decline, summed for the whole country. This approach attempts to estimate the net annual losses as a result of productivity losses stemming from erosion. The productivity approach applied by Bishop and Allen (1989) in their analysis of on-site costs of soil erosion in Mali adopted this kind of method. They used a model of the erosion/yield relationship based on research carried out by the International Institute for Tropical Agriculture in Ibadan, Nigeria. They then integrated the implications of the reduced yields into farm budgets to estimate the return foregone as a consequence of erosion. Also, Magrath and Arens (1989) estimate the costs of soil erosion on Java (in Indonesia) by using a variety of sources to estimate the annual percent change in yield associated with erosion and then used farm budget data to derive the implications for net output. The productivity loss method is theoretically much more precise. If good farm budget data are available, if the responses of farmers to changing productivity can be predicted, and if the areas suffering productivity losses under different farming systems are known, the net productivity loss can be approximated. Correctly used, this method reflects the true relationship between soil loss and real economic loss, linking diminished soil resource to decreased productivity.

- ***The Land Value Approach**:* this has erosion-induced losses reducing its value capitalized into the price of agricultural land. This approach, however, may be more applicable in a developed country context in which rural real estate markets are well established. Therefore, this approach is less applicable in the developing world because of the market failures and distortions of agricultural land prices. For example, Tutu in 1985 tried to apply this approach for Ghana, but because of the distortions of market land prices he failed.

- ***Replacement Cost Method**:* nutrient content is one of the most important soil characteristics for crop growth. Erosion translates physically into the depth of soil washed away, varying in severity from a few millimeters to several centimeters. With the soil go nutrients, principally nitrogen (N), phosphorous (P), and potassium (K). To restore soil fertility, nutrients would have to be replaced through fertilization. Depreciation can, therefore, be estimated as the cost of replacing lost nutrients with commercial fertilizers. Replacement cost is the approach adopted for most, if not all, case studies in developing countries (Norse and Saigal, 1994; Tutu, 1995; and Solorzano, 1991). However, the replacement cost method, as a measure of the cost of soil erosion, is never exact. It undervalues the depreciation cost for the profitable crops. On the other hand, it overvalues the depreciation cost for less profitable crops

In sum, neither the land value nor productivity approaches are applicable in the developing world, mainly because of lack of data and market failure. Although the replacement cost method does not reflect the real cost of soil erosion, it is considered the most suitable one for the developing world for the following reasons. First, it does not require a lot of data as do other approaches. Second, it could be modified according to the country circumstances and data availability, as in the case of this study which adopted the third-best approach in estimating the on-site cost of soil erosion. This will be explained below.

4.3 Depreciation of Soil Erosion in Egypt

4.3.1 On-Site Cost of Soil Erosion

The environmental deterioration to land is erosion and associated nutrient and soil loss. The major cost of soil erosion is the on-site losses (incurred by the farmer). On the other hand, in most cases, off-site losses are tangible as a result of siltation of irrigation systems, harbors, and reservoirs (including hydroelectric power reservoirs); damage to fisheries; and the effects of intensified flooding. To estimate the on-site cost of soil erosion using the replacement cost method the following steps have been followed:

1. estimating the total area that suffers from severe erosion in the country,
2. estimating the nutrient losses per feddan (mainly for nitrogen as one of the important soil constituents for plant growth),
3. determining the conversion factor to compensate the nutrient loss by commercial fertilizers,
4. estimating the cost of soil erosion using the commercial (constant) prices of fertilizers during the study period.

The total area suffering from severe erosion has been estimated based on two surveys of agricultural land classification in 1985 and 1990 (unpublished data). According to land classifications by the Ministry of Agriculture (MOA), land classes C, D and E have been categorised as suffering from severe erosion. In addition, based on the assumptions that the change in the total eroded area between the two surveys was constant for each year and lands of class C, D, and E have the same level of erosion, as reported by MOA, the annual average eroded area for the 1986 and 1990 period has been estimated as presented in Table 6.19 below.

Table 6.19: Non sustainable erosion, 1986-1990 (000s metric ton/year)

Year	*Eroded area (000s feddan)*	*Percentage of the total area*	*Total losses of nitrogen (000s mt./yr)*
1986	1018.80	16.08	173.20
1987	1322.60	20.89	224.80
1988	1626.40	25.69	276.49
1989	1930.20	30.50	328.13
1990	2234.00	35.00	379.78

INP (1993) estimated the average loss of nitrogen per feddan of eroded land to be about 170 kg/yr. Therefore, the total loss of nitrogen for the total eroded area can be estimated as is shown in Table 6.19. According to Ministry of Agriculture and Land Reclamation statistics, fertilizers' use in 1987/88 amounted to 990 thousand tons of nutrient equivalents, representing about 6,737 thousand tons of commercial fertilizers. That is to say an average volume per feddan of 1,101 kg (170 kg if expressed in nutrient equivalent) (MOA, 1992; INP, 1993). Now the conversion factor per feddan could be estimated, which is an average of 6.5 for all nutrients. The value of fertilizers for 1989 and 1990 years is obtained from the Ministry of Agriculture, but it is estimated for the remaining years by interpolation of the annual average increase in fertilizer prices between 1982 and 1988. Then, the prices deflated using 1990 prices. The constant prices of different types of fertilizers for the 1986-1990 period are presented in Table 6.20 below.

Table 6.20: Value of ton of fertilisers that could be used to determine cost of soil erosion in Egypt (£E1990)

Year	*Ammonium nitrate*	*Triple super phosphate*	*Potassium muriate*
1986	229.70	189.51	360.59
1987	229.04	194.41	370.22
1988	223.39	193.71	369.86
1989	234.99	187.99	358.36
1990	280.00	190.00	380.00

Fertilizers' prices that are used in estimating the on-site cost of soil erosion are subsidized[7] by the government. This, therefore, indicates that the rèal cost of soil erosion, as calculated by applying the replacement cost method, is a conservative estimate for soil depreciation. To monetize the physical losses of nitrogen, the equivalent cost of fertilizers containing this nutrient is calculated as is shown in Table 6.22. Ammonium nitrate, which is widely used by farmers, has been used as a commercial fertilizer to compensate the nitrogen lost in the eroded area and to estimate the total on-site costs of soil erosion.

Table 6.21: On-site cost of soil erosion in Egypt, 1986-1990 (£E1990)

Year	*Total replacement cost (000s £E)*	*Eroded area (000s feddan)*	*Average cost per feddan (£E)*
1986	234,018	1018.80	230
1987	302,934	1322.60	229
1988	363,315	1626.40	223
1989	453,574	1930.20	235
1990	625,520	2234.00	280

[7] This may explain why currently most developing countries have adopted a gradual strategy to remove subsidies from the agricultural sector, especially from chemical fertilizers which encourage farming practices which increase land degradation. Unless soil erosion is perceived to be a threat to farm profitability, or alternatively unless changes in land management lead to at least some immediate economic gains, farmers will be less willing to bear this substantial costs. For example, Lutz and Young (1990) traced the effects of agriculture policies on the natural resource base in the developing world. They found that where the removal of fertilizers or pesticides subsidy is being considered an adjusted program, government expenditures will decrease, farmer's use of these resources will decrease, and adverse environmental side effects will tend to diminish as well.

The economic depreciation per feddan is presented in Table 6.21. The increase in cost per feddan (£E1990) prices reflects the overall increase in fertilizer prices. The real sustainable level of agricultural production, therefore, is the gross agriculture value added less the depreciation of the soil resource. Table 6.22 shows the resulting net agriculture product after deducting the on-site cost of soil erosion.

Table 6.22: Value added to agriculture, gross and net of soil depreciation, 1986-90

Year	*Value added in agriculture * (£E million1990)*	*Soil depreciation (£E million)*	*Adjusted value added (£E million1990)*	*Depreciation as a % of agr. value added*
1986	20,957	234	20,723	2.0
1987	23,026	303	22,723	2.1
1988	22,504	364	22,140	2.2
1989	24,996	454	24'542	2.1
1990	23,268	626	22,642	2.7

* *Source: CAPMS, Egyptian National Accounts, Various Issues.*

4.3.2 Off-site Effects of Soil Erosion

As has been discussed above, erosion has on-site and off-site effects. The off-site effects cited by Shalaby and White in 1988 include:

- increase in sedimentation
- loss of Nile sedimentation load over the arable land
- aquatic weeds.

The above mentioned effects resulted from building the HAD in Upper Egypt. Few studies have been carried out to estimate the cost of the side effects of HAD. These effects could be discussed as follows:

Loss of Nile Sediment Load Over the Arable Land

It was estimated that the total yearly suspended sediment (S.S.) in the Nile water before the construction of HAD was about 139 million tons and most of it was deposited in the Mediterranean and the amount that settled over the arable land was about 13.0 million tons (MOIWR, 1981). After the construction of HAD, the water released from HAD is nearly free from S.S. The percentage of Azot in the Nile sediment is about 13% and only one-third of this amount is useful for feeding crops. White (1988) estimated the loss of nitrogen fertiliser from silt that is no longer deposited on the down stream fields to amounts to about 1,800 tons of nitrogen a year. Then, he estimated the monetary value of this loss to be $150,000 or about £E1/3 million a year.

Aquatic Weeds

The reason for the flourishing of weeds is due to the fact that water released from HAD round the year is clear and free from S.S. and hence sunlight and moderate weather encourage the growth of weeds. Also the decrease in water fluctuation and increase in fertilisers are helping the growth of weeds. Shalaby (1988) carried out a study on aquatic weeds and found that the combating of aquatic weeds costs about £E10 million every year.

Siltation in the Reservoir

The Nile used to transport 90% of suspended matter during the flood season. Since 1929, the Physical Department of the Ministry of Irrigation has undertaken monitoring of the studies of suspended sediment (S.S.) in the Nile water. The continuous monitoring of the Nile S.S. all the year round led to the conclusion that the S.S. passing Aswan is about 134 million tons on average (Dixon, 1989 and 1990). Siltation of the HAD reservoir (Lake of Nasser) was studied while designing the project. It was estimated that the amount of sedimentation in the reservoir will be about 60 10^6 m^3 annually. Thus, the dead storage capacity of 31 km^3, allocated for silt deposition (dead storage) will be sufficient for about 500 years (MOIWR, 1984). In conclusion, the siltation in the reservoir would not create any problem for the next three or four generations, but studies have to be started from now to specify the best use of this silt. One of the best uses of accumulated silt is to mix it with sand soil in the newly reclaimed land to improve its productivity. Thus, the total annual loss attributable to off-site cost was about £E10.35 million in 1988. This cost, however, is not reflected in the current Egyptian National Accounts.

4.4 Summary

The question that is stated in the introduction can now be answered. The depreciation cost of soil erosion per feddan, as a result of both on-site and off-site cost, is in a range between £E230-280 for the 1986-1990 period in 1990 prices. This is about one-quarter on average of the net annual income per feddan. However, it has to be admitted that farmers were not and would not be willing to pay this cost, essentially because most of them, if not all, are smallholders who are forced to consider only short-term profits for their own survival. Also, the erosion costs represented a range between 2 to 2.7 percent of the total agriculture value added in 1990 prices for the same study period. Consequently, if the government and/or society aims to achieve long-term sustainable development for agricultural land, this cost has to be considered as well as improving farmers' level of income.

5. CAPITAL CONSUMPTION ALLOWANCE (CCA) OF AGRICULTURAL LAND LOSS

As examined in Chapter Two, Egypt is a country with limited reserves of depletable resources (i.e., oil and gas) and with serious environmental problems such as air and water pollution, and land degradation. This section provides an estimate of the capital consumption allowance for agricultural land losses resulting from urbanization. Two different approaches (average and marginal) have been used to estimate annual physical land loss functions. From these the loss of agricultural land in monetary terms is evaluated using the Present Value method (PV). The section is divided into four parts. The first describes urban and rural expansion, as the result of high population growth and construction, as a major threat to agricultural land. The second and the third parts estimate annual physical land loss using the average and the marginal approach functions, respectively. The fourth calculates the monetary value of the physical loss using the present value method, while finally the fifth highlights the main findings of this section.

5.1 Urbanisation and Agricultural Land Losses

Population size in Egypt, as discussed in great detail, increased from 26 million in 1960 to 47.25 million in 1986 and 53 million by 1990 with a growth rate ranging around 3% per annum (CAPMS, 1992). Although the rate of growth started to decrease after 1986, absolute numbers continued to increase. Rapid population growth has had an impact on land use and Egypt is characterized by high population density of the limited inhabited area (4%). Density increased from 1034 to 1170 persons per square km between 1976 and 1986. It is even higher in areas such as Cairo, Giza, Port Said, and Qualubia due to high concentrations of industrial activities (Hassanin, 1993).

As has been stated in Chapter Two, Egypt has a total area of around 1 million km^2, but the cultivable area is only 6,525 thousand feddan or 2.6% of the total area of the country in 1990. In the last three decades, the area under crops declined in relation to the total area. The rapid growth in urban and rural economic activity (at the expense of agricultural land) on one hand and the slowing down in land reclamation of new land on the other, caused the area under crops to decline markedly between 1960 and 1990 (Galal and Fawzy, 1993; Biswas, 1991 and 1995). According to the last agriculture census (1982 and 1990) estimates by the Ministry of Agriculture, agricultural land per capita decreased from 0.11 feddan in 1960 to 0.05 feddan in 1990. In addition, according to FAO estimates, agricultural land per worker decreased from 0.35 feddan in 1960 to 0.21 feddan in 1990. Moreover, the crop area per capita declined from 0.36 to 0.21 feddan in the same period (see Figure 6.8 in Appendix 6.5).

Urban encroachment on agricultural land is also a serious problem. Egypt could lose up to 1.5 million feddan of fertile land due to urban encroachment by the year 2000 (Parker and Coyle, 1981; FAO, 1993). Causes of this loss of arable land include: (1) distortions in urban land markets (2) proliferation of spontaneous settlements, and (3) a lack of information about potential productive capacity of farm lands using treated wastewater. It is essential for many reasons that Egypt give urgent attention to reduce the loss of arable land due to urbanization. First, with the growing population, there is a need for more agricultural land to meet the population's need for food. Second, land reclamation is an expensive process. Finally, land lost due to urbanization is often, if not always, more fertile and productive than reclaimed land.

5.2 Average Land Loss Function

The most recent estimates (El Zanaty and Badawy, 1995) of the causes of agricultural land loss resulting from urbanization, attributed 54% of the total land loss from 1980-1991 to urban expansion. Another comprehensive study (Rizk, 1980) attributed 28% of the total loss from 1962-1979 to rural expansion. The total agricultural land loss is about 840,800 feddan for the period 1962-1990 (World Bank, 1990). Using the above estimates, for the period from 1962-1990, losses resulting from urban and rural expansion are calculated in Table 6.23. Two proxies have been used to measure these impacts: (1) annual population growth; (2) annual construction data. Table 6.23 was calculated by multiplying the total land loss by the percentage of loss due to urban and rural expansion. For example, the total land loss from 1962 to 1990 was about 840,800 feddan (54 percent because of urban expansion comes to about 454,032 feddan and 28 percent because of rural expansion to about 235,424 feddan of agricultural land loss, respectively). Table 6.23 shows the average land loss in feddan per capita for urban and rural areas, and the average of land loss per building for the 1962-1990 period.

The data in Table 6.23 yields the total and average land loss per capita and per building over the 1962-1990 period. For example, the increase of one capita of population over 1962-1990 period destroyed 0.037 and 0.014 feddan of agricultural land in urban and rural areas, respectively. One construction destroyed 0.365 feddan over the same period. Accordingly, two averages of land loss estimates may be derived; one based on population increase in urban and rural areas; the other on annual construction. From these data an average land loss estimate for year t based on population increase is given in equation (5.2.1) below.

Table 6.23: Egyptian agricultural lands loss due to urbanization and construction, 1962-1990

	Urban	Rural	Buildings
Total increase (population growth or construction)	12,406,262	16,543,540	1,886,975
Total land loss (in feddans)	454,032	235,424	689,465
Average loss per capita or building	0.036	0.014	0.365

$$ALS_t = 0.036\ UR_t + 0.014\ RU_t \qquad (5.2.1)$$

Where:

- ALS_t = agricultural land loss in year t due to urban and rural expansion.
- UR_t = population increase in urban areas in year t.
- RU_t = population increase in rural areas in year t.

An average land loss function for 1990 using annual construction of land loss per building of 0.365 feddan over the 1962-1990 period is given by equation (5.2.2) below.

$$ALS_t = 0.36\ BU_t \qquad (5.2.2)$$

Where:

- ALS_t = agricultural land loss.
- BU_t = annual construction in year t.

Table 6.35 in Appendix 6.5 presents agricultural land loss in each year according to equations (5.2.1) and (5.2.2) above. The average population increase-induced agricultural land loss using 1990 population increase data is 39,610 feddans, while the average loss using buildings data is 46,612 feddans. These estimates are our first proxies for 1990 agricultural land loss due to population increase and construction. The average historical agricultural land loss over these two periods (1962-90) reflects the total loss from population increase and construction. However, an average loss in any given year is inaccurate to the extent that the marginal loss (annual) may differ from the average loss over the time period. Using equation (5.2.2), as soon as current construction falls, land loss rates fall. However, this relation may not hold. Current land losses could increase even when current construction is declining if past construction has lagged effects on future land loss. Hence, it is useful to attempt to determine a land loss function, which takes into account marginal losses in a given year. This is the task of section 5.3.

5.3 Marginal Agricultural Land Loss Function

There are two problems with the method of determining an average land loss estimate in the previous section. First, it is based on arguable consensus estimates. Second, it only allows calculation of the average loss. This does not yield any direct information on the annual changes in population growth and construction-induced land loss over the period. However, these marginal changes will be different from the average except in the unlikely case where the marginal land loss is the same in every year. Hence a loss function based on marginal loss will present a more accurate picture than one based on average loss. An annual (marginal) loss function that allows for lagged effects of construction or population growth requires time series on annual agricultural land loss, construction or population growth, and other significant causes of agricultural land loss. Such a statistical model would be of the form:

$$ALS_t = f\ (\text{Intercept}, X_t,\ BU_t) + e_t \qquad (5.3.1)$$

or

$$ALS_t = f\ (\text{Intercept}, X_t, POP_t) + e_t \qquad (5.3.2)$$

Where:

- ALS_t = agricultural land loss in year t.

- X_t = important causes of land losses in year t other than current population growth or construction.
- BU_t or POP_t = annual population growth or construction in year t.
- e_t = error term representing unsystematic causes of agricultural land loss.

Given this model, the marginal agricultural land loss in year t due to population growth or construction could be estimated from the coefficients of the independent variables. However, it is difficult to use the above model in equation (5.3.1) or (5.3.2) due to several data limitations. The first statistical problem involves uncertainty as to the best available proxy for the environmental effects of major causes on agricultural land. Two proxies have been chosen for this environmental effect: annual construction, and annual population growth in all the country. The second statistical problem is the lack of annual data on other causes of agricultural land loss than buildings or population growth. Thus, the simplifications of equation (5.3.1) or (5.3.2) will be of the form shown below in equation (5.3.3) and (5.3.4).

$$ALS_t = f\,(\text{Intercept},\ BU_t\,) + e_t \qquad (5.3.3)$$

or

$$ALS_t = f\,(\text{Intercept},\ POP_t\,) + e_t \qquad (5.3.4)$$

Where:

- ALS_t = agricultural land loss in year t.
- BU_t or POP_t = annual population growth or buildings constructed in year t.
- e_t = error term representing unsystematic causes of agricultural land loss.

Egypt's Ministry of Agriculture in 1985 (unpublished data) estimated the annual agricultural land loss converted to urban land for the period 1971-1985. Thus, it is possible to use equation (5.3.3) and (5.3.4) to estimate the agricultural land loss for 1990. Two equations resulted from the regression procedures:

$$ALS_{1\,t} = C + \alpha_1\, BU_t + e_t \qquad (5.3.5)$$

$$ALS_{2\,t} = C + \alpha_2\, POP_t + e_t \qquad (5.3.6)$$

Where:

- C = intercept.

- BU_t = annual construction in year t.
- POP_t = annual population growth in year t.
- e_t = error term.

The results of the regression of the previous two equations are shown in Table 6.24.

Table 6.24: Results of regressions of construction and population growth (t statistics in parentheses).

Variable	*Buildings*	*Population*
Intercept (C)	11.5581 (2.160) **	-3.6408 (0.694)
α_1 and α_2	0.32319 (3.852)*	0.03949 (1.771)***
F stat. (1,13)	60.7213 (9.33)*	3.7168 (3.18)***
R^2	0.8967	0.5536

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.

As regressions (5.3.5) and (5.3.6) show, as expected there is a positive relationship between population growth, construction and agricultural land losses. But, the relationship is much stronger between construction and land losses explained by the significance of α_1 at 1 percent and 0.8967 for adjusted R^2. This makes the results of equations (5.3.5) more credible than those of equation (5.3.6). Based on historical data for the period 1971-1985 (MOA data), we have obtained the agricultural land loss function (for buildings and population) that is shown in equations (5.3.5) and (5.3.6). Now, these equations may be used in estimating agricultural land losses for the period 1986-1990. The results are shown in Table 6.25 below.

Table 6.25: Estimated agricultural land losses using marginal approach (in 000s feddan), 1986-1990.

Year	*Population growth*	*Constructions*
1986	47.421	42.950
1987	48.850	43.950
1988	50.320	45.012
1989	51.831	47.223
1990	53.384	49.250

From Table 6.25 the estimated physical land losses using the marginal approach for 1990, as a result of construction or population growth, are 53.384 and 49.250 thousand feddan, respectively. Based on the above calculations physical agricultural land losses, resulting from population growth or construction, for the average and marginal approaches will be used in estimating a capital consumption allowance for land loss in 1990. This is the task of the next section.

5.4 CCA of Egyptian Agricultural Land Losses

In this section, the physical agricultural land loss derived in the last two sections along with estimates of agricultural land values, will be used to form agricultural land capital consumption allowances for 1990, the year when Egyptian environmental-economic accounts will be established. The capital consumption allowance for agricultural land loss is equal to the stream of undiscounted agricultural land losses in each year multiplied by the present value of feddan lost in each year as shown in equation (5.4.1) below.

$$CCA_t = ALS_0 * PV + ALS_1 * PV/(1+r) + ALS_2 * PV/(1+r)^2 + \dots \qquad (5.4.1)$$

Where:

- ALS_t = undiscounted agricultural land loss in year t.
- PV = monetary present value of one feddan lost in 1990.
- r = discount rate (5% or 10%).

Factoring the present value term from the right hand side of equation (5.4.1) yields equation (5.4.2), which expresses the CCA as the physical feddan present value of agricultural land multiplied by the monetary present value of one feddan lost in 1990.

$$CCA = PV \sum_{t=0}^{n} \frac{ALS}{(1+r)^t} \qquad (5.4.2)$$

Where:

- ALS_t = undiscounted agricultural land loss in year t.
- n = number of years of agricultural land loss until there is less than one feddan of agricultural land loss.

The average and marginal approaches yield the land loss per capita or buildings. In the average approach, the CCA in year t is simply equal to the estimated agricultural land loss in year t due to population increase or construction multiplied by the present value of feddan of agricultural land loss in year t. Thus, equation (5.4.2) above simplifies to equation (5.4.3) below for the average approach.

$$CCA_t = PV * ALS_t \qquad (5.4.3)$$

Where:

- PV = present value of feddan lost in year t.
- ALS_t = estimate of agricultural land loss according to the average approach.

In the marginal approach, the CCA in year t is equal to marginal agricultural land loss α_1 or α_2 , multiplied by an additional building or person, respectively. Thus, equation (5.4.2) could be simplified to equation (5.4.4) and (5.4.5) for the marginal approach.

$$CCA_t = PV * \alpha_1 BU_t \qquad (5.4.4)$$

or

$$CCA_t = PV * \alpha_2 POP_t \qquad (5.4.5)$$

Where:

- α_1 = marginal increase of agricultural land loss from additional building

- α_2 = marginal increase of agricultural land loss from additional person
- PV = present value of feddan in monetary terms.
- BU_t = buildings constructed in year t.
- POP_t = population increase in year t.

One of the main characteristics of most developing countries, if not all, is that land markets exhibit imperfections and distortions. This leads to the use of a second best methodology, which is estimating the present value of land rent (LR) or shadow price (SP), as proxies of land value. Biswas et al (1993), in the World Bank country study, estimated the shadow price per feddan of agricultural land to be about £E1011 for 1990. On the other hand, the only available data on land rent are the records of the official land rents. The official land rent was constrained to seven times the amount of the land tax of around £E20 per feddan. In the mid 1980s land rent changed to 22 times the land tax. However, the marginal value of land is much higher than the official rent. Hakim and Aboumandour (1993) reported that the actual rent either in cash or implicit in sharecropping arrangements, is equal to or above seven times the official land rent depending on soil, location and crops. This means that the annual rent per feddan is £E980. This estimation is almost the same as that calculated by Biswas et al.

Now we have two ranges of monetary values per feddan, the SP and LR estimates, to use in constructing monetary capital consumption allowances. These values will be used in equation (5.4.3), (5.4.4) and (5.4.5) for deriving capital consumption allowances using the average and the marginal approaches. Accordingly, the calculation of CCA using the average approach is shown in Table 6.26 below. The average loss estimates assume loss due to 1990 activity will ultimately equal that implied by the long-run historical average. Multiplying the estimated 1990 agricultural land loss, due to population growth or construction, by the present value of feddan lost in 1990 produces the CCA estimates in Table 6.26.

Table 6.26: Estimated 1990 CCA using the average measure of land loss.

	Population growth		*Construction*	
Estimated agricultural land loss (in feddans)	39,610		46,612	
Discount rate	5%	10%	5%	10%
SP - PV (£E) CCA - SP (£E million.)	20,220 809.91	10,110 400.24	20,220 942.49	10,110 471.24
LR - PV (£E) CCA - LR (£E million.)	19,600 776.35	9,800 388.17	19,800 922.91	9,800 456.79

Using the 39,610 feddans lost due to population growth, the CCA-PV at 10% is then £E10,110 per feddan multiplied by 39,610 feddans, or £E400.245 million as shown in Table 6.26. The capital consumption allowances using buildings and land rent (LR) present values are calculated in the same manner. Now, we turn to the calculation of CCA using the marginal approach, as explained by equations (5.4.4) and (5.4.5). This is shown in Table 6.27 below.

Table 6.27: Estimated 1990 CCA using marginal approach.

	Population growth		*Construction*	
Estimated land loss (in feddans)	53,384		49,251	
Discount rate	5%	10%	5%	10%
SP - PV (£E.) CCA - SP (£E million.)	20,220 1,079.42	10,110 539.71	20,220 995.85	10,110 496.91
LR - PV (£E) CCA - LR (£E million.)	19,600 1,046.32	9,800 523.16	19,600 965.31	9,800 482.65

In Table 6.27 CCA-SP using construction, for example, is 49,251 feddan lost multiplied by SP-PV of feddan lost at 5% or 10%. For example, CCA-SP at 10% is about £E496.917 million. That is calculated using the agricultural land loss resulting from construction multiplied by the SP-PV of feddan at 10%. The rest of the Table is calculated in the same manner.

We have calculated two sets of capital consumption allowances (CCA): one set using the average approach in Table 6.26, and the second set using the marginal approach in Table 6.27. Each CCA is an estimate of the capitalized environmental loss to Egypt of 1990, as a result of construction or population growth. At 10%[8] and 5%, CCA-SP and CCA-LR estimates for the average and marginal approaches using buildings data are very similar, regardless of the method of estimation, ranging from £E456.797 to £E496.917 and from £E922.918 to £E995.855 million respectively. The 10% or 5% CCA-SP and CCA-LR estimates for the average and marginal approaches using population data are not similar, ranging from £E388.178 to £E539.712 and from £E783.745 to £E1,079.424 million respectively. Therefore, using construction in estimating agricultural land losses is more acceptable than using population growth. As explained above, construction is a better proxy for agricultural land loss, which gives very similar results regardless of the applied approach. Therefore, CCA for agricultural land loss, using construction and 8 percent discount rate, for the average and marginal approaches, is calculated as is shown in Table 6.28.

Table 6.28: Estimated 1990 CCA for the average and marginal approaches and construction (8%).

	Average	*Marginal*
Estimated land loss (in feddan)	46,612	49,251
SP - PV (£E)	12,637.5	12,637.5
CCA – SP (£E million.)	589.05	622.41
LR - PV (£E.)	12,250	12,250
CCA - LR (£E million.)	570.99	603.32

8 Markets in developing countries are uncompetitive and people's income is low. From consumers' perspective, the lower people's income, the higher rate of return they need to divert resources from consumption to investment. Poor people are assumed to discount the future heavily. This explains the high discount rate in the developing world. On one hand, the World Bank in its analysis for the developing world has adopted 10% discount rate (Convery, 1995). On the other hand, Nelson (1995) has used 5% discount rate when he calculated the environmentally-adjusted product for African countries. The results of CCA using 10% discount rate seem to be more acceptable than 5%. However, 10 percent for the Egyptian economy is a high discount rate, because Egypt is categorized as one of the top 20 developing countries. Thus, 8 percent, as an average, would be more appropriate for Egyptian economic analysis.

From Table 6.28 CCA, for the marginal approach and 8 percent discount rate in 1990, is calculated by multiplying 49,251 feddan by SP and LR present value per feddan. This yields £E622.410 and £E603.325 million for CCA-SP and CCA-LR, respectively. The CCA for the average approach is calculated in the same manner. Finally, the CCA for the marginal approach and the average of SP and LR present value is £E612.868 million, that is, considering our estimation of CCA for agricultural land loss in 1990.

5.5 Summary

Two different methods were used in this section to estimate the physical area lost due to construction or population growth. The first relied on an estimation of total land loss due to urban and rural expansion. It yielded two average agricultural land loss functions for the entire 1962-1990 time period. This method is based on arguable consensus estimates, and does not explicitly allow estimation of lagged effects of construction or population growth on land loss. Thus we also estimated the physical loss functions by using the marginal approach. Using construction in estimating agricultural land loss yields constant results, regardless of the estimation approach, at 10 and 5 percent discount rates. Therefore, CCA-SP and CCA-LR estimates for the average and marginal approaches using building data in 1990 ranged from £E456.797 to £E496.917 and from £E922.918 to £E995.855 million, respectively. The sensitivity of the results to the changes in the discount rates and land prices for the average and marginal approaches can be seen from Table 6.36 & 6.37 and Figures 6.9 & 6.10 in Appendix 6.5. Finally, the average of SP and LR, for the marginal approach and construction, was used to estimate the monetary value of land loss for Egypt. From this the estimated CCA for agricultural land loss was about £E612.868 million or about 3 percent of agricultural gross domestic product in 1990.

However, 5 or 10 percent discount rates are not appropriate for the Egyptian economy. Therefore, 8 percent discount rate and construction, which gives quite similar results for the physical agriculture land loss regardless of the applied approach, were used in estimating CCA for 1990. However, in estimating the CCA for agricultural land losses for the 1981-1990 period, the shadow prices of land values were not available for the rest of the years (1981-1989). Therefore, the present value of agricultural land rent at 8 percent discount rate and the physical land loss, which resulted from marginal approach and construction, are used. The estimates of CCA for agricultural land losses, for the 1981-1990 period, are presented in Table 6.29 below.

Table 6.29: CCA of agricultural land losses for marginal approach and construction, 1981-1990[9].

Year	*Land rent*	*PV per feddan*	*Physical loss (marg. and construction)*	*CCA*	*CCA 1990 (£E million)*
1981	523.70	6,546.25	40.00	261.85	765.05
1982	555.70	6,946.25	36.00	250.06	674.00
1983	599.30	7,491.25	35.00	262.19	654.38
1984	644.70	8,058.75	36.00	290.11	651.37
1985	691.10	8,638.75	44.00	380.10	782.89
1986	739.60	9,245.00	42.95	397.07	724.96
1987	790.00	9,875.00	43.95	434.00	688.60
1988	842.30	10,528.75	45.01	473.92	649.89
1989	896.70	11,208.75	47.22	529.31	621.90
1990	980.00	12,250.00	49.25	612.85	612.85

6. CONCLUSION

In this chapter, we have attempted to calculate the cost of the depletion and degradation of renewable (non-marketable) natural resources, as the second and last adjustment to the current GDP. This is to arrive at an estimation of Environmentally-adjusted net Domestic Product (EDP). In addition, this chapter provided illustrative

[9] It is important to have in mind that the estimates of the present value of agricultural land in this table are based on the official land rents, except for 1990. As explained in the text this is because of the absence of market values as well as shadow prices for Egyptian agricultural land. Therefore, the official land rents, obtained from Ministry of Agriculture records, are used as conservative estimates in calculating the capital consumption allowance for agricultural land losses for the 1981-1989 period.

examples of environmental accounting by estimating the various capital consumption allowances (environmental damages) for air, water and agricultural land.

In section 6.2 the cost of air pollution was calculated, by measuring air pollution's damaging impacts on both human and physical capital. Two main costs were calculated in the case of human capital. The first was the direct cost (treatment cost). The second was the indirect costs (earnings forgone), as a result of disability and premature death that resulted from air pollution. In addition, the comparison approach was used in estimating the cost of air pollution damage to one of the elements of physical capital (buildings). The total estimated costs of air pollution in 1990 for urban areas were about £E442.9 million, or 2.2 percent of the industrial gross domestic product. These costs , however, could be considered as conservative estimates, or the minimum social value of capital consumption allowance for this environmental capital. Following the same approach that has been used in the case of air pollution, the cost of water pollution was calculated in section 6.3. These costs were calculated for both urban and rural areas. As expected, mortality costs were a minor cost compared to morbidity, about one-tenth, and the rural areas were the most suffering from water pollution. The total cost of water pollution was £E1,257.359 million in 1990, or about 4 percent of the industrial gross domestic product. Again, these costs could be considered as a minimum social value of capital consumption allowance for this environmental capital as in the case of air pollution.

The cost of agricultural land depletion and degradation (i.e., soil erosion and land losses) were calculated in sections 6.4 and 6.5. Firstly, in section 6.4 the depreciation of soil costs that resulted from the farmers' misuse of lands for their own survival (On-site cost), and the cost of the outside factors that affect land productivity such as the accumulation of silt in dam reservoirs (Off-site cost) were estimated. The on-site cost is the major cost of soil erosion; it was about 2.7% of the agricultural gross domestic product in 1990. Secondly, the capital consumption allowance for agricultural land loss due to urbanization was calculated in section 6.5. In particular, the study has developed a Capital Consumption Allowance (CCA) estimate for agricultural land loss resulting from the economic activity. Two different approaches were used to estimate the physical loss of agricultural land first. In cognizance of market imperfections and distortions, the monetary value was calculated using two different proxies of land value, the LR and SP, in order to arrive at the total value of agricultural land loss in monetary terms second. This was about 3% of the agricultural gross domestic product in 1990, a loss that is clearly seen to be a significant quantity.

Table 6.30 below summarizes the total environmental depletion and degradation costs, for the 1981-1990 period, of renewable natural resources. The value of environmental impacts by resource are: health impacts of water pollution (£E1,257 million or 42.92% of the total); health and physical capital impacts of air pollution (£E442.89 million or 15.12% of the total); agricultural output losses due to soil erosion (£E626 million or about 21.37% of the total); and finally agricultural land losses due to urban and industrial expansion (£E603.31 million or 20.59% of the total). Even though these estimates are conservative- due to conservative assumptions and items not valued- this magnitude of the impacts could be comparable to estimates made in some other developing and transitional countries, such as 6.4 percent of GDP in India, and 3.5 percent in Mexico. However, the detailed estimates can not be compared between these countries because of the differences in methodologies and sets of environmental costs[10].

This chapter has been concerned with the issue of accounting for environmental goods and services in Egypt. Its underlying theme is that standard measures of macroeconomic quantities significantly underestimate or ignore the costs associated with the use of natural resources. The depletion and degradation of just three natural resources, land, water and air, amounted to more than £E2.93 billion in 1990, almost 3.5 percent of GDP and 4.5 percent of NDP (see Table 6.30 below). Comparison with gross capital formation and fixed capital depreciation is more dramatic. The environmental assets degradation exceeded 17 and 23 percent of gross capital formation and fixed capital depreciation, respectively, suggesting that the conventional Egyptian System of National Accounts have been overstating net asset

[10] See Parikah, 1991; and Parikah et al 1993.

growth by ignoring the loss of productive natural assets. In addition, the Egyptian national accounting system, which does not account for the degradation and depletion of environmental assets along with man-made assets, has led decision-makers farther and farther from development choices that would have been economically and environmentally sustainable.

Table 6.30: Depletion and degradation costs of renewable natural resources, 1981-1990 (£E million 1990)

Year	*GDP*	*CCA1990 (£E million)*	*Total cost of water pollution 1990 (£E million)*	*Total Cost of air pollution 1990 (£E million)*	*Soil Depreciation 1990 (£E million)*	*Total Degradation cost as % of GDP*
1981	56.33	765.05	495.06	303.25	n.a	2.78%
1982	62.04	674.00	579.20	355.86	n.a	2.59%
1983	62.67	654.38	796.58	382.15	n.a	2.92%
1984	67.01	651.37	995.57	383.18	n.a	3.03%
1985	65.89	782.89	1068.28	380.15	n.a	3.39%
1986	65.20	724.96	1167.10	414.91	234.00	3.90%
1987	72.48	688.60	1189.27	422.40	303.00	3.59%
1988	73.14	649.89	1186.72	421.08	364.00	3.58%
1989	76.89	621.90	1193.49	423.08	454.00	3.50%
1990	84.01	603.31	1257.35	442.89	626.00	3.49%

Note:
n.a: not available because of non-available data for soil erosion from 1981-1985.

The macroeconomic implications of environmental assets depletion and degradation will be more obvious when these resource accounts will be incorporated in the conventional SNA. The appropriate adjustment will be to adjust GDP for environmental assets depreciation, along with the conventional capital consumption allowance (for man-made assets), to calculate environmentally-adjusted net domestic product. The empirical results of this chapter and the previous one will be used to show how the environmental dimension could be incorporated into the conventional System of National Accounts to arrive at a better measure of economic performance, which will be useful in policy analysis and long-term planning. This is the task of Chapter Seven.

PART D

ENVIRONMETAL ACCOUNTING FRAMEWORK AND ITS POLICY IMPLICATIONS

CHAPTER SEVEN

INCORPORATING NATURAL CAPITAL DEPLETION AND DEGRADATION INTO THE SYSTEM OF NATIONAL ACCOUNTING

1. INTRODUCTION

Results of accounting for the depletion and degradation of non-renewable and renewable environmental natural resources in Chapters Five and Six now can be aggregated and incorporated into SNA to estimate the revised GDP, GDI, and CA or EDP, EDI, ECA of Egypt. These modified indicators should provide an accurate estimate of the impact of environmental resource development in Egypt during the study period 1981-1990. The comparison between the conventional and environmental indicators will reveal the significance of the omitted costs of resource depletion and degradation in the present approach of national accounts. In addition, some implications based on the analysis and comparisons of conventional and environmental accounting indicators are explored here for both macro and sectoral levels.

As has been seen from Chapters Five and Six, Egypt needs a new SNA framework to reflect the major changes in its natural capital, through depletion and degradation. This framework will be a great help to gauge macroeconomic and sectoral performance properly, and to offer sound policy advice. Therefore, this chapter aims at incorporating the environment into the Egyptian SNA. The rest of this chapter is divided into three sections. The second section proposes a modified SNA framework, which includes the depletion and degradation of the environment, for Egypt. This framework, therefore, will be used as a base to calculate the modified national accounting aggregates such as Environmentally-adjusted net Domestic Product

(EDP), Environmentally-adjusted Domestic Investment (EDI), and the Environmentally-adjusted Current Account (ECA). The third section shows how the modified macro framework could be disaggregated by economic activities in order to examine the performance and productivity of these activities; and the fourth and final section presents conclusions.

2. SYSTEM OF NATIONAL ACCOUNTS

2.1 Sustainable Income

As has been stressed earlier, adjustments to GDP are required in order to derive a "sustainable income" measure which includes the depreciation of renewable and non-renewable natural resources. An adjustment is already made to GDP for the depreciation of produced capital. NDP is obtained by subtracting capital consumption allowance (CCA) from GDP. NDP could be viewed as a measure of sustainable output. However, the concept of Hicksian income requires other adjustments to traditional NDP due to the depletion and degradation of environmental capital.

First, depletion includes loss in quantity of natural resources such as oil and gas (depletion). Second, degradation includes loss in quality of natural resources such as waste disposal capacity (degradation). This degradation of (usually) non-marketable capital is attributable to the use of the services of that environmental capital above and beyond its ability to provide perpetual services. The depreciation allowance for this loss in environmental capital would be the minimum of the social value of its loss or the cost of replacing its service with man-made goods and services.

The proper measure of sustainable income, the environmentally adjusted measure, is NDP adjusted for the depletion and degradation of environmental capital. Therefore, the output side in the national accounting framework, shown in Table 7.1 below for 1990 as an example, should be adjusted for environmental depletion and degradation to yield Environmentally-adjusted net Domestic Product (EDP). On the other hand, the same adjustments must be made to the input side to preserve the balance of the accounting framework. The adjustments in the input side could be viewed, of course, as cost of production for the depletion and as a loss in environmental subsides to production for the degradation of natural capital. EDP should be considered as a better indicator of the sustainability of current income in terms of renewable and non-renewable resources.

From Table 7.1, one can see that two more steps have to be followed to calculate Hicksian income or sustainable income. First, to subtract the depletion of natural capital from NDP to arrive at the first variant of eco-net product. Second, to subtract the degradation cost that is equal to the first definition of sustainable income (GDP1) in Peskin's framework (GDP-ED)[1]. The modified national accounts framework, presented in Table 7.1, is an extension to the conventional one, and it focuses only on the flow accounts which, of course, is the main concern in all economic analysis. In other words, is concerned with the year-to year change in stock rather than the value of the stock at a point in time, which may be an impossible task, especially in the developing world.

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[1] Peskin in 1978 and 1989 has proposed three different definitions for sustainable income. The first and most practical one is GNP1, that subtracts from GNP the value of environmental damage, (GNP1= GNP-ED), a measure of the loss of environmental capital due to current economic production. The second is equal, GNP2, to (GNP + ES) the conventional measure plus environmental services. This measure does not provide a sound Hicksian income because it does not tell how much of GDP can be consumed without impairing the total produced and natural capital stock. GNP2 provides a measure of the gross contribution to production without subtracting for depreciation of natural capital caused by economic activities counted in GNP. Finally, the third definition is very ambitious namely, (GNP3 = GNP + ES – ED), therefore no economist would believe that a monetary measure for the total output such as GNP3 is possible in the foreseeable future

able 7.1: Environmental national income and product account[2], 1989/1990 (£E million)

Input			Output		
			6. Sales to:		
			a. Households	52,422	
1. Compensation of employees	25,172		b. Exports	24,004	
2. Operating surplus	35,356		c. Imports (-)	27,211	
3. Indirect taxes	7,210		d. Government	11,445	
4. Subsidies (-)	1,936		7. Sales for gross investment		
5. Capital consumption allowance	11,092		a. Change in stocks	1,214	
			b. Gross fixed capital Formation	15,020	
Charges Against Gross Domestic Product		*76,894*	***Gross Domestic Product (GDP)***		*76,894*
8. Capital consumption allowance	11,092		Capital consumption allowance		
Charges against Net Domestic Product		*66,751*	*Net Domestic Product*		*66,751*
9. Environmental depletion (-)[3]			9. Environmental depletion (-)		
a. Oil and gas[4]	1,100		a. Oil and gas	1,100	
b. Land transfer	621		b. Land transfer	621	
Charges against Environmentally-adjusted net Domestic Product 1 (EDP1)		***64,082***	***Environmentally-adjusted net Domestic Product (EDP1)***		***64,082***
10. Environmental degradation [ED]			10. Environmental degradation (-) [ED][5]		
a. Air	423		a. Air	423	
b. Water	1,194		b. Water	1,194	
c. Land	454		c. Land	454	
Charges against Environmentally-adjusted net Domestic Product 2 (EDP2)		***62,011***	***Environmentally-adjusted net Domestic Product (EDP2)***		***62,011***

[2] This is the main consolidated account for Egypt, proposed in UN SNA 1968, and currently considered the main framework for the Egyptian System of National Accounts.

[3] The negative sign assumes that depletion cost has to subtracted from NDP to arrive at EDP1. However, this may not be always the case because if we have adopted NPII, as in the case of Repetto's framework for Indonesia, the negative sign may change to be positive.

[4] UC calculations are used in including oil and gas depletion in this framework because it is the more acceptable to policymakers than NPI. This will be explained in detail in the next sections.

[5] Environmental degradation entry in the output side, used in the determination of Egyptian sustainable income, is equal to environmental damage (ED) entry in Peskin's framework (Peskin, 1978).

The proposed framework in Table 7.1 can be extended over time to include more resources, as knowledge of the resources base increases and methods of calculations improve. Second, following SNA 1993 it is a supplement [6]to the main national account of the nation, which in turn keeps the core of the system of national accounts intact of any distortions and disturbance. Third, the proposed modifications are presented in a format that can be easily understood by all the users of SNA, and at the same time it can be ignored by other SNA users who are not interested in these modifications. Finally and most importantly, a supplementary environmentally adjusted SNA and corresponding performance indicators would encourage policy-makers to reassess the macroeconomic situation in light of environmental concerns and trace the link between economywide policies and natural resources management.

The environmental national income and product account, presented in Table 7.1, is divided into three sections: the first ends with GDP calculations; the second calculates EDP1; and the third presents the second variant of Eco-net product (EDP2) that could be considered as a measure of Hicksian income because it accounts for man-made assets depreciation as well as natural capital depletion and degradation. EDP[7] in 1989/90, for example, is about 88.88% of NDP, and final consumption is 109.19% as a percentage of EDP compared to 83.06% as a percentage of GDP. This will be explained in full detail when environmental and conventional accounting indicators are compared at the end of this section. Therefore, the rest of this section aims at explaining the effects of including the environmental costs, for both User Cost and Degradation (UCD) and NPI and Degradation (NPID), that have been accounted for in Chapters Five and Six in the System of National Accounts for the 1981-1990 period.

The user cost method and degradation of environmental capital indicates that Egypt has experienced slower growth in environmentally-adjusted net domestic product

[6] Placing natural capital changes (i.e., depletion and degradation) in satellite accounts will be politically motivated, which is really needed to introduce and start this type of work in developing countries.

[7] EDP = EDP2, the second variant of Eco-Domestic Product that resulted from NDP and EDP1 (the first variant of Eo-Domestic Product). This terminology is borrowed from United Nations 1993.

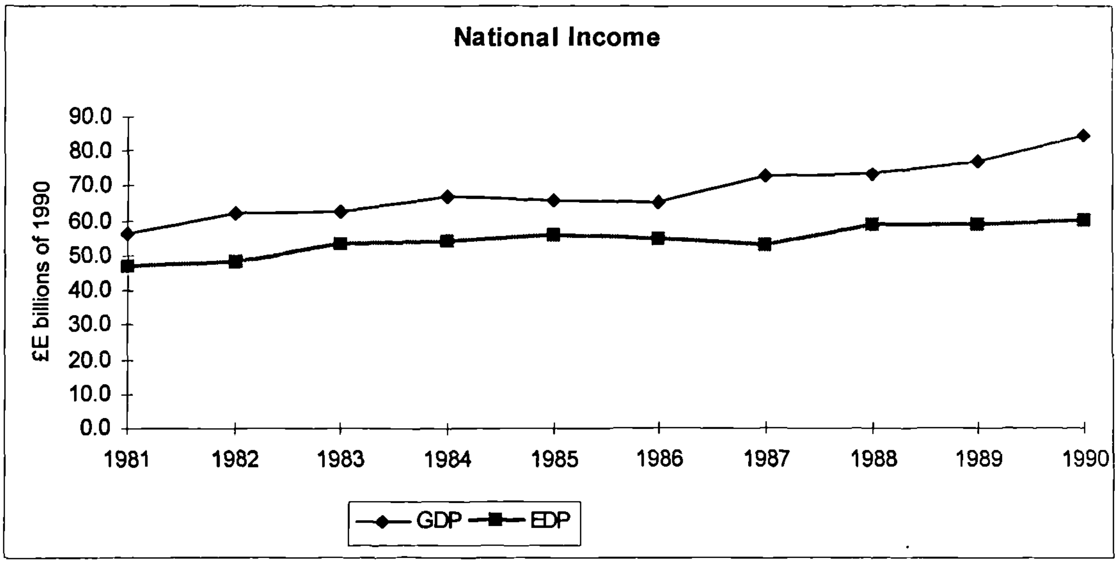
compared to GDP from 1981 to 1990 (Table 7.2). Incorporating natural capital depletion and degradation into the System of National Accounts indicate that EDP1 and EDP2 grew at an annual rate of 2.92% and 2.75% compared to 4.65% for GDP over the ten-year period. In addition, the sum of natural capital user cost and degradation from 1981 to 1990 is valued at £E35.07 billion 1990, equivalent to 5.12% of GDP or 43.7% of the value of fixed capital depreciation (£E80.32 billion 1990). Depletion of oil and gas only accounts for 36% of natural capital depreciation on average.

Table 7.2: National income, user cost method and degradation (£E billions of 1990)

Year	*Gross Domestic Product*	*Fixed Capital Depreciation*	*User Cost as % of GDP*	*Degradation Cost as % of GDP*	*GDPG*	*EDP1G*	*EDP2G*
1981	56.33	5.82	3.07%	2.78%	-		
1982	62.04	5.34	2.18%	2.59%	10.14	1.75	1.72
1983	62.67	5.21	2.26%	2.92%	1.01	11.63	11.56
1984	67.01	5.47	2.05%	3.03%	6.92	0.75	0.40
1985	65.89	7.69	2.07%	3.39%	-1.66	3.82	3.59
1986	65.20	7.27	1.94%	3.90%	-1.05	-1.03	-1.62
1987	72.48	8.71	1.38%	3.59%	11.16	-3.27	-3.54
1988	73.14	10.54	1.28%	3.58%	0.92	9.95	10.40
1989	76.89	11.09	1.14%	3.50%	5.12	0.30	0.19
1990	84.01	13.14	1.32%	3.49%	9.25	2.39	2.09
Average	68.57	8.03	1.87%	3.28%	4.65	2.92	2.75

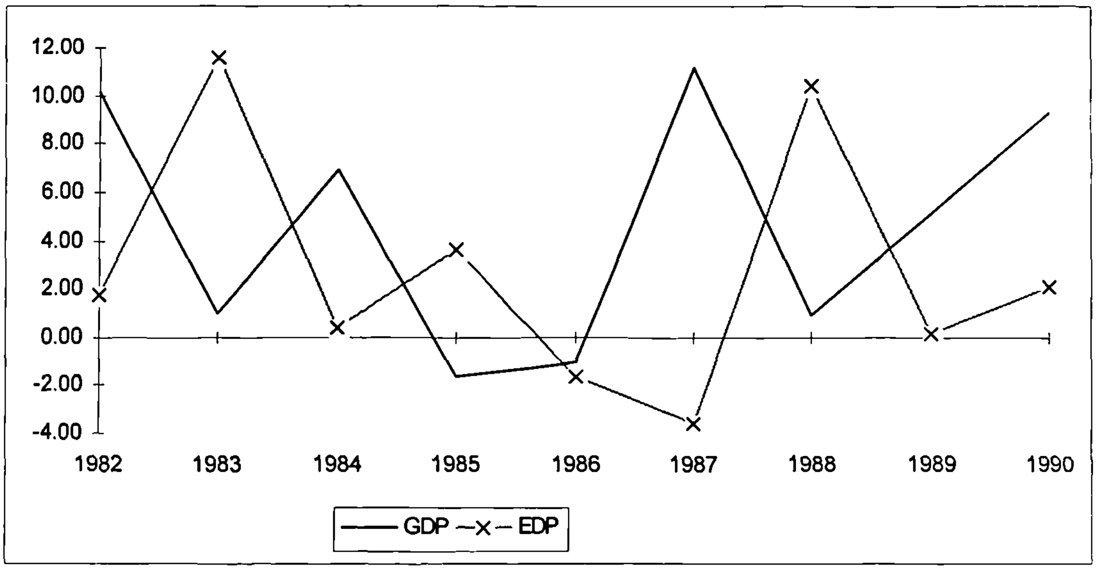
GDPG = Gross Domestic Product Growth;
EDP1G = Environmentally-adjusted net Domestic Product 1 Growth
EDP2G = Environmentally-adjusted net Domestic Product 2 Growth =EDPG

Figure 7.1: EDP for user cost and degradation, 1981-1990 (£E billions of 1990)



UCD caused a moderate fall in GDP compared to NPID

Figure 7.2: EDP and GDP growth for UCD, 1981-1990



The annual growth rate of EDP is moderately lower than GDP compared to NPID

On the other hand, the depreciation method[8] and degradation offer significantly different results. NPID over the ten years totals £E 63.52 billion 1990, approximately twice the value of the environmental cost as measured by user cost method and degradation (Table 7.3).

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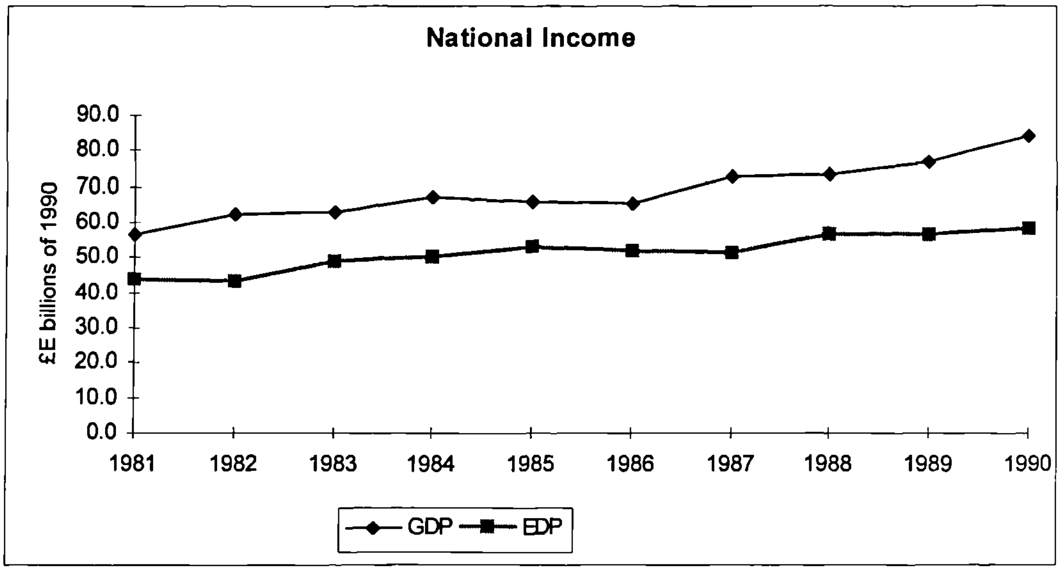
[8] As has been explained in great detail in Chapter Five, NPI will represent the depreciation approach in all the analysis of this chapter.

Table 7.3: National income, NPI method and degradation (£E billions of 1990)

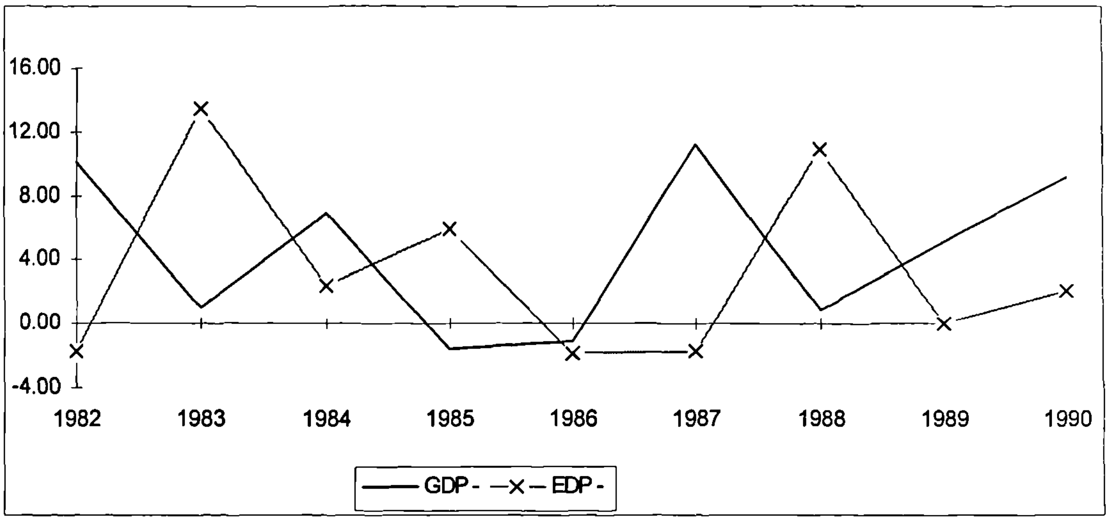
Year	Gross Domestic Product	Fixed Capital Depreciation	Natural Capital Depreciation as % of GDP	Degradation Cost as % of GDP	GDPG	EDP1G	EDP2G
1981	56.33	5.82	8.95%	2.78%	-	-	-
1982	62.04	5.34	10.07%	2.59%	10.14	-1.61	-1.77
1983	62.67	5.21	9.67%	2.92%	1.01	13.47	13.45
1984	67.01	5.47	7.53%	3.03%	6.92	2.73	2.43
1985	65.89	7.69	6.02%	3.39%	-1.66	6.13	5.97
1986	65.20	7.27	6.10%	3.90%	-1.05	-1.27	-1.91
1987	72.48	8.71	3.72%	3.59%	11.16	-1.57	-1.77
1988	73.14	10.54	3.46%	3.58%	0.92	10.46	10.96
1989	76.89	11.09	3.31%	3.50%	5.12	0.17	0.05
1990	84.01	13.14	3.29%	3.49%	9.25	2.48	2.18
Average	68.57	8.03	6.21%	3.28%	4.65	3.44	3.29

Figure 7.3: EDP for NPI and degradation, 1981-1990 (£E billion of 1990)



NPID caused EDP to fall significantly below GDP in the 1981-1990 period

Figure 7.4: EDP and GDP growth for NPI and degradation, 1981-1990



The annual growth rate of EDP is significantly lower than GDP in five of nine years

The dramatic picture that is offered by the depreciation method and degradation resulted from the higher contribution of NPI in the total cost. Depletion of oil and gas measured by NPI accounts for 68% of total natural capital depreciation compared to 36% for the UC (8%) over the ten years period, and the average annual depletion cost for NPI is 6.21% of GDP compared to 2% for the user cost approach over the 1981-1990 period. In addition, the natural capital depreciation and degradation is greater than fixed capital depreciation in four of ten years (1981-1984). As has been explored in Chapter Five, these differences resulted from the assumption that user cost divides the net rent from the natural resource into income and user cost, but the NPI treats all the net rent as a depreciation cost. In short, both the NPI and UC will never fall below zero and NPI will always be higher than UC. The different assumptions behind both the depreciation (NPI and NPII) and user cost approaches have been analysed and compared when accounting for the depletion of non-renewable resources (Chapter Five).

On the basis of the above results of EDP shown in Tables 7.2 & 7.3 and Figures 7.1 & 7.3, the net adjustments to Egypt's GDP for environmental "depreciation" amounted to between 5.15% and 9.49% of GDP per year on average during the ten-year study period covered. The same Tables and Figures show, also, the growth rate of GDP, EDP1 and EDP2, for UCD and NPID. The average growth rate for EDP1 and EDP2 falls to 2.92% and 2.75% compared to 4.65% for GDP for UCD over the ten years period. The NPID shows a quite different picture- the average growth rate for EDP1 and EDP2 fell to 3.44% and 3.29% compared to 4.65% for GDP for the same period. However, the individual annual growth rates for EDP1 and EDP2, as shown in Figures 7.2 & 7.4, are more important in economic and growth analysis than the average growth rate over the study period.

Economic development is a much wider concept than economic growth. Economic development includes economic growth and some other aspects such as equity and freedom,....etc. Economic growth is generally defined as an increase in the level of real gross domestic product per capita (or, sometimes the real level of consumption per capita). Therefore, both sustainable development and sustainable growth are linked. A country that does not maintain or improve its real income per capita is unlikely to be developing (Pearce and Warford, 1993).

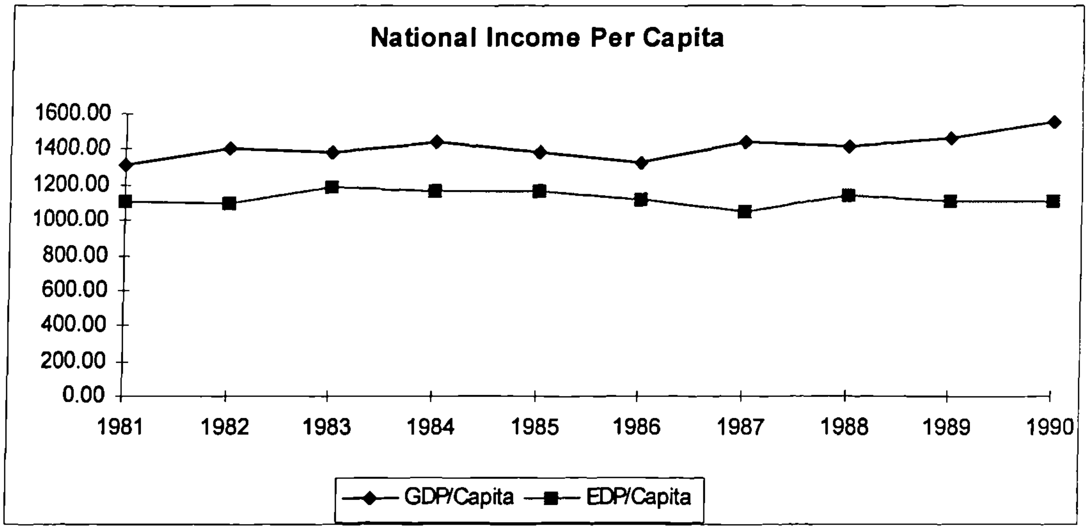
Although both GDP and EDP are useful indicators in comparing the size of the country's economy to another or comparing the progress of the country across different points of time, they may be misleading figures if they used to compare the standards of living either between countries or with some points in the past for the same country. Therefore, to judge the country's standard of living it useful to look at income per head of population (income per capita)[9] rather than the aggregated GDP or EDP. It is also important to note that deciding to report income per capita rather than aggregated GDP gives a very different perspective on economic performance welfare (see Tables 7.4 & 7.5 and Figures 7.5 & 7.7).

[9] However, Young (1993) and Common (1995) and (1996) have criticised GDP per capita as a measure and indicator of economic performance and welfare from three standpoints: first, national income is an inaccurate measure of the delivery of welfare to a nation's, and growth of per capita is in no way an indicator of fair distribution of income or social progress. On the contrary, it can hide very deep social gaps increasing within society. Second, as discussed in Chapter Two, GDP normally measure market things, that have a market value, and does not measure the ultimate end of economics: the degree of satisfaction of individuals. Lastly, and this is the one related to the objective of this thesis, GDP takes no account for the environmental impacts of economic activities.

Table 7.4: National Income per capita for user cost and degradation (£E 1990)

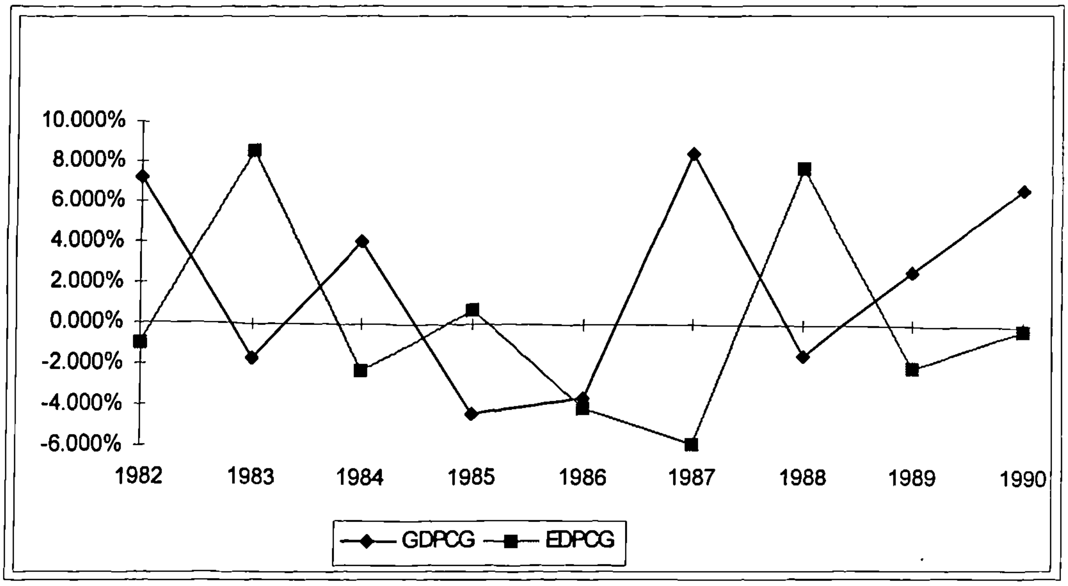
Year	*GDP*	*EDP*	*GDP/Capita*	*EDP/Capita*	*GDPCG*	*EDPCG*
1981	56.33	47.21	1314	1102	-	-
1982	62.04	48.02	1409	1091	7.19%	-1.01%
1983	62.67	53.57	1385	1184	-1.68%	8.57%
1984	67.01	53.79	1442	1157	4.07%	-2.27%
1985	65.89	55.72	1378	1165	-4.42%	0.68%
1986	65.20	54.81	1329	1117	-3.55%	-4.11%
1987	72.48	52.88	1441	1051	8.46%	-5.87%
1988	73.14	58.38	1420	1134	-1.45%	7.80%
1989	76.89	58.49	1459	1110	2.70%	-2.11%
1990	84.01	59.71	1558	1107	6.76%	-0.23%
Average	68.57	54.26	1414	1122	2.00%	0.16%

Figure 7.5: GDP and EDP per capita for UCD, 1981-1990 (£E 1990)



EDP per capita on average is twenty percent lower than GDP per capita for the nine years

Figure 7.6: GDP and EDP per capita growth for UCD, 1982-1990



The average growth rate of EDP per capita for the nine years is significantly lower than GDP per capita growth for the same period.

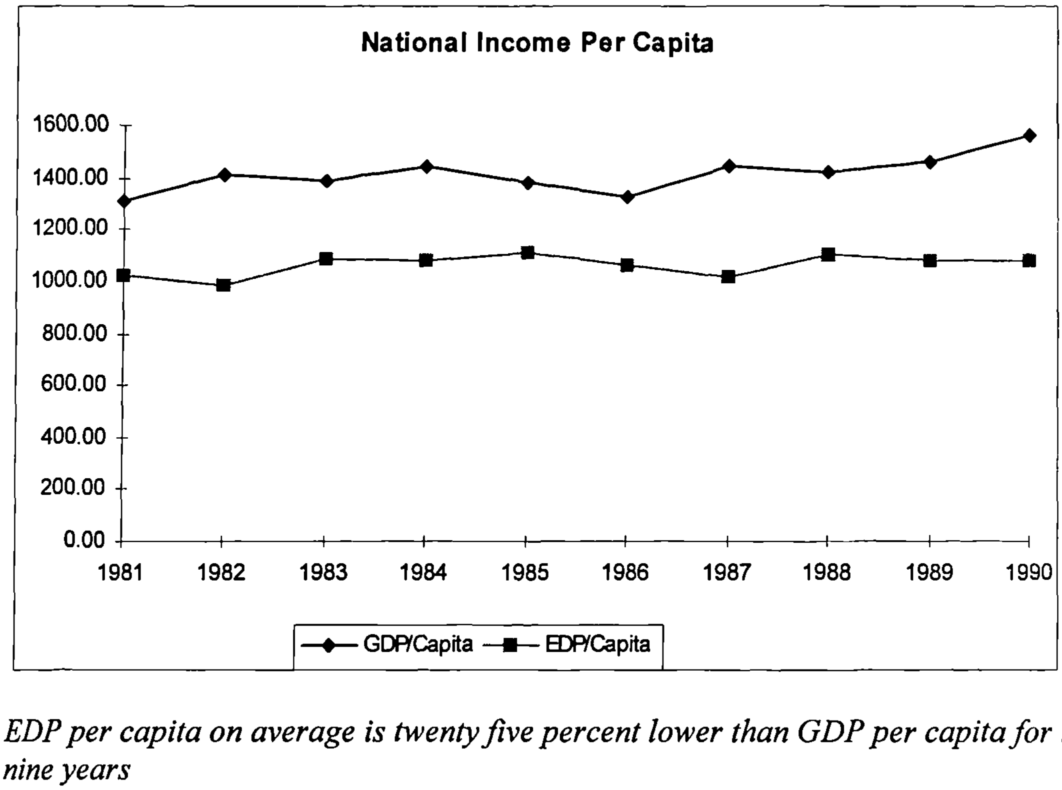
As stated in Chapter Two Egypt's population was increasing at rate a of 2.6 percent on average for the 1981-1990 period. This means that income per capita must keep rising by, at least, 2.6 percent a year so that the Egyptian will remain as well off as they were in the previous year. However, as shown in these figures and tables, the conventional GDP per capita growth on average is about 23% lower than the population growth; and the picture became even worse when the environmental costs were accounting for and incorporated in GDP estimates (see Figures 7.5 & 7.7).

On the basis of the above discussions, it would be useful to estimate and compare GDP and EDP per capita, as better measures of economic performance and welfare, rather than the total ones. As shown in Table 7.4, it is clear that EDP per capita growth for UCD on average is twenty percent lower than GDP per capita for the 1981-1990 period in 1990 prices. However, EDP per capita growth for NPID shows a quite significant decrease, it is on average more than 25 percent lower than conventional GDP per capita growth for the same study period in 1990 prices (Table 7.5).

Table 7.5: National Income per capita for NPI and degradation (£E 1990)

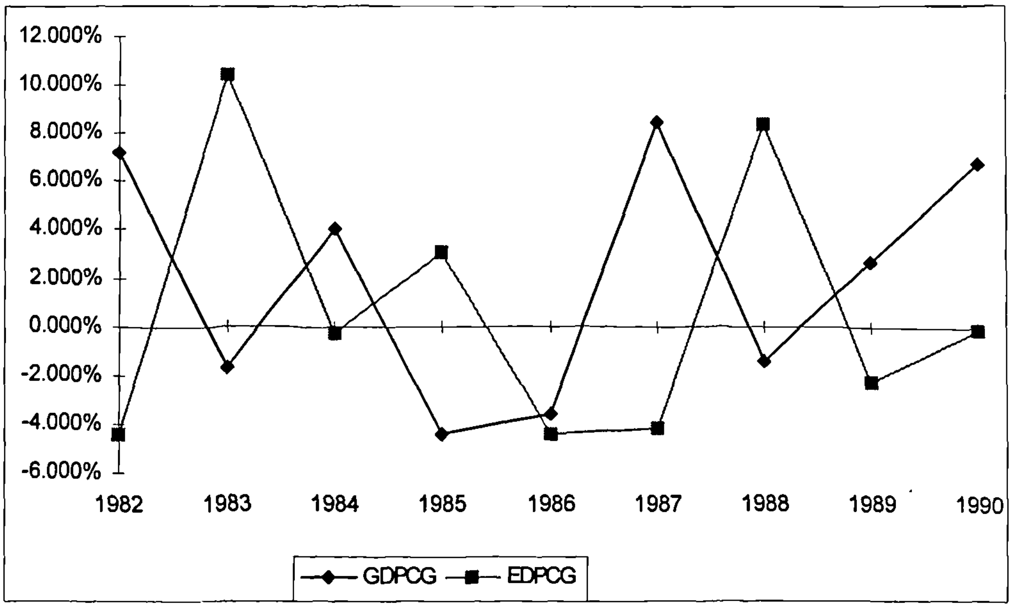
Year	GDP	EDP	GDP/Capita	EDP/Capita	GDPCG	EDPCG
1981	56.33	43.90	1314	1024	-	-
1982	62.04	43.13	1409	979	7.19%	-4.40%
1983	62.67	48.93	1385	1081	-1.68%	10.41%
1984	67.01	50.12	1442	1078	4.07%	-0.29%
1985	65.89	53.12	1378	1111	-4.42%	3.00%
1986	65.20	52.10	1329	1062	-3.55%	-4.39%
1987	72.48	51.18	1441	1018	8.46%	-4.15%
1988	73.14	56.79	1420	1103	-1.45%	8.34%
1989	76.89	56.82	1459	1078	2.70%	-2.24%
1990	84.01	58.06	1558	1076	6.76%	-0.14%
Average	68.57	51.41	1414	1061	2.00%	0.68%

Figure 7.7: GDP and EDP per capita for NPID, 1981-1990 (£E 1990)



EDP per capita on average is twenty five percent lower than GDP per capita for the nine years

Figure 7.8: GDP and EDP per capita growth for NPID, 1982-1990



The average EDP per capita growth, for the 1982-1990 period, is lower than GDP per capita growth in six of nine years.

On the basis of the results presented in Tables 7.4 & 7.5 and Figures 7.5 & 7.7 the EDP per capita annual growth rates, for both UCD and NPID, are compared with GDP per capita growth, for the 1981-1990, in Figures 7.6 And 7.8. From these figures the average EDP per capita growth for NPID falls to 0.68 percent compared to 2.01 percent for GDP per capita, on average, over the ten years study period. On the other hand, EDP per capita growth for UCD shows a quite different picture- the average growth rate falls dramatically to 0.16 percent compared to 2.01 percent for GDP per capita growth for the same study period. However, as argued earlier, the individual annual growth rates for GDP and EDP per capita are an important indicators in economic growth analysis than the simple average of growth rates over the years. As shown in figures 7.6 & 7.8 the EDP per capita annual growth, for both UCD and NPID, is lower than GDP per capita growth in six of nine years. This assured the fact that the conventional Egyptian GDP per capita growth, over the ten years study period, was highly relying on and financed by the depletion and degradation of environmental and natural capital.

2.2 Domestic Investment

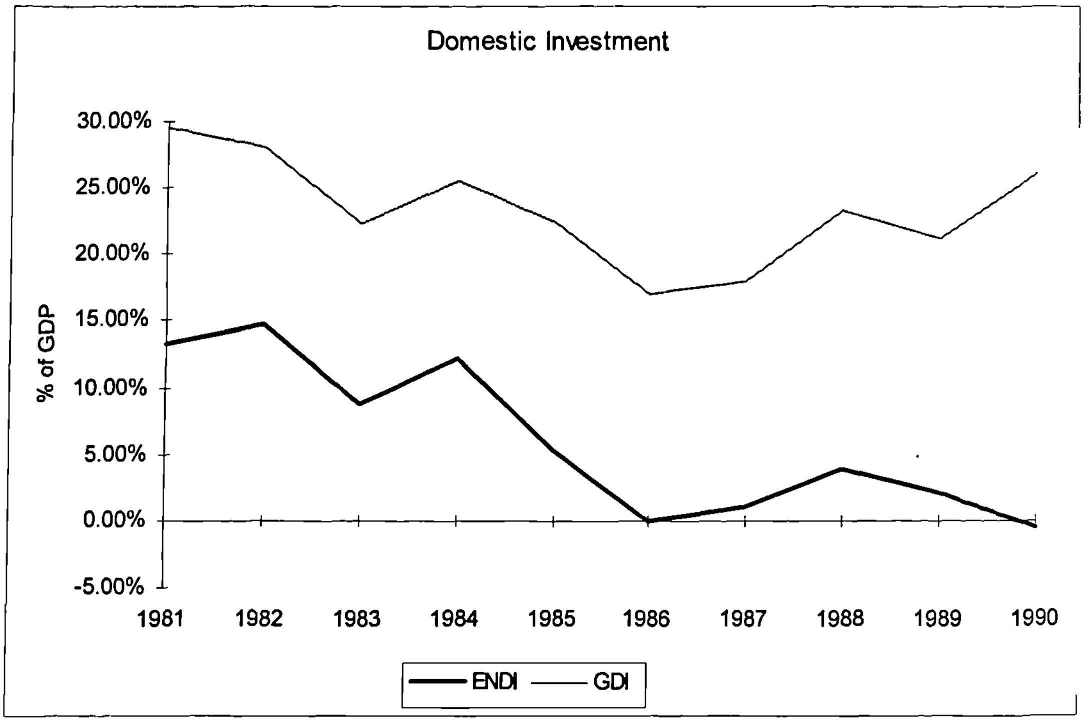
Gross domestic investment fell from 30% of GDP in 1981 to 20% of GDP in 1990, while net domestic investment fell from 20% of GDP to 5% of GDP. Incorporating natural capital depletion and degradation, thereby deriving Environmentally-adjusted net Domestic Investment (EDI), demonstrates an even more startling statistic: EDI fell from 14.72% of GDP to -0.40% of GDP (UCD) and from 8.36% of GDP to -4.11% of GDP (NPID) (Tables 7.6 & 7.7). Figures 7.5 and 7.6 indicate the clear downward trend in EDI. Indeed Egypt has experienced negative or zero net investment in at least two of ten years. The NPID highlights the particularly low level of investment throughout the second half of the 1980s.

Table 7.6: Domestic investment for user cost and degradation (£E billion of 1990)

Year	*Gross Domestic Investment*	*Fixed Capital Depreciation*	*User Cost and Degradation*	*Environmentally adjusted Net Domestic Investment*	*EDI as % of GDP*
1981	16.61	5.82	3.29	7.50	13.32%
1982	17.43	5.34	2.96	9.13	14.72%
1983	13.94	5.21	3.24	5.47	8.74%
1984	17.08	5.47	3.40	8.20	12.25%
1985	14.75	7.69	3.59	3.46	5.25%
1986	11.08	7.27	3.80	0.00	0.01%
1987	13.04	8.71	3.60	0.72	1.00%
1988	16.97	10.54	3.55	2.86	3.92%
1989	16.23	11.09	3.56	1.57	2.05%
1990	16.83	13.14	4.03	-0.33	-0.40%

GDI: Gross Domestic Investment
EDI: Environmentally-adjusted net Domestic Investment
EDI=GDI - Fixed Assets Depreciation - User cost and Degradation of Natural Capital.

Figure 7.9: EDI for user cost and degradation, 1981-1990 (% of GDP)



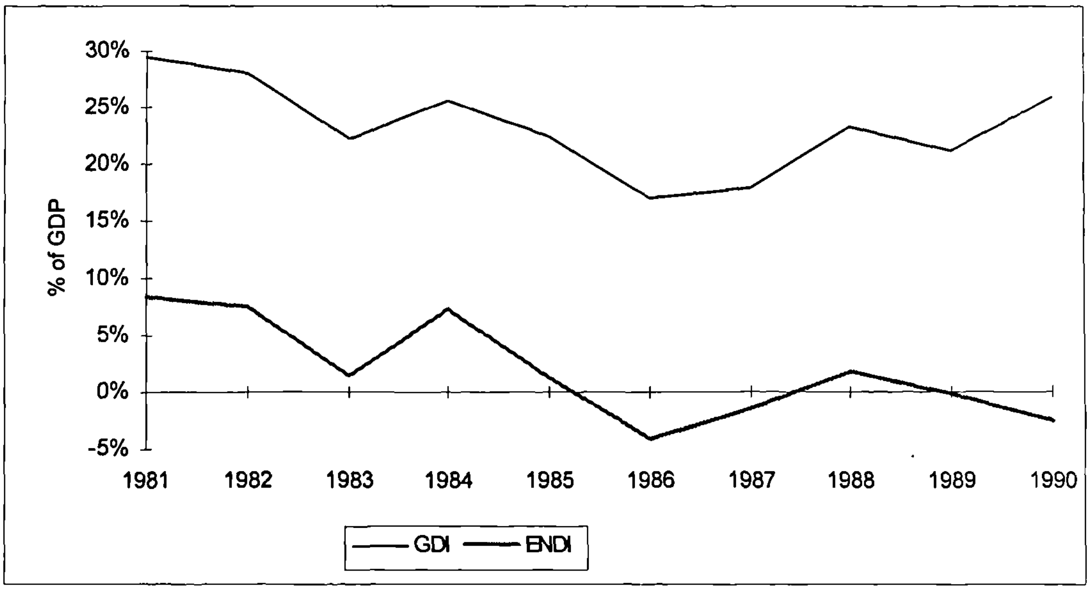
EDI is zero and negative in two of ten years

Table 7.7: Domestic investment for NPI and degradation (£E billion of 1990)

Year	*Gross Domestic Investment*	*Fixed Capital Depreciation*	*Natural Capital Depreciation and Degradation*	*Environmentally adjusted net Domestic Investment EDI*	*EDI as % of GDP*
1981	16.61	5.82	6.60	4.19	8.36%
1982	17.43	5.34	7.85	4.23	7.52%
1983	13.94	5.21	7.89	0.83	1.34%
1984	17.08	5.47	7.07	4.54	7.24%
1985	14.75	7.69	6.19	0.85	1.28%
1986	11.08	7.27	6.51	-2.70	-4.11%
1987	13.04	8.71	5.30	-0.97	-1.49%
1988	16.97	10.54	5.14	1.27	1.76%
1989	16.23	11.09	5.23	-0.09	-0.13%
1990	16.83	13.14	5.69	-1.99	-2.59%

GDI: Gross Domestic Investment
EDI: Environmentally-adjusted net Domestic Investment
EDI=GDI - Fixed Assets Depreciation - Depreciation and Degradation of Natural Capital.

Figure 7.10: EDI for NPI and degradation, 1981-1990 (% of GDP)



EDI declined gradually and was negative in three of the final five years

2.3 Balance of Payments

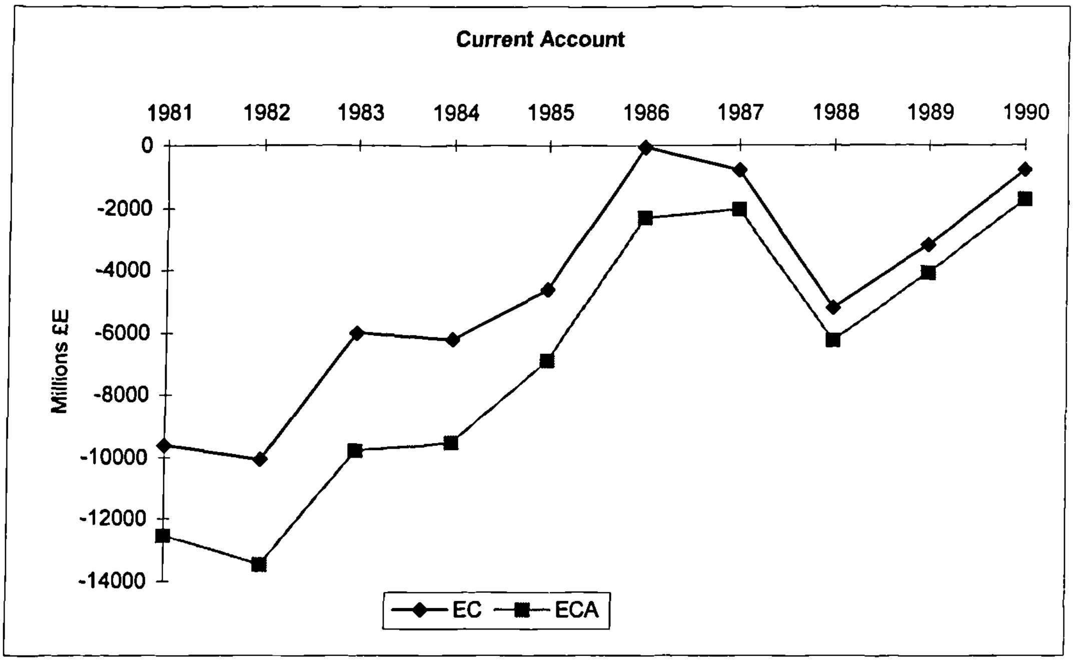
One of the important indicators of the health of an economy is the balance of payments that allows policy-makers the opportunity to keep track of changes in a country's indebtedness to foreign countries. The current account is the most important account in the balance of payments; the balance of this account is equal to the investment-savings gap according to national accounting equations. More importantly, El Serafy explained how the balance of payments could be regarded as a signal of actual or potential threat to the existing exchange rate system. Therefore, he warns of the danger of relying too heavily upon this macroeconomic indicator that focuses on short-term exchange rate imbalances rather than long-term sustainability. Instead he proposes the calculations of an Environmentally-adjusted Current Account (ECA) that removes the value of natural capital depletion from the natural capital exports in the current account. Capital exports would thus appear as credits in the capital account rather than the current account. Failure to account for natural capital in this manner may lead to a situation whereby the CA may be in serious deficit but the inflow of foreign exchange earned by natural capital exports causes it to appear in lower deficit or even in surplus (El Serafy, 1993).

Table 7.8: Current account for NPI method (£E million of 1990)

Year	*Current Account*	*Natural Capital Depreciation NP*	*Environmentally adjusted Current Account*	*ECA as % of GDP*
1981	-9625.7	2919.2	-12545.0	-22.3%
1982	-10060.7	3412.3	-13473.0	-21.7%
1983	-6006.8	3806.6	-9813.4	-15.7%
1984	-6206.1	3334.7	-9540.9	-14.2%
1985	-4615.6	2286.7	-6902.3	-10.5%
1986	-70.8	2244.5	-2315.4	-3.6%
1987	-783.4	1252.8	-2036.3	-2.8%
1988	-5206.4	1029.6	-6236.1	-8.5%
1989	-3207.4	888.0	-4095.4	-5.3%
1990	-801.2	942.1	-1743.3	-2.1%

ECA = Current Account-Natural Capital Depletion (Oil exports)

Figure 7.11: The balance of CA for NPI, 1981-1990 (£E million of 1990)



NPI offers a significantly higher deficit for ECA that began to improve in 1986/87 after the £E devaluation.

Tables 7.8 and 7.9 show the ECA deficit after removing the value of natural capital exports[10] from the current account. For the depreciation approach, the ECA deficit was greater than 10% of GDP for five of ten years. This contrasts with only two years in which the conventional CA deficit was greater than 10% of GDP. On the other hand, the user cost approach offers a moderate appraisal for the current account deficit (Figure 7.12); the ECA deficit exceeded 10% of GDP in only four of ten years. The 1981-1985 period showed the highest CA deficit at a range –7.0% - (-17.09%) of GDP. This could be explained by the government open door policy, adopted in the late 1970s, which aimed at encouraging imports to lower the local prices for capital, intermediate goods, and food-stuffs. However, exports have continued to follow the pattern of depending heavily on a single primary commodity of oil which has replaced the traditional major export item of cotton, and the diversification of export items has hardly developed. ECA (Figures 7.11 & 7.12) improved significantly after the devaluation of the Egyptian pound in 1986/87, and continued its recovery in the 1990s.

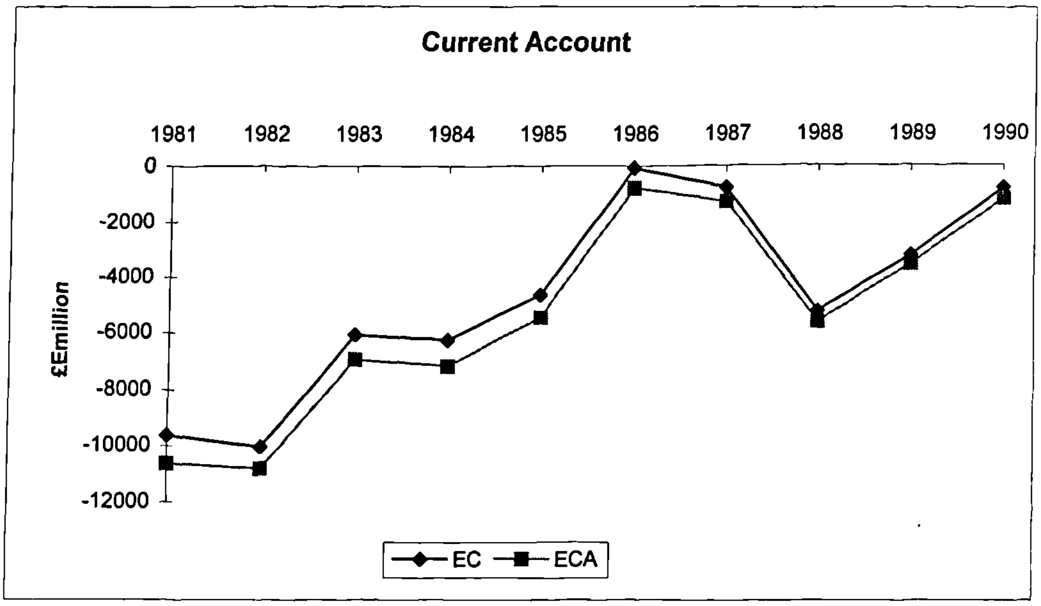
Table 7.9: Current account, user cost method (£E million of 1990)

Year	*Current Account*	*User Cost of Petroleum*	*Environmentally adjusted Current Account*	*ECA as % of GDP*
1981	-9625.7	1002.4	-10628.2	-18.9%
1982	-10060.7	738.4	-10799.1	-17.4%
1983	-6006.8	889.6	-6896.4	-11.0%
1984	-6206.1	909.0	-7115.2	-10.6%
1985	-4615.6	785.2	-5400.9	-8.2%
1986	-70.8	713.6	-784.5	-1.2%
1987	-783.4	464.6	-1248.1	-1.7%
1988	-5206.4	381.8	-5588.3	-7.6%
1989	-3207.4	304.9	-3512.3	-4.6%
1990	-801.2	377.3	-1178.6	-1.4%

ECA = Current Account-Natural Capital Depletion (Oil exports)

[10] Analysis focuses solely upon oil exports that constituted 55% - 60% of Egypt exports from 1981 to 1990,; therefore the ECA is calculated after removing the capital element of oil exports.

Figure 7.12: CA for user cost approach, 1981-1990 (£E million of 1990)



UC offers a moderate appraisal of ECA deficit, it improves gradually after the £E devaluation in 1986/87

2.4 Comparison Between Conventional and Environmental Accounting Indicators

Tables 7.10 and 7.11 refer to a ten year time series (1981-1990) for environmentally-adjusted net domestic product in Egypt that would give a brief summary for the analysis of the sustainability of growth in the country. Environmental costs are mirrored in the value of changes in capital formation, that reduced its contribution from between 29.5% - 18% to between 1.36% - (-0.40%) for GDP in the 1981-1990 period when UCD costs are incorporated. On the other hand, NPID offers a different picture: the contribution of Environmentally-adjusted Net Capital Formation (ENCF) decreased to range between 7.48% - (-4.15%) for GDP for the same ten year study period.

A comparison of the ratios of final consumption to GDP and to EDP indicates that consumption exceeded EDP for most of the study years. There is a tangible increase in the contribution of final consumption from a range between 80.91% - 87.59% for GDP, to between 98.85% - 113.88% for EDP for UCD and to between 104% -

126.75% for EDP for UCD and NPID, respectively, in the 1981-90 period. Finally, the balance of current account as a percentage of GDP has changed from between -17.09% - (-0.11%) to range between -20.95% – (-0.13%) of EDP for UCD and to between -23.33% – (-0.14%) of EDP for NPID for the same ten-year study period. These new indicators, which are offered by environmental accounting, are very important for policy analysis as well as sending early warning signals for policy-makers on the sustainability of Egyptian economic growth. However, the benefits of environmental accounting will be most appreciable if it is disaggregated by economic sectors. This is the task of the next section, which will present the disaggregated environmental accounting by economic activities, and will show how beneficial it is in planning and policy analysis.

Table 7.10: Comparative analysis between conventional and environmental accounting indicators for UCD, 1981-1990 (£E billion of 1990)

Adjusted Items	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
GDP	56.3326	62.0460	62.6745	67.0142	65.8987	65.2039	72.4819	73.1485	76.8944	84.0098
EDP	47.2180	48.0282	53.5785	53.7950	55.7243	54.8189	52.8806	58.3812	58.4906	59.7158
EDP as % of GDP	***83.82%***	***77.41%***	***85.49%***	***80.27%***	***84.56%***	***84.07%***	***72.96%***	***79.81%***	***76.07%***	***71.08%***
Consumption	49.3403	54.6718	54.7362	56.1317	55.7621	54.1879	60.2186	61.3845	63.8680	67.9713
Consumption as % of GDP	87.59%	88.11%	87.33%	83.76%	84.62%	83.11%	83.08%	83.92%	83.06%	80.91%
Consumption as % of EDP	***104.49%***	***113.83%***	***102.16%***	***104.34%***	***100.07%***	***98.85%***	***113.88%***	***105.14%***	***109.19%***	***113.82%***
Gross Capital Formation	16.6181	17.4349	13.9451	17.0886	14.7523	11.0868	13.0467	16.9705	16.2338	16.8399
GCF as % of GDP	***29.50%***	***28.10%***	***22.25%***	***25.50%***	***22.39%***	***17.00%***	***18.00%***	***23.20%***	***21.11%***	***20.05%***
Fixed Capital Depreciation	5.8203	5.3432	5.2181	5.4744	7.6970	7.2740	8.7191	10.5415	11.0915	13.1431
NCF	10.7978	12.0917	8.7270	11.6142	7.0553	3.8128	4.3276	6.4290	5.1423	3.6967
Environmental Depreciation	3.2943	2.9612	3.2494	3.4050	3.5929	3.8058	3.6041	3.5593	3.5664	4.0354
ENCF	7.5035	9.1305	5.4776	8.2091	3.4624	0.0070	0.7235	2.8697	1.5759	-0.3387
ENCF as % of GDP	***13.32%***	***14.72%***	***8.74%***	***12.25%***	***5.25%***	***0.01%***	***1.00%***	***3.92%***	***2.05%***	***-0.40%***
Exports - Imports	-9.6258	-10.0607	-6.0068	-6.2062	-4.6157	-0.0708	-0.7834	-5.2065	-3.2074	-2.7200
X-M as % of GDP	-17.09%	-16.21%	-9.58%	-9.26%	-7.00%	-0.11%	-1.08%	-7.12%	-4.17%	-3.24%
X-M as % of ***EDP***	***-20.39%***	***-20.95%***	***-11.21%***	***-11.54%***	***-8.28%***	***-0.13%***	***-1.48%***	***-8.92%***	***-5.48%***	***-4.55%***

Explanations:

EDP = Environmentally-adjusted net Domestic Product =EDP2

GCF= Gross Capital Formation

NCF = Net Capital Formation

ENCF = Environmentally -adjusted Net Capital Formation

X = Exports, M = Imports

Table 7.11: Comparative analysis between conventional and environmental accounting indicators for NPID, 1981-1990 (£E billion of 1990)

Adjusted Items	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
GDP	56.3326	62.0460	62.6745	67.0142	65.8987	65.2039	72.4819	73.1485	76.8944	84.0098
EDP	43.9083	43.1322	48.9350	50.1263	53.1209	52.1058	51.1828	56.7908	56.8196	58.0607
EDP as % of GDP	***77.94%***	***69.52%***	***78.08%***	***74.80%***	***80.61%***	***79.91%***	***70.61%***	***77.64%***	***73.89%***	***69.11%***
Consumption	49.3403	54.6718	54.7362	56.1317	55.7621	54.1879	60.2186	61.3845	63.8680	67.9713
Consumption as % of GDP	87.59%	88.11%	87.33%	83.76%	84.62%	83.11%	83.08%	83.92%	83.06%	80.91%
Consumption as % of EDP	***112.37%***	***126.75%***	***111.86%***	***111.98%***	***104.97%***	***104.00%***	***117.65%***	***108.09%***	***112.40%***	***117.07%***
Gross Capital Formation	16.6181	17.4349	13.9451	17.0886	14.7523	11.0868	13.0467	16.9705	16.2338	16.8399
GCF as % of GDP	***29.50%***	***30.10%***	***22.25%***	***27.50%***	***22.01%***	***20.00%***	***18.00%***	***24.20%***	***24.11%***	***21.90%***
Fixed Capital Depreciation	5.8203	5.3432	5.2181	5.4744	7.6970	7.2740	8.7191	10.5415	11.0915	13.1431
NCF	10.7978	12.0917	8.7270	11.6142	7.0553	3.8128	4.3276	6.4290	5.1423	3.6967
Environmental Depreciation	6.6040	7.8572	7.8929	7.0738	6.1963	6.5189	5.3020	5.1497	5.2374	5.6905
ENCF	4.1938	4.2345	0.8341	4.5404	0.8590	-2.7061	-0.9744	1.2793	-0.0951	-1.9938
ENCF as % of GDP	***7.44%***	***6.82%***	***1.33%***	***6.78%***	***1.30%***	***-4.15%***	***-1.34%***	***1.75%***	***-0.12%***	***-2.37%***
Exports - Imports	-9.6258	-10.0607	-6.0068	-6.2062	-4.6157	-0.0708	-0.7834	-5.2065	-3.2074	-2.7200
X-M as % of GDP	-17.09%	-16.21%	-9.58%	-9.26%	-7.00%	-0.11%	-1.08%	-7.12%	-4.17%	-3.24%
X-M as % of EDP	***-21.92%***	***-23.33%***	***-12.28%***	***-12.38%***	***-8.69%***	***-0.14%***	***-1.53%***	***-9.17%***	***-5.64%***	***-4.68%***

Explanations:
EDP = Environmentally-adjusted net Domestic Product =EDP2
GCF= Gross Capital Formation
NCF = Net Capital Formation
ENCF = Environmentally -adjusted Net Capital Formation
X = Exports, M = Imports

3. SECTORAL ACCOUNTS

3.1. Environmental Accounting by Economic Activities

The analysis of environmental impacts on economic aggregates has been carried out in a macroeconomic format to show how net product is affected when depletion and degradation are incorporated, how final consumption ratios have changed as percentage of EDP compared to GDP, how NDI has changed to EDI which was in at least two years negative values as a percentage of GDP, and finally how ECA has offered a more dramatic picture for the deficit of the balance of payments, when depletion costs of oil exports was accounted for, compared to the conventional CA.

Despite the usefulness of these indicators, they do not provide the detailed information that would be helpful for operational government policies. Therefoie the analysis must be extended to identify the depletion and degradation cost by economic activities and to determine the sectors that use the natural capital in their production process. The sectoral analysis focuses on the value added made by different sectors. The quantitative results of environmental sectoral accounts for the 1986/87–1990/91[11] period are presented in Tables 7.12 – 7.16.

As can be seen from these tables, the net product concepts have been identified in each of the three sections of the tables. NDP is calculated first, followed by EDP1 after the depletion and land-use effect have been incorporated, and EDP2 is calculated after the incorporation of degradation effects. The environmental costs are the same in Table 7.11. However, the only difference is that £E36.85 million is added to the degradation cost each year[12]- this amount is allocated in the third five year plan for protecting the Egyptian natural heritage, therefore, it is allocated for trade, restaurants, and hotels that includes the tourism sector. On the other hand, the water and air pollution costs were allocated for industrial sector, soil erosion for the

[11] The third Five Year Plan (FYP).

[12] This is a defensive expenditure that is paid by the government on behalf of the tourism sector.

agricultural sector and transfer land losses[13] due to urbanisation are allocated for the construction industry.[14]

3.2. Comparison Between Conventional and Environmental Sectoral Accounts

The information on value added and capital productivity by economic activities can be used to assess each sector performance and growth potential, using alternatively estimates that are linked to EDP1 and EDP2. This is done in Tables 7.17 – 7.20 below. Each table has two sections. The first sections of these tables, which presents an alternative distribution of GDP, EDP1 and EDP2, show that there is a considerable change in the distribution of the value added when environmental depletion and degradation are incorporated. The sectors' contributions significantly affected are those of oil and gas, manufacturing, construction and electricity, gas and water: the contribution of oil and gas drops from 5.98% for GDP in 1988/89 to 3.77% for EDP1 and to 3.89% for EDP2. Manufacturing sector contribution drops from 22.35% for GDP to 19.74% for EDP1, and 17.68% for EDP2 in 1988/89. In addition, construction sector contribution in 1989/90 fall from 4.32% for GDP to 3.24% for EDP1 and 3.3% for EDP2. Moreover, in 1990/91 the contribution of the electricity, gas, and water sectors falls from 1.20% for GDP to 0.062% for EDP1 and 0.06% for EDP2.

In contrast, the agriculture sector's contribution increased in the case of EDP1 (in 1988/89, for example, from 26.33% to 31.00%), and decreased again in the case of EDP2 (30.44% for the same year). The transport, storage and communication sector followed the opposite pattern: its contribution decreased in the case of EDP1 from 8.71% of GDP to 5.48%, and increased again in the case of EDP2 to 5.67% in 1990/91 for example. On the other hand, all services sectors followed almost the

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[13] It estimates the costs of losing productive agricultural land through urbanisation. New urban land increases construction output, which in turn will be reflected in a higher level of personal consumption. Nevertheless, the cost associated with this increase in economic output is the loss to present and future generations of agriculture productivity.

[14] The value added of this industry includes all the costs related to construction undertaken for the purpose of urbanisation.

same pattern, that is, their contribution increased in the modified concepts EDP1 and EDP2 compared to GDP. This is because these sectors are less depleting or degrading. In 1988/1989 for example, the trade sector's contribution increased from 11.61% for GDP to 13.26% for EDP1 and 13.65% for EDP2. Finance, insurance, real estate and business services, Community, social and personal services, Government services and Household production activities contributions increased from 7.96%, 1.31%, 10.23%, 0.33% for GDP to 8.82%, 1.29%, 12.27%, 0.36% for EDP1 and 9.12%, 1.33%, 12.63%, 0.38% for EDP2, respectively for the same year.

One of the logical ways to start planning the general growth rate of economic development is: first, to estimate the amount of domestic savings and capital transfers that could be expected with no change in economic policies; second, to calculate the rate of growth that this level of savings and investment would provide; and finally, to compare it with the desirable growth rate. After estimating the rate of domestic investment, the crucial question is what amount of net national product would be expected from that investment. One of the important tools in estimating the amount of capital required to increase output by one unit per annum in each sector of the economy and for the national economy as a whole, is called "capital output ratio" or "capital coefficient".[15]

The second half of the tables shows the marginal Incremental Capital–Output Ratios (ICORs)[16]. Inefficient and less productive investment would normally reflect itself in high ICORs[17], whereas efficient and productive investment would lower the value of measured ICORs. Where natural capital is being rapidly depleted and the depletion is

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[15] This method of projecting the future level of national output can be checked by other ways of forecasting, e.g., extrapolation of past figures (Meier, 1984).

[16] Although ICOR is only one measure of sectoral as well as macroeconomic productivity, it is the one commonly used (together with labor productivity) in the developing world for allocating investment to economic sectors when preparing a country's short-term as well as long-term plans. ICORs are usually calculated from national account publications because it requires only the change in stock and production. On the other hand, the average capital-output ratio is almost neglected because it requires the total value of capital stock, which is usually not available in developing countries.

[17] ICOR = $I/\Delta Y$ = total investment divided by the change in production; it is an important ratio for measuring capital productivity and economic analysis. In addition, ICOR does provide one tool that can be used in the difficult but important procedure of estimating future investment requirements. Therefore, a higher or lower ICOR is not in itself a sufficient argument for or against investment in any particular activity.

wrongly reflected in growing income, the ICOR measured would be deceptively low, and whatever inference gleaned from them about the productivity of capital, highly misleading. If natural capital depletion and degradation were to be incorporated in ICOR measurement, as shown in Tables 7.17 - 7.20 for four of the five years environmental sectoral accounts, the adjusted ICORs theoretically should rise indicating lower capital efficiency than had been previously thought[18]. Therefore, when including natural capital disinvestment in calculating ICOR for the sectors' accounts, it resulted in deceptively higher ICORs for EDP1 and EDP2 when it remains positive. For example, in 1987/88 and 1990/91 ICOR ratios were 1.810, 2.479 for GDP and it changed to 2.383, 4.055 for EDP1 and 3.546, 10.737 for EDP2 respectively (Tables 7.17 & 7.20). Therefore, using ICOR ratios in economic planing and analysis as conventionally calculated will be highly misleading. The negative aggregated and disaggregated ICORs in the 1987-1991 period (Tables 7.17 - 7.20) are derived from declining output. The oil and gas sector in two of four years shows negative ICOR because the level of the change in output was negative even though the level of investment ratio for these years was high. On the other hand, Manufacturing and Transport, storage, and communications show considerably larger positive ICORs for almost the four years of disaggregated environmental sectoral accounts (see Tables 7.17 – 7.20) for all concepts: GDP, EDP1 and EDP2.

The non-manufacturing industrial sectors present a special different feature. The public utility industries of electricity, gas, and water, by their nature require a very high fixed capital stock in relation to output in order to distribute power and water to consumers over the country – the capital coefficient for this sector is by far the highest shown in Tables 7.17 – 7.20 across the five years sectoral accounts. In 1988/89, for example, the ratio was 24.737 for EDP1 and EDP2. Construction, on the other hand, is not a highly capitalised industry, its capital coefficient is one of the lowest and decreasing as shown in Tables 7.17 – 7.20. With small capital stock, the burden of replacement on current gross investment is light so that increasing investment is associated with a rapidly increasing output. This is a sector, therefore, where the ICOR is low even though the gross investment is low. For example, in

[18] If natural capital depletion and degradation is denoted by d, fraction that will denote the adjusted ICOR will be $(I - d)/(\Delta Y - d)$ instead of the original $I/\Delta Y$, (where I denotes investment and Y income). The ICOR will always be larger than the unadjusted ICOR (if it remains positive) because $I > \Delta Y$.

1987/88 the ICOR was -0.653[19] for GDP and increased to 0.45 for EDP1 after taking into account the depletion of agriculture land resulting from urbanisation, and it remained constant for EDP2. In addition, the highly increasing negative ICOR for Government services assure the lower production of this sector compared to its higher investment expenditure.

Environmental-economic sectoral accounts indicated a quite different picture for capital efficiencies[20] on macro and sectoral levels if natural disinvestment (depletion and degradation) is accounted for in the production process. Reduction in capital productivity is reflected in increasing ICORs for EDP1, and EDP2 compared to GDP, when it remains positive.

4. CONCLUSIONS

Environmental accounting, as explained and examined above, offers some real prospects for incorporating environmental depletion and degradation into the macroeconomic policy framework. The coverage is never going to be complete and there are many methodological issues need to be resolved but the effort is worth making. A country would then have to introduce the main adjustments that need to be made on the environmental and natural resource front, as described above.

This study shows that Egypt has been rapidly using up its natural capital. In just one decade, from 1981-1990, Egypt depleted and degraded its environment by more than £E35.07 billion 1990 (see Table 7.2). This sum exceeds half the average value of one years' GDP during this period. The implications of this loss for development can not be determined with any precision, but at least as shown in the macro analysis, the

[19] Negative ICORs figures were a result of the decrease in the sector's generated income (in real terms) in the specified year when it is deducted from the previous one in order to arrive at ΔY.

[20] Data on total capital stock were not available. However, it is not an easy task to prepare the country balance sheet for produced capital and it may be an impossible task to include environmental assets, therefore flow accounts in this exercise are more important than stock accounts. Consequently, this study, as emphasised earlier, is more concentrated on including the environmental costs in flow accounts rather than stock accounts.

capital loss averaging 5.15%[21] of GDP a year could easily have reduced the potential growth rate of GDP by 1.90% a year. Since the actual growth rate over this period averaged 4.65%, this would represent a 41% reduction in the potential economic growth. More importantly, as explained in the text, the individual annual change in the growth rate, which may convey a different message from the average, is a very important indicator in economic and growth analysis (see Figures 7.2 and 7.4). More importantly, EDP per capita, as a better measure of economic performance and welfare, on average, was twenty percent lower than conventional GDP per capita over the ten years study period. In addition, the average EDP per capita growth, over the ten year, was almost 80 percent lower than GDP per capita growth for the same period (see Tables 7.4 & 7.5). This confirmed the fact that Egypt's economic growth and development, in the 1981-1990 period, was highly reliant on and financed by the depletion and degradation of the environmental and natural capital.

The EDI estimate shows more drastic changes in the investment accounts (see Table 7.6 and Figure 7.9). Natural resource depreciation averaged 23% of gross capital formation throughout the period 1981 to 1990. The conventional accounting framework thus overstated actual net capital formation in the Egyptian economy by more than 47% over the study period by ignoring the disappearance of Egypt's most productive assets-natural resources. An accounting system so misleading about an economic process as important as capital formation can be of no use for economic analysis, planning, or evaluation.

On the other hand, the balance of payments as an important macroeconomic indicator deteriorated significantly after removing the capital element of oil exports from the current account. The ECA deficit was greater than 10% for five of ten years compared to only two years for CA. This in turn may have a great effect on exchange

[21] UCD results used in these analyses because, as explained earlier, the results of UC approach are more acceptable to authoritative people than NPI, which offers an overestimation for non-renewable resources depletion. Moreover, on the theoretical level, the user cost approach appears to be more defensible. The modification of national income accounts following a user approach would bring the system more closely in line with the proper economic definitions of production and capital consumption. It would separate the cost of environmental disinvestment from value-added and income.

rate polices, such as appreciation and depreciation, which is wrongly determined from the conventional framework of national accounts. In addition, this may support the fact that the contribution of oil exports in foreign and net savings is not as great as shown by conventional SNA, and therefore policies that aimed at boosting savings by exporting scarce natural capital did not have the effect on net savings that conventional accounting suggested.

As shown above, preparing environmental sectoral accounts, along with environmental macro accounts, has portrayed a detailed different picture for the macro and sectoral economy compared to the conventional one. From the analysis of these accounts, as shown in Tables 7.12 – 7.20, one can conclude that the environmental-economic sectoral accounts have indicated a quite different picture for sectoral performance and capital efficiencies. Therefore, establishing environmental sectoral accounts has to be looked at as an important step in environmental accounting analysis. This type of analysis would provide the useful information that is mostly needed for operational government policies. Some policy implications based on these accounts will be discussed in Chapter Eight to show the significance and the importance of preparing the environmental sectoral accounts in addition to the environmental macro accounts.

Table 7.12: Integrated environmental and economic accounts by economic activities- Egypt 1986/1987 (£E million 1990)

Economic Activities	*Agriculture, hunting, forestry, and fishing*	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
A. Supply								
Total supply of goods and services	27,236.266	6,078.929	902.562	34,224.219	1,601.650	6,645.606	10,503.484	6,686.531
B. Use-value added								
Total use of goods and services	8,994.679	2,349.761	71.901	21,812.224	683.709	3,490.404	2,535.810	2,376.404
Gross value added (GDP)	18,241.587	3,729.168	830.661	12,411.995	917.941	3,155.203	7,967.673	4,310.128
Consumption of fixed capital	314.126	658.499	56.349	2,540.186	600.465	463.172	294.149	1,767.049
Net value added (NDP)	17,927.461	3,070.670	774.312	9,871.809	317.477	2,692.031	7,673.525	2,543.078
Environmental use of natural resources and the environment								
A. Depletion								
Oil and gas		937.566						
Agriculture land								
Transfer losses						724.961		
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	17,927.461	2,133.104	774.312	9,871.809	317.477	1,967.070	7,673.525	2,543.078
B. Degradation								
Air				414.918				
Air pollution								
Water				1,167.106				
Water pollution								
Land	234.000							
Soil erosion								
Natural heritage							36.859	
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	17,693.461	2,133.104	774.312	8,289.785	317.477	1,967.070	7,636.666	2,543.078

Economic Activities	*Finance, insurance, real estate and business services*	*Community, social and personal services*	*Total industries*	*Household production activities*	*Government services*	*Total production activities*
A. Supply						
Total supply of goods and services	7,685.103	1,596.535	103,160.885	358.008	12,803.450	116,322.343
B. Use-value added						
Total use of goods and services	1,377.509	576.116	46,050.874	149.055	4,918.513	51,118.441
Gross value added (GDP)	6,307.594	1,020.419	57,110.011	208.954	7,884.937	65,203.902
Consumption of fixed capital	400.308	154.904	7,249.206	15.286	10.352	7,274.844
Net value added (NDP)	5,907.286	865.515	49,860.805	193.667	7,874.586	57,929.058
Environmental use of natural resources and the environment						
A. Depletion						
Oil and gas			937.566			937.566
Agriculture land						
Transfer losses			724.961			724.961
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	5,907.286	865.515	48,198.278	193.667	7,874.586	56,266.531
B. Degradation						
Air						
Air pollution			414.918			414.918
Water						
Water pollution			1,167.106			1,167.106
Land						
Soil erosion			234.000			234.000
Natural heritage			36.859			36.859
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	5,907.286	865.515	46,345.395	193.667	7,874.586	54,413.648

***Table 7.13*: Integrated environmental and economic accounts by economic activities- Egypt 1987/1988 (£E million 1990)**

Economic Activities	*Agriculture, hunting forestry, and fishing*	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
A. Supply								
Total supply of goods and services	27,024.139	6,191.137	901.500	39,152.541	1,751.266	6,051.797	11,498.053	8,086.557
B. Use-value added								
Total use of goods and services	7,143.008	2,157.432	110.966	23,984.989	821.338	3,345.222	2,713.668	3,120.237
Gross value added (GDP)	19,881.131	4,033.705	790.534	15,167.552	929.928	2,706.575	8,784.385	4,966.320
Consumption of fixed capital	376.534	789.324	67.544	3,044.850	719.760	555.191	352.588	2,118.113
Net value added (NDP)	19,504.597	3,244.381	722.991	12,122.702	210.168	2,151.384	8,431.797	2,848.207
Environmental use of natural resources and the environment								
A. Depletion								
Oil and gas		873.915						
Agriculture land								
Transfer losses						688.603		
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	19,504.597	2,370.466	722.991	12,122.702	210.168	1,462.781	8,431.797	2,848.207
B. Degradation								
Air				422.404				
Air pollution								
Water				1,189.275				
Water pollution								
Land	303.000							
Soil erosion								
Natural heritage							36.850	
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	19,201.597	2,370.466	722.991	10,511.023	210.168	1,462.781	8,394.947	2,848.207

Economic Activities	*Finance, insurance, real estate and business services*	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
A. Supply						
Total supply of goods and services	7,472.541	1,694.552	109,824.083	13,359.452	369.732	123,553.266
B. Use-value added						
Total use of goods and services	1,371.721	654.863	45,423.443	5,500.934	146.965	51,071.342
Gross value added (GDP)	6,100.820	1,039.690	64,400.640	7,858.517	222.767	72,481.924
Consumption of fixed capital	479.838	185.679	8,689.421	12.408	17.316	8,719.146
Net value added (NDP)	5,620.982	854.010	55,711.219	7,846.109	205.451	63,762.779
Environmental use of natural resources and the environment			0.000			
A. Depletion			0.000			0.000
Oil and gas			873.915			873.915
Agriculture land			0.000			0.000
Transfer losses			688.603			688.603
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	5,620.982	854.010	54,148.701	7,846.109	205.451	62,200.261
B. Degradation			0.000			0.000
Air			422.404			422.404
Air pollution						
Water			1,189.275			1,189.275
Water pollution						
Land			303.000			303.000
Soil erosion						
Natural heritage			36.850			36.850
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	5,620.982	854.010	52,197.173	7,846.109	205.451	60,248.733

Table 7.14: Integrated environmental and economic accounts by economic activities- Egypt 1988/1989 (£E million 1990)

Economic Activities	*Agriculture, hunting, forestry, and fishing*	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
A. Supply								
Total supply of goods and services	25,700.366	8,059.235	1,388.530	42,942.511	1,675.780	6,672.067	11,476.934	7,889.930
B. Use-value added								
Total use of goods and services	6,440.974	3,688.073	138.729	26,592.834	754.371	3,449.174	2,986.475	3,111.741
Gross value added (GDP)	19,259.392	4,371.163	1,249.801	16,349.678	921.409	3,222.892	8,490.459	4,778.189
Consumption of fixed capital	394.792	973.732	149.360	4,338.281	595.084	493.123	419.779	2,515.698
Net value added (NDP)	18,864.600	3,397.431	1,100.442	12,011.397	326.325	2,729.769	8,070.680	2,262.490
Environmental use of natural resources and the environment								
A. Depletion								
Oil and gas		1,105.866						
Agriculture land								
Transfer losses						649.891		
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	18,864.600	2,291.564	1,100.442	12,011.397	326.325	2,079.878	8,070.680	2,262.490
B. Degradation								
Air				421.089				
Air pollution								
Water				1,186.720				
Water pollution								
Land	364.000							
Soil erosion								
Natural heritage							36.850	
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	18,500.600	2,291.564	1,100.442	10,403.588	326.325	2,079.878	8,033.830	2,262.490

Economic Activities	*Finance, insurance, real estate and business services*	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
A. Supply						
Total supply of goods and services	7,115.389	1,691.525	114,612.267	12,100.064	387.957	127,100.288
B. Use-value added						
Total use of goods and services	1,290.883	733.255	49,186.509	4,616.413	148.871	53,951.793
Gross value added (GDP)	5,824.506	958.269	65,425.758	7,483.650	239.086	73,148.494
Consumption of fixed capital	455.329	173.872	10,509.051	14.717	17.684	10,541.452
Net value added (NDP)	5,369.177	784.397	54,916.708	7,468.933	221.402	62,607.042
Environmental use of natural resources and the environment			0.000			0.000
A. Depletion			0.000			0.000
Oil and gas			1,105.866			1,105.866
Agriculture land			0.000			0.000
Transfer losses			649.891			649.891
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	5,369.177	784.397	53,160.950	7,468.933	221.402	60,851.285
B. Degradation			0.000			0.000
Air			421.089			421.089
Air pollution						
Water			1,186.720			1,186.720
Water pollution						
Land			364.000			364.000
Soil erosion						
Natural heritage			36.850			36.850
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	5,369.177	784.397	51,152.292	7,432.083	221.402	58,842.627

Table 7.15: Integrated environmental and economic accounts by economic activities- Egypt 1989/1990 (£E million 1990)

	Agriculture, hunting, forestry, and fishing	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
A. Supply								
Total supply of goods and services	28,113.252	6,867.341	1,183.178	45,940.019	2,118.296	7,001.321	11,956.191	8,647.960
B. Use-value added								
Total use of goods and services	6,838.334	3,142.637	118.212	27,929.088	953.233	3,677.609	3,279.322	3,556.327
Gross value added (GDP)	21,274.918	3,724.704	1,064.966	18,010.931	1,165.063	3,323.712	8,676.869	5,091.633
Consumption of fixed capital	463.317	856.403	92.047	4,052.875	881.933	625.912	457.496	2,860.758
Net value added (NDP)	20,811.601	2,868.301	972.919	13,958.056	283.130	2,697.800	8,219.373	2,230.875
Environmental use of natural resources and the environment								
A. Depletion								
Oil and gas		1,100.296						
Agriculture land								
Transfer losses						621.908		
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	20,811.601	1,768.005	972.919	13,958.056	283.130	2,075.892	8,219.373	2,230.875
B. Degradation								
Air pollution				423.080				
Water pollution				1,193.498				
Soil erosion	454.000							
Natural heritage							36.850	
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	20,357.601	1,768.005	972.919	12,341.479	283.130	2,075.892	8,182.523	2,230.875

Economic Activities	*Finance, insurance, real estate and business services*	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
A. Supply						
Total supply of goods and services	7,249.903	1,921.153	120,998.614	12,150.340	418.055	133,567.009
B. Use-value added						
Total use of goods and services	1,311.329	823.384	51,629.475	4,883.073	160.110	56,672.658
Gross value added (GDP)	5,938.574	1,097.769	69,369.139	7,267.267	257.945	76,894.351
Consumption of fixed capital	539.239	216.885	11,046.864	20.354	24.266	11,091.484
Net value added (NDP)	5,399.335	880.884	58,322.275	7,246.913	233.679	65,802.867
Environmental use of natural resources and the environment			0.000			0.000
A. Depletion			0.000			0.000
Oil and gas			1,100.296			1,100.296
Agriculture land			0.000			0.000
Transfer losses			621.908			621.908
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	5,399.335	880.884	56,600.071	7,246.913	233.679	64,080.663
B. Degradation			0.000			0.000
Air			423.080			423.080
Air pollution						
Water			1,193.498			1,193.498
Water pollution						
Land			454.000			454.000
Soil erosion						
Natural heritage			36.850			36.850
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	5,399.335	880.884	54,492.644	7,246.913	233.679	61,973.236

Table 7.16:Integrated environmental and economic accounts by economic activities- Egypt 1990/1991

Economic Activities	*Agriculture, hunting, forestry, and fishing*	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
A. Supply								
Total supply of goods and services	24,935.426	7,025.921	1,298.680	44,391.128	2,278.474	7,296.061	12,786.354	32,004.030
B. Use-value added								
Total use of goods and services	5,906.477	1,398.693	111.624	23,920.455	1,272.255	3,877.755	3,393.315	24,685.744
Gross value added (GDP)	19,028.949	5,627.228	1,187.056	20,470.672	1,006.219	3,418.306	9,393.039	7,318.286
Consumption of fixed capital	908.511	632.997	150.956	4805.634	966.743	639.805	584.867	3526.268
Net value added (NDP)	18,120.438	4,994.231	1,036.099	15,665.038	39.476	2,778.500	8,808.172	3,792.017
Environmental use of natural resources and the environment								
A. Depletion								
Oil and gas		1,016.776						
Agriculture land								
Transfer losses						603.313		
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	18,120.438	3,977.455	1,036.099	15,665.038	39.476	2,175.187	8,808.172	3,792.017
B. Degradation								
Air				442.899				
Air pollution								
Water				1,257.356				
Water pollution								
Land	626.000							
Soil erosion								
Natural heritage							36.850	
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	17,494.438	3,977.455	1,036.099	13,964.783	39.476	2,175.187	8,771.322	3,792.017

Economic Activities	*Finance, insurance, real estate and business services*	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
A. Supply						
Total supply of goods and services	7,752.716	3,677.410	143,446.200	12,131.155	393.008	155,970.362
B. Use-value added						
Total use of goods and services	1,279.777	904.328	66,750.423	5,056.241	153.859	71,960.524
Gross value added (GDP)	6,472.939	2,773.081	76,695.776	7,074.913	239.149	84,009.839
Consumption of fixed capital	610.202	243.463	13069.449	41.693	31.996136	13143.139
Net value added (NDP)	5,862.737	2,529.618	63,626.327	7,033.219	207.153	70,866.699
Environmental use of natural resources and the environment			0.000			0.000
A. Depletion			0.000			0.000
Oil and gas			1,016.776			1,016.776
Agriculture land			0.000			0.000
Transfer losses			603.313			603.313
Environmentally adjusted net value added/ net domestic product 1 (EDP1)	5,862.737	2,529.618	62,006.238	7,033.219	207.153	69,246.610
B. Degradation			0.000			0.000
Air			442.899			442.899
Air pollution						
Water			1,257.356			1,257.356
Water pollution						
Land			626.000			626.000
Soil erosion						
Natural heritage			36.850			36.850
Environmentally adjusted net value added/ net domestic product 2 (EDP2)	5,862.737	2,529.618	59,643.133	6,996.369	207.153	66,883.505

Table 7.17: Comparative analysis between GDP, EDP1 and EDP2 by economic activities in 1987/88: (£E million of 1990).

	Agriculture, hunting, forestry, and fishing	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
GDP	19,881.131	4,033.705	790.534	15,167.552	929.928	2,706.575	8,784.385	4,966.320
Percent distribution	27.43%	5.57%	1.09%	20.93%	1.28%	3.73%	12.12%	6.85%
EDP1	19,504.597	2,370.466	722.991	12,122.702	210.168	1,462.781	8,431.797	2,848.207
Percent distribution	31.36%	3.81%	1.16%	19.49%	0.34%	2.35%	13.56%	4.58%
EDP2	19,201.597	2,370.466	722.991	10,511.023	210.168	1,462.781	8,394.947	2,848.207
Percent distribution	31.87%	3.93%	1.20%	17.45%	0.35%	2.43%	13.93%	4.73%
ICORS								
GDP	0.481	3.693	-1.343	1.007	246.140	-0.653	0.287	3.253
EDP1	0.446	-0.194	-19.414	1.007	-8.889	0.452	0.227	6.395
EDP2	0.310	-0.194	-19.414	1.018	-8.889	0.452	0.227	6.395

	Finance, insurance, real estate and business services	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
GDP	6,100.820	1,039.690	64,400.640	7,858.517	222.767	72,481.924
Percent distribution	8.42%	1.43%	88.85%	10.84%	0.31%	100.00%
EDP1	5,620.982	854.010	54,148.701	7,846.109	205.451	62,200.261
Percent distribution	9.04%	1.37%	87.06%	12.61%	0.33%	100.00%
EDP2	5,620.982	854.010	52,197.173	7,846.109	205.451	60,248.733
Percent distribution	9.33%	1.42%	86.64%	13.02%	0.34%	100.00%
ICORS						
GDP	-8.688	10.506	1.604	-80.452	1.082	1.811
EDP1	-4.379	-2.945	2.026	-74.051	1.131	2.383
EDP2	-4.379	-2.945	2.853	-31.843	1.131	3.546

Table 7.18: Comparative analysis between GDP, EDP1 and EDP2 by economic activities in 1988/89: (£E million of 1990).

	Agriculture, hunting, forestry, and fishing	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
GDP	19,259.392	4,371.163	1,249.801	16,349.678	921.409	3,222.892	8,490.459	4,778.189
Percent distribution	26.33%	5.98%	1.71%	22.35%	1.26%	4.41%	11.61%	6.53%
EDP1	18,864.600	2,291.564	1,100.442	12,011.397	326.325	2,079.878	8,070.680	2,262.490
Percent distribution	31.00%	3.77%	1.81%	19.74%	0.54%	3.42%	13.26%	3.72%
EDP2	18500.600	2291.564	1100.442	10403.588	326.325	2079.878	8033.830	2262.490
Percent distribution	31.44%	3.89%	1.87%	17.68%	0.55%	3.53%	13.65%	3.84%
ICORS								
GDP	-1.356	2.531	0.095	1.695	-248.917	1.213	-1.559	-8.643
EDP1	-1.246	0.517	-0.087	28.533	24.737	0.183	-1.124	-2.987
EDP2	-0.441	0.517	-0.087	0.479	24.737	0.183	-1.124	-2.987

	Finance, insurance, real estate and business services	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
GDP	5,824.506	958.269	65,425.758	7,483.650	239.086	73,148.494
Percent distribution	7.96%	1.31%	89.44%	10.23%	0.33%	100.00%
EDP1	5,369.177	784.397	53,160.950	7,468.933	221.402	60,851.285
Percent distribution	8.82%	1.29%	87.36%	12.27%	0.36%	100.00%
EDP2	5369.177	784.397	51152.292	7432.083	221.402	58842.627
Percent distribution	9.12%	1.33%	86.93%	12.63%	0.38%	100.00%
ICORS						
GDP	-5.441	-5.471	9.636	-5.705	0.812	17.608
EDP1	-4.784	-5.214	-2.464	-5.728	0.827	-2.802
EDP2	-4.784	-5.214	-0.955	-5.124	0.827	-1.250

Table 7.19: Comparative analysis between GDP, EDP1 and EDP2 by economic activities in 1989/90: (£E million of 1990).

	Agriculture, hunting, forestry, and fishing	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
GDP	21,274.918	3,724.704	1,064.966	18,010.931	1,165.063	3,323.712	8,676.869	5,091.633
Percent distribution	27.67%	4.84%	1.38%	23.42%	1.52%	4.32%	11.28%	6.62%
EDP1	20,811.601	1,768.005	972.919	13,958.056	283.130	2,075.892	8,219.373	2,230.875
Percent distribution	32.48%	2.76%	1.52%	21.78%	0.44%	3.24%	12.83%	3.48%
EDP2	20,357.601	1,768.005	972.919	12,341.479	283.130	2,075.892	8,182.523	2,230.875
Percent distribution	32.21%	2.9%	1.6%	19.9%	0.5%	3.3%	13.2%	3.6%
ICORS								
GDP	0.595	-1.796	-0.507	2.477	8.802	9.160	3.573	11.697
EDP1	0.591	0.035	-0.478	2.652	10.051	-0.507	3.891	17.951
EDP2	0.470	0.035	-0.478	-17.721	10.051	-0.507	3.891	17.951

	Finance, insurance, real estate and business services	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
GDP	5,938.574	1,097.769	69,369.139	7,267.267	257.945	76,894.351
Percent distribution	7.72%	1.43%	90.21%	9.45%	0.34%	100.00%
EDP1	5,399.335	880.884	56,600.071	7,246.913	233.679	64,080.663
Percent distribution	8.43%	1.37%	88.33%	11.31%	0.36%	100.00%
EDP2	5,399.335	880.884	54,492.644	7,246.913	233.679	61,973.236
Percent distribution	8.7%	1.4%	87.9%	11.7%	0.4%	100.0%
ICORS						
GDP	13.115	2.347	3.817	-9.446	1.133	4.683
EDP1	16.757	2.445	7.683	-9.839	1.126	10.361
EDP2	16.757	2.445	-26.205	-8.212	1.126	-20.765

Table 7.20: Comparative analysis between GDP, EDP1 and EDP2 by economic activities in 1990/91: (£E million of 1990).

	Agriculture, hunting, forestry, and fishing	*Oil and gas*	*Other minerals*	*Manufacturing*	*Electricity, gas and water*	*Construction*	*Trade, restaurants and hotels*	*Transport, storage and communications*
GDP	19,028.949	5,627.228	1,187.056	20,470.672	1,006.219	3,418.306	9,393.039	7,318.286
Percent distribution	22.65%	6.70%	1.41%	24.37%	1.20%	4.07%	11.18%	8.71%
EDP1	18,120.438	3,977.455	1,036.099	15,665.038	39.476	2,175.187	8,808.172	3,792.017
Percent distribution	26.168%	5.74%	1.50%	22.62%	0.062%	3.14%	12.72%	5.48%
EDP2	17,494.438	3,977.455	1,036.099	13,964.783	39.476	2,175.187	8,771.322	3,792.017
Percent distribution	26.157%	5.95%	1.55%	20.88%	0.061%	3.25%	13.11%	5.67%
ICORS								
GDP	-0.482	0.428	0.479	1.396	-19.713	11.782	0.919	1.620
EDP1	-0.272	-0.111	-0.125	1.494	-15.046	-0.714	0.904	1.911
EDP2	-0.026	-0.111	-0.125	4.583	-15.046	-0.714	0.904	1.911

	Finance, insurance, real estate and business services	*Community, social and personal services*	*Total industries*	*Government services*	*Household production activities*	*Total production activities*
GDP	6,472.939	2,773.081	76,695.776	7,074.913	239.149	84,009.839
Percent distribution	7.70%	3.30%	91.29%	8.42%	0.28%	100.00%
EDP1	5,862.737	2,529.618	62,006.238	7,033.219	207.153	69,246.610
Percent distribution	8.47%	3.65%	89.54%	10.16%	0.30%	100.00%
EDP2	5,862.737	2,529.618	59,643.133	6,996.369	207.153	66,883.505
Percent distribution	8.77%	3.78%	89.17%	10.46%	0.31%	100.00%
ICORS						
GDP	3.190	0.262	2.104	-11.223	-1.249	2.479
EDP1	4.412	0.235	3.206	-10.812	-0.745	4.055
EDP2	4.412	0.235	7.034	-8.967	-0.745	10.737

CHAPTER EIGHT

POLICY IMPLICATIONS OF ENVIRONMENTAL MACRO AND SECTORAL ACCOUNTS

"Proper accounting will not solve the whole range of environmental problems. But it will help to bring them, or some of them, into the open, especially those necessary for sustaining economic activity. They will indicate counter actions that may eventually be taken. Accounting is like writing economic history, it deals with the past so that the future can benefit. But the benefit will not occur automatically, and has to be pursued actively in order to translate the lessons into actions. Such actions will help to sustain development, but the accounts by themselves can not do the task." (*El Serafy, 1993*).

1. INTRODUCTION

The preceding chapters examined the Egyptian economic performance, state of environment and System of National Accounts over the last three decades (Chapter Two); provided the theoretical and empirical foundations and proposed the most appropriate approach for lunching Environmental Accounting exercise in developing world (Chapters Three); designed the methodology of including the environment into the Egyptian SNA (Chapter Four); accounted for the economic value of depletion of non-renewable natural resources from 1972-1990 (Chapter Five); and accounted for the depletion and degradation of renewable resources, land, water and air from 1981-1990 (Chapter Six). Incorporated the value of natural capital depletion and degradation into a macro and sectoral accounts framework for the 1981-1990 period, as benchmark years, and offers several indicators for sustainable development (Chapter Seven). In this chapter the Egyptian environmental accounting, developed in Chapter Seven, will be examined to show the policy implications on both macro and sectoral levels. On the macro level a fundamental question will be answered: are

Egypt's development and growth sustainable? On the sectoral level the current policy on the resource economic sectors will be reviewed.

This chapter is divided into three sections: the first section examines the sustainability of Egypt's economic development and growth in the 1981-1990 period. The second section examines some policy options related to the Egyptian economic sectors. The third and final section presents conclusions.

2. THE POLICY IMPLICATIONS OF ENVIRONMENTAL MACRO ACCOUNTS

2.1 Sustainability Indicators

2.1.1. Pearce-Atkinson Measure (PAM)

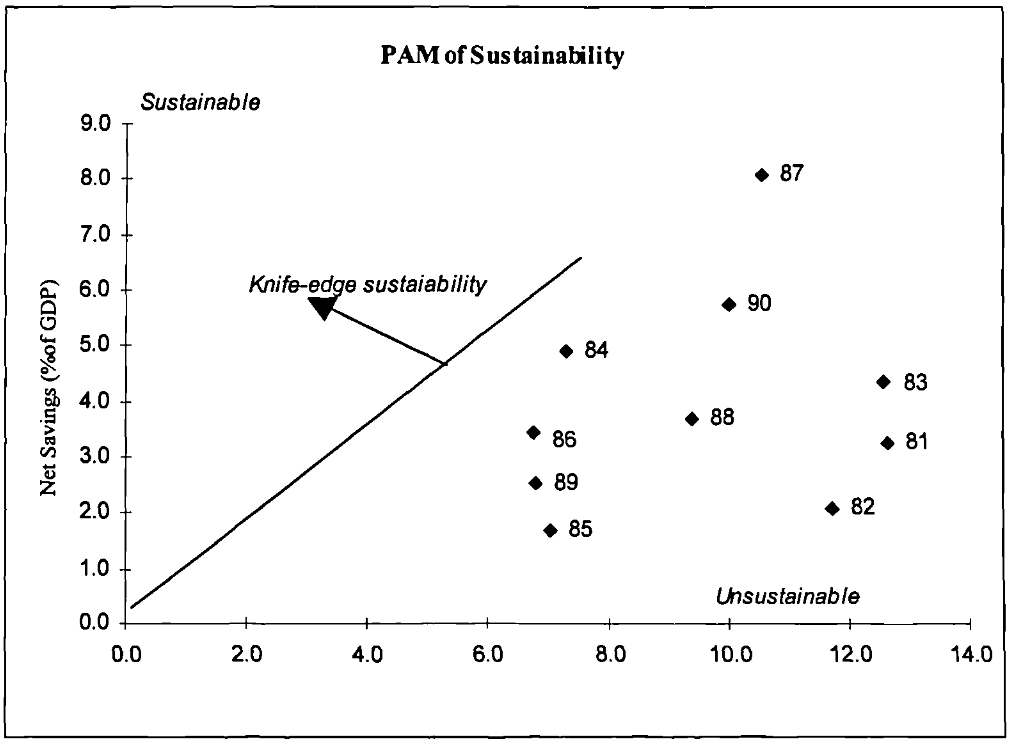
From the preceding Chapters it is clear that it is very important to calculate EDP as a better measure for sustainable income or long-run income. EDP calculations resulted in declining EDI that should serve as a warning signal to Egyptian policy-makers regarding the economic prospects for the future. Indeed, EDI derived using the NPID shows clear trends of low, if not negative, domestic investment throughout the 1980s. Pearce and Atkinson in 1993 have proposed a similar warning indicator for weak sustainability based on the neo-classical assumptions inherent in the Hartwick/Solow approach, in that man-made and natural capital are assumed to be perfect substitutes for each other.

Table 8.1: Pearce's indicator of sustainability for NPID (£E billion of 1990)

Year	*Gross Domestic Product*	*Fixed Capital Depreciation*	*Public and Private Consumption*	*Net Savings as % of GDP*	*Depreciation and Degradation as % of GDP*	*Indicator of Sustainability*
1981	56.33	5.82	49.34	2.08%	11.72%	Unsustainable
1982	62.04	5.34	54.67	3.27%	12.66%	Unsustainable
1983	62.67	5.21	54.73	4.34%	12.59%	Unsustainable
1984	67.01	5.47	56.13	8.07%	10.56%	Unsustainable
1985	65.89	7.69	55.76	3.70%	9.40%	Unsustainable
1986	65.20	7.27	54.18	5.74%	10.00%	Unsustainable
1987	72.48	8.71	60.21	4.89%	7.31%	Unsustainable
1988	73.14	10.54	61.38	1.67%	7.04%	Unsustainable
1989	76.89	11.09	63.86	2.52%	6.81%	Unsustainable
1990	84.00	13.14	67.97	3.45%	6.77%	Unsustainable

Net Savings = Gross Domestic Product - Consumption (Public and Private) - Fixed Capital Depreciation

Figure 8.1: Pearce and Atkinson indicator of sustainability for NPID, 1981-1990



All the ten years from 1981-1990 were unsustainable

The Pearce and Atkinson Measure (PAM)[1] plots the value of natural capital depletion and degradation against net savings with each of the two magnitudes expressed as a percentage of GDP. Net savings refers to the amount available for domestic investment after subtracting man-made capital depreciation. PAM considers the that 45° line is marginal, or "knife-edge" sustainability (i.e., natural capital depletion and degradation equal to net savings). Tables 8.1 & 8.2 highlight the fact that Egypt's development from 1981-1990 can not be considered sustainable. Regardless of environmental accounting methods used, only one-fifth of the study years fall into the sustainable category. Table 8.1 -for the NPID- indicates that none of the ten years in the study period is sustainable. On the other hand, UCD as shown in Table 8.2 indicate that only three years, 1984, 1986, and 1987 which are correspondent with the fall in oil prices and revenues, are marginal and sustainable. This demonstrates, regardless of the approach, the over-dependence of the Egyptian economy upon depleting and deteriorating the environmental capital in the surveyed years.

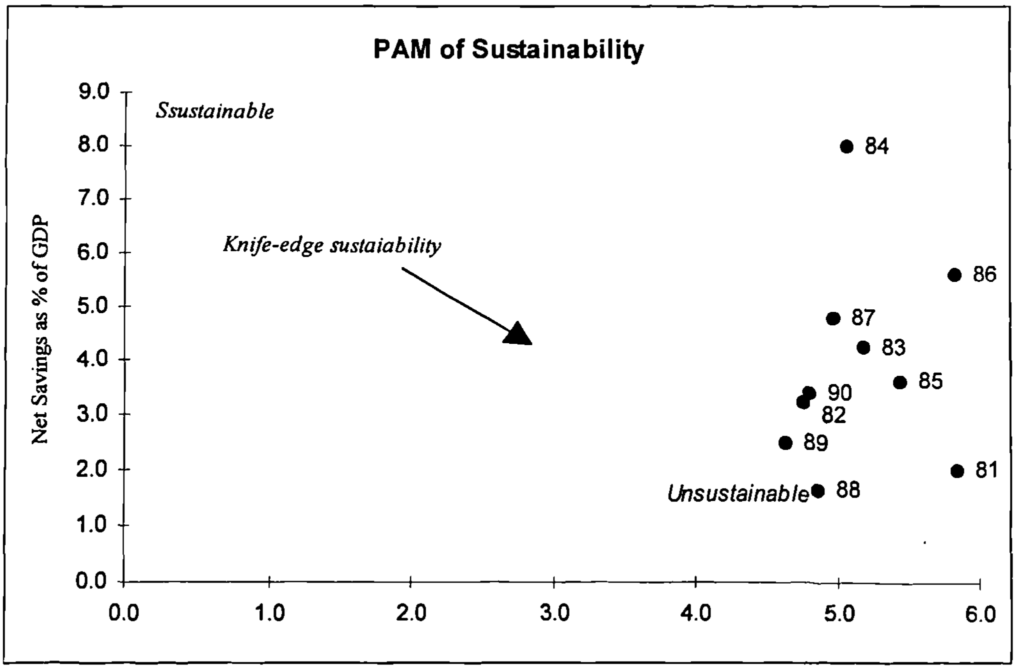
Table 8.2: Pearce's indicator of sustainability for UCD (£E billions of 1990)

Year	*Gross Domestic Product*	*Fixed Capital Depreciation*	*Public and Private Consumption*	*Net Savings as % of GDP*	*User Cost and Degradation as % of GDP*	*Indicator of Sustainability*
1981	56.33	5.82	49.34	2.08%	5.84%	Unsustainable
1982	62.04	5.34	54.67	3.27%	4.77%	Unsustainable
1983	62.67	5.21	54.73	4.34%	5.18%	Unsustainable
1984	67.01	5.47	56.13	8.07%	5.08%	Sustainable
1985	65.89	7.69	55.76	3.70%	5.45%	Unsustainable
1986	65.20	7.27	54.18	5.73%	5.83%	"Knife-edge"
1987	72.48	8.71	60.21	4.89%	4.97%	"Knife-edge"
1988	73.14	10.54	61.38	1.67%	4.86%	Unsustainable
1989	76.89	11.09	63.86	2.51%	4.63%	Unsustainable
1990	84.00	13.14	67.97	3.44%	4.80%	Unsustainable

Net Savings = Gross Domestic Product - Consumption (Public and Private) - Fixed Capital Depreciation

[1] Two criticisms could be made of PAM: (1) it assumes perfect substitutability between natural and man-made capital; (2) in practice very incomplete estimates of natural capital depletion and degradation are available.

Figure 8.2: Pearce and Atkinson indicator of sustainability for UCD, 1981-1990



Only three of ten years fall in the marginal and "sustainable range"

2.1.2 Genuine Savings

The World Bank in 1995 offers a similar measure for economic sustainability. The World Bank stated that "while a greener measure of gross national product would have some policy uses, a related measure, genuine saving, would get directly to the question of whether a country is on a sustainable path". Genuine savings depart from standard national accounts in several ways, notably by expanding the range of assets being valued. Genuine saving is the rate of savings after accounting for depreciation of produced assets, and depletion and degradation of the environment.

Consideration of environmental depletion, for example, within the genuine saving framework also casts a somewhat different light on resource exports. When a natural resource is sold at the border price in international markets, the full value of this sale shows in the conventionally measured national income of the exporting country. However, a part of this income is in fact the liquidation of an asset, as measured by the value of depletion. This suggests that investment policies (in terms of investing resource rents) should also form a component of policies aimed at trade expansion and that the foregoing concerns about efficient exploitation rates for resources need to be considered as well. The bottom line is that the net benefit of exporting a natural resource commodity is not as great as conventional accounting implies. In addition, thinking about net savings can also shed light on policies concerning export-led growth based on natural resources. The value of exports less imports on the current account is a measure of net foreign saving, which increases total savings when the current account balance is positive. However, a portion of the value of exports consists of resource depletion which, as argued above, contains a capital element. From the point of view of environmental accounting, therefore, policies aimed at boosting saving by exporting natural resources do not have the effects on net saving that traditional national accounting would suggest.

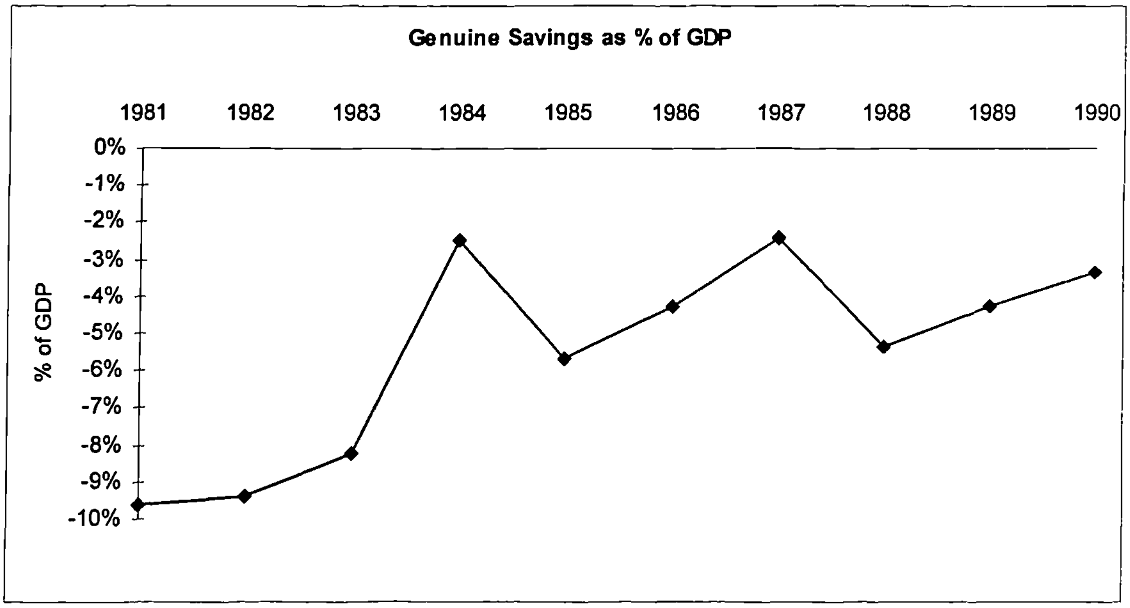
Last but not least, as well as an indicator of sustainability, genuine savings has another advantage as a policy indicator. It presents resource and environmental issues within a framework that finance and development planning ministers can understand. It reinforces the need to boost domestic savings, and therefore the need for sound macroeconomic policies. It highlights the fiscal aspects of environment and resource management, since collecting pollution taxes both raises development finance and also ensures efficient use of the environment. Measuring genuine savings also makes the growth-environment trade-off more explicit, because country planning to grow today and protect the environment tomorrow will have depressed rates of genuine savings.

Table 8 3: GSI for NPID, 1981-1990 (% of GDP)

Year	*Gross Domestic Product*	*Public and Private Consumption*	*Fixed Capital Depreciation*	*Natural Capital Depletion and Degradation*	*Genuine Savings*	*Genuine Savings as % of GDP*
1981	56.33	49.34	5.82	6.60	-5.43	-9.64%
1982	62.04	54.67	5.34	7.85	-5.82	-9.39%
1983	62.67	54.73	5.21	7.89	-5.17	-8.25%
1984	67.01	56.11	5.47	7.07	-1.66	-2.49%
1985	65.89	55.71	7.69	6.19	-3.75	-5.70%
1986	65.20	54.18	7.27	6.51	-2.77	-4.26%
1987	72.48	60.21	8.71	5.30	-1.75	-2.43%
1988	73.14	61.38	10.54	5.14	-3.92	-5.37%
1989	76.89	63.86	11.09	5.23	-3.30	-4.29%
1990	84.00	67.97	13.14	5.69	-2.79	-3.33%

Genuine Savings I =GDP - Consumption (Private and Public) - Depreciation of Fixed capital - Depreciation and Degradation of Natural Capital

Figure 8.3: Genuine savings I for NPID, 1981-1990 (% of GDP)



GSI fall below zero in all the ten years (1981-1990).

Therefore, the "genuine savings" indicator serves as a measure of effort to create new wealth. Although an optimal genuine savings for developing countries is not provided, negative "genuine savings" indicate that the country is on an unsustainable path. Tables 8.3 & 8.4 provides genuine savings estimates for the 1981-1990 period. Genuine savings results are similar to that of PAM of sustainability for both UCD and NPID calculations. Therefore, PAM or GSI are useful, practical, sustainability indicators that generate information about the minimal necessary condition for sustainability[2].

Having positive GSI as been discussed in greater detail in Chapters One and Two, however, should not lead to the conclusion that sustainability is assured, but if it is negative then there are grounds for doubting the current behaviour is consistent with sustainability. Once again, as shown in Figures 8.3 & 8.4, Egypt's economy experienced the unsustainable path in at least eight of ten years, and was over-depending on depleting and degrading its natural capital.

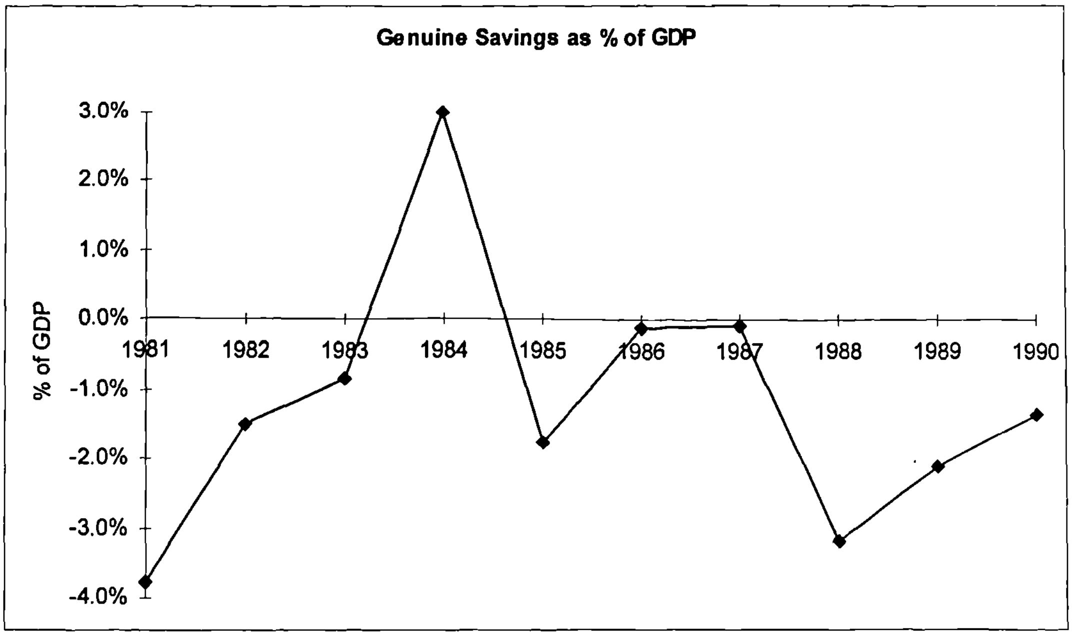
Table 8.4: GSI for user cost and degradation,1981-1990 (% of GDP)

Year	*Gross Domestic Product*	*Public and Private Consumption*	*Fixed Capital Depreciation*	*User Cost and Degradation of Natural Capital*	*Genuine Savings*	*Genuine Savings as % of GDP*
1981	56.33	49.34	5.82	3.29	-2.12	-3.77%
1982	62.04	54.67	5.34	2.96	-0.93	-1.50%
1983	62.67	54.73	5.21	3.24	-0.52	-0.84%
1984	67.01	56.13	5.47	3.40	2.00	2.99%
1985	65.89	55.76	7.69	3.59	-1.15	-1.75%
1986	65.20	54.18	7.27	3.80	-0.06	-0.10%
1987	72.48	60.21	8.71	3.60	-0.06	-0.08%
1988	73.14	61.38	10.54	3.55	-2.33	-3.19%
1989	76.89	63.86	11.09	3.56	-1.63	-2.12%
1990	84.00	67.97	13.14	4.03	-1.14	-1.36%

Genuine Savings =GDP - Consumption (Private and Public) - Depreciation of Fixed capital - User Cost and Degradation of Natural Capital.

[2] As been discussed in Chapter Two it has to be noticed that both PAM and GSI are two different formats for one measure with the same policy implications.

Figure 8.4: GSI for user cost and degradation, 1981-1990



Genuine savings is only above or around zero in three of ten years

Another extension has been proposed for GSI, by the World Bank in 1997, called GSII, to include expenditures on education and health as investments in development[3], boosting genuine savings rates for countries making significant effort on the educational front. Many claim that investing in people-alleviating poverty, addressing population growth, and developing human resources– is essential for long-term prosperity. Perhaps if natural capital were replaced with human capital, negative rates of domestic savings would be less worrisome. Table 8.4 indicates that human capital expenditures in 1990 increased to the first half of 1980s levels (in real terms). Figure 8.5 shows that human capital expenditure as a percentage of GDP peaked in 1982, 1986, and 1990 at approximately 5% of GDP.

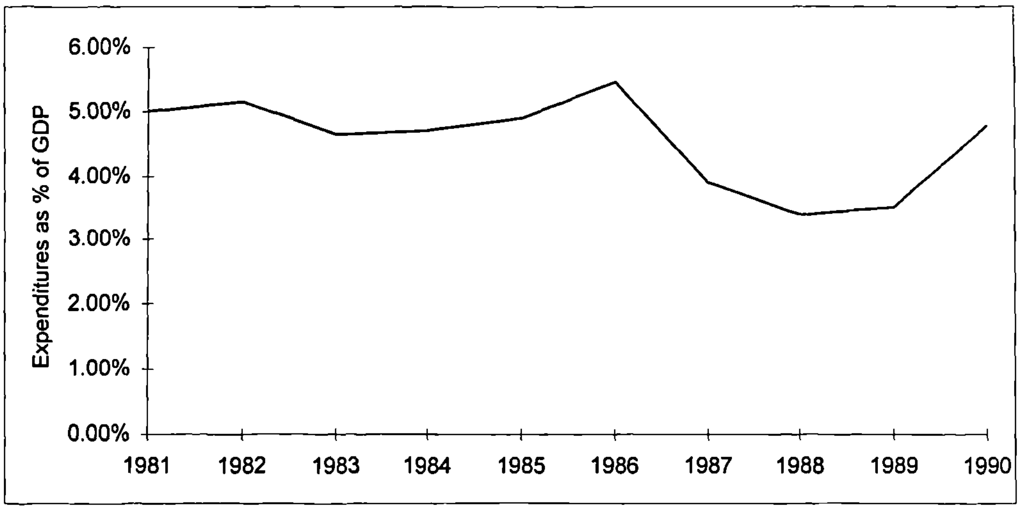
[3] Economic rate of return on human capital investments for Egypt, particularly for education, is a range from –4.7% for elementary/preparatory school to 10.8% for high school graduates for the 1981-1991 period (Richard and Adams, 1991). These rates are low compared to 14 developing countries with an average of 12.2% for the same graduates (Psachropoulos, 1991).

Table 8.5: Human capital development, (£E billion of 1990)

Year	*Gross Domestic Product*	*Public Sector Expenditure (a)*	*Human Capital Expenditures (b)*	*Development Effort (b/a)*	*Development Effort as % of GDP*
1981	56.33	7.54	2.81	37.30%	5.00%
1982	62.04	8.87	3.20	36.10%	5.16%
1983	62.67	9.24	2.91	31.50%	4.65%
1984	67.01	9.34	3.15	33.70%	4.70%
1985	65.89	11.14	3.22	28.91%	4.89%
1986	65.20	10.44	3.56	34.10%	5.46%
1987	72.48	10.07	2.82	26.71%	3.90%
1988	73.14	10.84	2.48	20.96%	3.39%
1989	76.89	10.11	2.70	26.78%	3.52%
1990	84.00	11.26	4.00	32.64%	4.77%

Source : Ministry of Planning
Human Capital Expenditures include Education, Culture, Health and Community Development

Figure 8.5: Human capital expenditures, 1981-1990 (£E billions 1990)



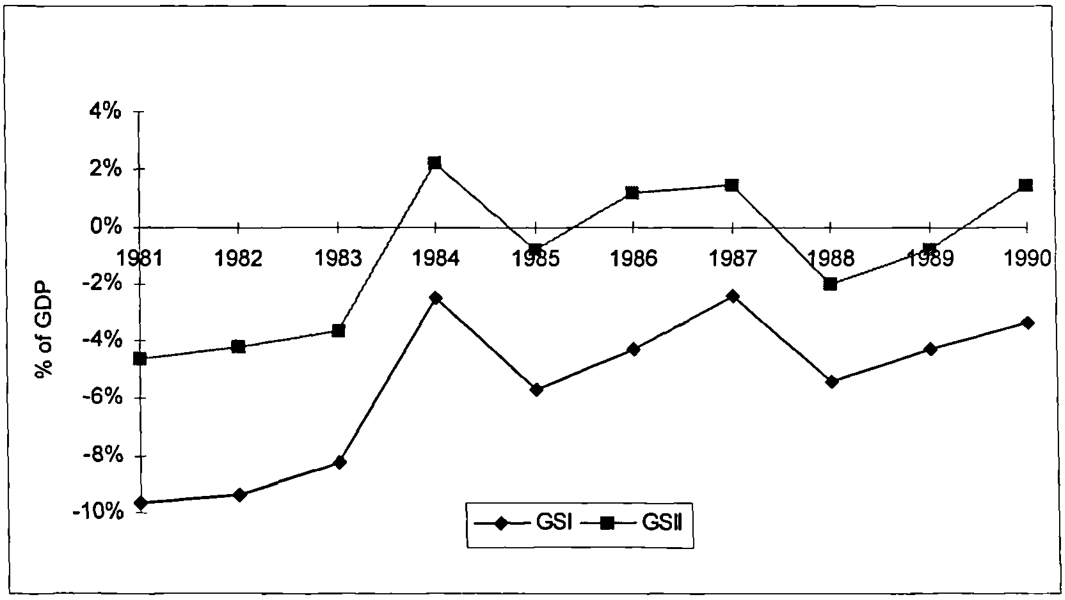
Human Capital Expenditures rose from 3.39% to 4.8% which is almost equal to 1981 and 1996 levels

Figures 8.6 & 8.7 show GSII after adding the investment in human capital to GSI. The picture has changed considerably, especially for UCD calculations. It has turned from seven years negative savings to approximately two years. On the other hand, only three years have turned to a positive GS for NPID calculations: this means that two–thirds of the surveyed period is still on an unsustainable path.

Table 8.6: GSII for NPID and UCD, 1981-1990 (% of GDP)

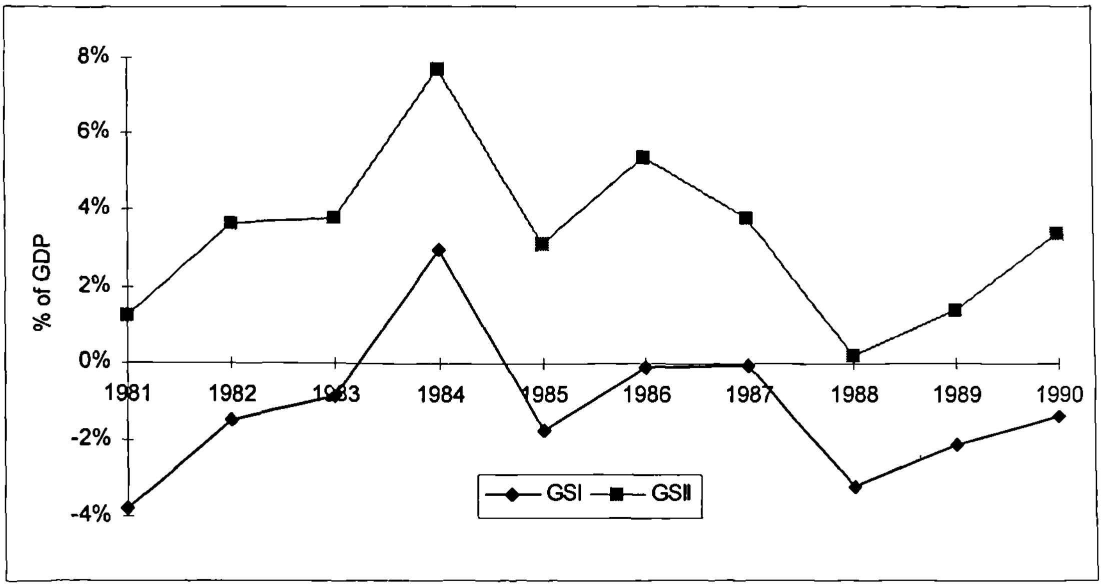
Year	*Development Effort as % of GDP*	*GS I as % of GDP (NPID)*	*GSII as % of GDP (NPID)*	*GSI as % of GDP (UCD)*	*GSII as % of GDP (UCD)*
1981	5.00%	-9.64%	-4.64%	-3.77%	1.23%
1982	5.16%	-9.39%	-4.23%	-1.50%	3.66%
1983	4.65%	-8.25%	-3.61%	-0.84%	3.80%
1984	4.70%	-2.49%	2.22%	2.99%	7.69%
1985	4.89%	-5.70%	-0.81%	-1.75%	3.14%
1986	5.46%	-4.26%	1.20%	-0.10%	5.36%
1987	3.90%	-2.43%	1.47%	-0.08%	3.81%
1988	3.39%	-5.37%	-1.97%	-3.19%	0.20%
1989	3.52%	-4.29%	-0.77%	-2.12%	1.40%
1990	4.77%	-3.33%	1.44%	-1.36%	3.41%

Figure 8.6: GS1 and GSII for NPID, 1981-1990 (% of GDP)



GSII is positive in only three of ten years.

Figure 8.7: GSI and GSII for UCD, 1981-1990 (% of GDP)



GSII is around zero in three of ten years.

Regardless of calculation methods, either for GSI or GSII, one can conclude that in the 1981-1990 period Egypt's genuine savings rate was near zero or negative for at least half of the period. Second, investment in human capital as a share of GDP shrank for the 1986-1990 period. Finally, a negative genuine saving implies that total wealth is in decline. Policies resulting in persistently negative genuine savings lead to unsustainability.

3. THE POLICY IMPLICATIONS OF ENVIRONMENTAL SECTORAL ACCOUNTS

The neglect of environmental costs of natural resource depletion and degradation can be considered as generating structural distortions in the economy by (subsidising) under-pricing those activities that use the environment as a suppliers of natural resources inputs and waste absorption services. Therefore, environmental accounting by economic activities can help , at least as an initial step, to define these instruments and measure the appropriate level of incentives (subsidies) or disincentives (charges).

Given the inefficiencies of command and control measures in environmental protection and natural resource conservation, the application of market instruments of setting economic incentives and disincentives has been advocated. These instruments aim at the internalization of external dis (economies) into budgets of economic sectors to achieve optimal allocation of scarce resources in the economy. The rationale behind this cost allocation is reflected in the polluter-pays and user-pays (for the depletion and degradation of natural resources) principles[4]. The aim in both cases is to make those who cause environmental problems accountable for their environmental impacts.

3.1 Petroleum Sector

Egypt's petroleum sector faces a difficult road ahead. The life span of crude oil reserves has fallen from 19 to 14 in the last ten years (1983-1992). In addition, the subsidies that are given to local consumption encourage the misuse of the finite resource. Despite such obstacles, Egyptian policy-makers are debating an increase in the level of national production. Central to this debate is the huge amount of recent gas discoveries that can be used as a substitute for oil in local consumption, whilst on the other hand offering attractive terms for foreign companies to increase their drilling efforts for oil discoveries.

The growth of the petroleum industry has been largely evidenced by the growth of exports in the form of crude petroleum and increasing domestic demand for petroleum products, which is attributed mainly to the low domestic prices of oil. The

[4] The polluter pays principle (PPP) is intended to internalize the external diseconomies so that the cost of pollution carried by the polluted. PPP is suppose to serve double purposes: to penalise the culprit as a matter of equity, and to equalise the private with social cost of production or consumption. On the other hand, it is capable of two interpretations: as requiring polluters to pay only the cost of pollution control and clean ups (standard PPP) or, in addition, to compensate citizens for the damage they suffer from pollution (extended PPP).

subsidy implicit in such pricing policy[5] encourages wasteful consumption. As a result of this, Egypt is losing the opportunity to use its finite petroleum wealth to mobilise domestic financial resources, the shortage of which is becoming the main constraint on investment. Therefore, in the absence of major new discoveries, the peaking oil fields production and sharply rising domestic demand could transform Egypt from an exporter to a net importer in the near future.

Chapter Five has shown that links between economic activities and resource depletion is possible. The user cost technique is an appropriate tool in estimating costs of non-renewable resources because it can provide guidance on what the current generation should do to make resource development sustainable. The GDP after netting the user cost, which is EDP1, is a more appropriate indicator for policy and planning as it better reflects the environmental cost.

From examining the role of the petroleum sector in the Egyptian economy, it seems very important to intensify investment in oil exploration activities in order to increase and secure oil reserves which in turn secure oil supply[6]. On the other hand, it seems unreasonable for a country building its economy, with a policy of oil production which produces a sufficient level to be exchanged for financial resources, to run out of reserves that are not mainly directed to investment in capital formation and thus developing productive sectors. Such policy is not, thus, taking account of future generations by directing oil revenues to future welfare through investment channels, which is against the core of sustainability.

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[5] According to the petroleum minister of Egypt, petroleum products sold in the country in fiscal year 1983-84 totaled $4.3 billion in terms of international price, but the actual amount paid by Egyptian consumers was $1.3 billion. This means that domestic prices of petroleum products then were on the average only about 30 percent of international prices (The Economist Intelligence Unit, Country Profile Egypt).

[6] It has to be mentioned that oil revenues contribution in foreign savings is much more secure compared to tourism and worker remittances. These resources revenues rely on the security conditions which can not be highly guaranteed in the Middle East. The October 1997 tourists bus attack, which caused a big drop in tourism revenues, is relatively recent. The same argument could be applicable for worker remittances that mainly comes from Gulf countries, in the sense that any political conflict with these countries may lead to the loss of this important source of foreign savings.

It can be concluded that reconsidering the domestic pricing policy of oil in Egypt is crucial in order to decrease and rationalise domestic consumption. In particular, the subsidies for petroleum in Egypt have to be (at least gradually) stopped. On the other hand, offering more attractive terms for foreign companies for gas discoveries, as has recently been practised, to be used as a substitute for oil in domestic consumption. This will result in allocating a higher percentage of production for exports and therefore directing its revenues for investment for the welfare of the current and future generations.

3.2 Agriculture Sector

As noted in Chapter Six, two serious problems are facing the growth of Egyptian agriculture sectors, namely: (1) land loss due to urban expansion; and (2) man-made soil erosion. The government policy of keeping lower prices for agriculture production causes the reduction in the farming profits, that in turn lower the value of agriculture land because the value of land is the capitalisation of the stream of profits from the uses of this land. This makes alternative uses for agriculture land, urban and industrial, more attractive. Population growth and industrialisation are responsible for the loss of most Egyptian fertile land. However, no serious actions have been taken by the government to put an end to this problem, especially if the alternative to replace this loss, through land reclamation, is a very expensive process. As has been emphasised in Chapter Six Section 5, the real problem is that there is no accurate and updated data that could be used as a basis for taking actions. Therefore, having the value of this loss in economic terms is a very great help in addressing this problem that has a very serious impact on the growth of the agriculture sector and on the Egyptian economy.

Secondly, soil erosion, which resulted mainly from land tenure and property right distortions, has a damaging impact on the sustainability of land resources in Egypt. The distorted owner-tenant relationship is one of the major factors that are preventing farmers and owners from investing in land improvement. On the other hand, high rate of fertilizer and pesticides application that result from its subsidies, is another major reason for eroding the land to get the highest yield in the short-term without considering the land's long-term productivity. In addition, the majority of Egyptian landowners, about 95%, are smallholders (less than 5 feddans or 2 hectares) with a very low level of income, therefore, they use their land in an unrational way for survival. Agriculture policies oriented toward achieving the goal of sustainable agriculture growth should consider removing subsidies[7], at least gradually, as disincentives to conserve land productivity for the long-run. In addition, the tenant-owner relationship should include an obligation to sustain land productivity through regulatory terms.

It has to be admitted that recently, in 1992, a new law was approved for land tenure-arrangement[8]. With the new law there is a transition period of 8 years up to 1998/99, during which time land rent will be fixed at 22 times land tax, and after the transitional period land rents will be free to be determined by market forces, and owners will be able to terminate the tenant contract. This change is clearly a step in the right direction; however, the value of land tax continues to remain extremely low, at an average of around £E20 per feddan (and which is revised only once every ten years).

The polluter pays principle should be translated into concrete rules and regulations that are administratively efficient and cost-effective. Many existing laws and

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[7]In Egypt a considerable amount of environmental degradation is a result of failure to price resources and goods at their marginal private cost, let alone their social value. For example, Government subsidies for fertilizers and pesticides is a range between 30-90% of the total value of these products (INP, 1993). In addition, as reported by WRI (1985) cited in Pearce and Warford (1993) Egypt pesticides subsidies in 1985, among eight other developing countries, was 83 percent of the total full cost of pesticides or $207 million (0.9 percent of GDP). This compared to only 19 percent of the total full cost of pesticides in China. This highly overuse of pesticides has a strong damaging impact on human and natural capital such as the adverse impacts on the quality and quantity of agriculture production, human health (morbidity and mortality), fish caught and extinction,.....etc.

[8] After a short period of passing law 1992, which gives the landowners the rights to take over of their lands from the tenants, a significant decrease in both land prices and rents has happened. For example, the price of one feddan, that was expected to be sold at £E80,000 or to be rented at £E2,000, has been offered only for £E40,000, £E1,200 for sale and rent, respectively (Al-Ahram Newspaper, 1998).

regulations are neither efficient nor effective in their impact on people's behavior because they are not properly formulated and their implementation leaves much to be desired. However, there is now a great appreciation by the government of the fact that sustainable agriculture needs from the government a macroeconomic and legal framework which produces the right signals for people to take risks, allocate resources rationally, and internalise (positive and negative) externalities. Environmental accounting is helpful tool in correcting the bias that has resulted from the lack of consideration of externalities, the structure of property rights, limits to information, and distorting pricing signals resulting from government interventions in key products and in market factors, in macro and sectoral economic indicators for environmental scarcity.

3.3 Industrial Sector

The Egyptian industrial sector is responsible for two major environmental problems, air and water pollution. Air pollution has resulted from the mistaken allocation of heavy industries in urban areas, which has a damaging impact on human and physical capital. Water pollution has resulted from the industrial effluent discharges, especially from food industries which are allocated along the Nile River from Aswan to Cairo. As seen from environmental sectoral accounts, the contribution of this sector is not as great as traditionally reported by conventional national accounting. Its contribution has fallen by 5% a year, on average for the 1986-1990 period.

The costs incurred by the manufacturing sector degrades the environment and need to be incorporated in taxation policy. This will be an effective tool in managing the environment, however, in practice the government needs to be closely monitor the effluent discharged from manufacturing sector, and effectively utilize law enforcement, in order to meet the objectives of the plan. Perhaps direct taxation on the output of firms on manufacturing sector could be a more effective policy instrument, providing a disincentive due to higher costs, as well as a source of revenues for expenditure on repair[9]. Economic instruments of cost internalization for

[9] An example is the cement and chemical industries in Norway which are charged to pay 16-19 percent of their total production price as pollution tax (MOE, 1976).

the industrial sector could include: first, effluent charges for industries that are responsible for water pollution along the Nile River, especially food industries; second, imposing a high tax rate on heavy polluting industries which in turn leads to increasing the production costs, as a consequence increasing the prices of their products. This could be an obstacle to establishing these industries because the profits will be lower compared to other investment options. For example, the cement and chemical industries which are responsible for most of the human and physical capital damage in Egypt, as a result of its allocation in urban areas, should pay a very high rate of pollution tax as a disincentive and to be correctly allocated in remote areas.

The examples discussed above illustrate the way that the results of the research can be used in Egypt's resource management policy. By linking the results to taxation and subsidies levels it is apparent that there is scope for increased government charges and decreasing subsidies, which could begin to reshape resource utilization so that it reflects real environmental costs.

3.4 Construction Sector

As discussed earlier, the current approach in the system of national accounting is wrongly treats agriculture land transfer, due to urbanization and industrialization, as a part of income in the construction sector. As explained in Chapter Six Section 5 that the capital consumption allowance of agriculture land is estimated. Therefore, an adjustments is made to construction sector, where environmental damage is losing the most fertile agriculture land. This adjustment, as shown in the Chapter Seven, has shown quiet different picture to the contribution of construction sector in the whole economy.

3.5 Implication of the Study for the Environmental Impact of other Economic Sectors

The insight provided by the environmental accounting to previous economic resources and sectors could be extended to cover other sectors in terms of their data, particularly on production costs, environmental impacts, and environmental abatement costs. Thus additional study on these issues of each economic sector is needed to develop estimation routines.

3.5.1 Transportation and Communication Sector

The sector that is a second major contribution to the air pollution, especially in big cities such as Cairo, is the transportation and communication sector. The main environmental concern of this sector is the gaseous emission from vehicles. The gaseous emissions are mainly nitrous oxides (NO_x) and carbon monoxide (CO). the sector also emits lead and smoke into the air. The environmental cost estimation of this sector could be carried out by classifying transportation into land, air and water transportation. These three types can be further classified into smaller groups such as buses, trucks, trains, planes, and passenger boats, for example, which is the way current GDP estimation of transportation sector proceeds. This approach could make it possible to link environmental costs to each vehicle type in the GDP, if this cost could be imputed , the EDP of the transportation sector could be obtained.

3.5.2 The Electricity and Water Supply Sector

The electricity and water supply sector consists of electricity generation, water supply, gas manufacturing and distribution. The most environmental concern by the sector is from electricity generation. In Egypt, electricity production uses various fuel sources, and environmental impacts are also different from one fuel to another, for instance, EEAA (1995) estimates that around 13 percent of electricity produced in Egypt uses lignite, which generates various types of pollutants such as sulfur dioxide, nitrogen oxide, and suspended particulate matter, whereas using natural gas will produce only some gaseous emission, at much lower levels. This suggests that studies on this sector need to focus of the fuel source, which in Egypt can be oil (27%), natural gas (38%), and hydropower (10%) as well as (25%) of fuel used in production. These environmental impacts need to be counted as another cost in the energy production. It is believed that the energy demand will be substantially increase in the current Fourth-Five-Year Plan (1996/97-2001/02) by 9% per annum (INP, 1991). This means that the pollution created by the sector will also significantly increase, and there is even greater need to look carefully at the GDP of the sector, so that its environmental elements are properly understood. The study may have to take into account the difference in size of electricity plants since different plant size can produce different impacts to the environment. Data on environmental costs per unit of each energy source can be used as guideline in choosing suitable energy sources, and can assist in establishing tax or charging levels on polluters in the electricity supply sector.

3.5.3 Services Sectors

The other sectors in the Egyptian economy mainly provide services like trade, banking, insurance and real estate, public administration and defense sectors, ownership and dwellings. The environmental impacts of these sectors can not be so easily visualized in the national accounts framework except for some kinds of household waste that could be monetized as an environmental cost. It is likely that emphasis on other sectors is more appropriate in the current Egypt context.

The relative shift in production in favour of tradable goods (chiefly made up of the outputs of the agricultural, mining and manufacturing sectors) and away from non-tradable (principally various service activities) is liable to be environmentally damaging to some extent, via intensification of cultivation, accelerated depletion of non-renewable assets and greater industrial pollution. However, non-tradable services are more environmentally friendly since they require only limited material inputs and lower capital. From environmental sectoral accounts, for the 1986/87-1990/91 period, it is noticeable that the contributions of services sectors have increased in the modified value added, EDP by sectors. In contrast, the contribution of the oil and gas, agriculture, construction and manufacturing sectors in the modified value added have decreased as a result of incorporating the depletion and degradation costs. This may emphasise the potential leading role of services sectors (which are more environmentally friendly) in the Egyptian economy.

4. CONCLUSION

The fundamental question for macro concerns (are development and growth sustainable?) now could be answered. PAM, GSI, and GSII indicated that Egypt has experienced an unsustainable path in at least half of the study period, five of ten years. 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 directly relevant in addition to the more traditional elements of monetary and fiscal policy as they affect public and private saving and investment behavior. Green national accounts can be made policy relevant, but perhaps not in the ways originally envisaged. Knowing your true level of income is intrinsically important, but only indirectly useful for policy. Knowing your true level of saving, both domestic and foreign, speaks directly to a range of policies concerning whether income can be sustained in the future.

Finally, if the environmental impacts of every sector in the Egyptian economy were monetized and incorporated in EDP and genuine savings estimates, this would for the first time provide a complete picture of the sustainable and environmentally friendly levels of economic growth for the nation. These EDP and genuine savings estimates would be lower than the current GDP and GDI. As noted earlier, up to now the economic growth of Egypt has been seriously exaggerated. As noted earlier, up to now the economic growth of Egypt has been seriously exaggerated. As noted by Report Repetto in Chapter One, "a nation can exhaust its minerals resources, cut down its trees, erode its soil, pollute its aquifers and hunt its wildlife and fisheries to extinction, but its measured income would rise steadily as these assets degraded or disappeared". Egypt could head in the direction outlined in that quote unless the real costs in each sector are recognized in planning and policy development. The incorporation of real costs as shown in the integrated accounts could change the priority of particular sectors, and provide for investment. For example, as seen from environmental sectoral accounts, which involve measuring sectoral productivity and performance, both the performance and the productivity of tradable sectors such as agriculture, manufacturing, oil and gas, and construction have decreased when incorporating their depletion and degradation costs. But services sectors, which are less depleting and degrading, have conveyed the opposite message. This, in turn, may emphasise the potential leading role for services sectors in the Egyptian economy.

CHAPTER NINE

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The subsequent four sections in this chapter are structured as follows. The first section summarises the research findings. The second section presents conclusions. The third section gives the recommendations for Egypt in particular and for developing countries in general. Finally, based on the results of this research, further developments of national accounts and suggestions for further research are made in section four.

1. SUMMARY AND FINDINGS

The first research question was: How could the Egyptian System of National Accounting be modified in order to incorporate the environmental factors; and how could environmentally and economically sustainable income be measured? The second was: what are the policy implications that could be derived from these estimates on both the macro and sectoral levels? To answer these questions the study has been constructed in four parts. The first part (Chapter Two) provided an overview of the Egyptian economy; examined the macro and sectoral performance of the Egyptian economy; examined the status of the environmental and natural resource base in Egypt; and finally, discussed the main linkages between population, economy, and environment in order to stress the necessary dimensions which need to be taken into consideration when trying to define and to measure the sustainability of the Egyptian economy. Therefore, this chapter set the foundations for the following ones. This chapter provided a basis for the incorporation of the environmental dimension in the national accounts, and provided the broad context for the thesis.

Part B (Chapters Three and Four) looked into the alternative approaches to, and the valuation techniques used in, natural resource and environmental accounting. Chapter Three investigated an appropriate approach that could used in modifying the Egyptian System of National Accounts, through examining a series of natural resource and environmental accounting country case studies and highlighted some of the struggles involved in launching environmental accounting exercises in developing countries. This chapter concluded with the specification of the appropriate approach that can be used for a developing country, Egypt. In Chapter Four an environmental accounting model for a developing country, Egypt, was developed. In this chapter theoretical discussions about valuation techniques for non-renewable and renewable natural resources were undertaken. This chapter, therefore, specified the valuation techniques that are appropriate to each resource type, to provide an effective and useful way to incorporate the environmental costs into the system of national accounts. These two chapters represent one of the key contributions of the thesis.

In Part C (Chapters Five and Six) the environmental accounting model, which is developed in Chapter Four, was operationalized in order to account for the depletion and degradation of environmental and natural resources. In Chapter Five the depletion of non-renewable resources such as oil and gas was accounted for. The depletion and degradation of renewable natural resources such as land losses, soil erosion, and air and water pollution were accounted for in Chapter Six.

In part D, Chapter Seven incorporated the value of natural capital depletion and degradation into the macro and sectoral accounts frameworks for the 1981-1990 period as benchmark years, and provided several indicators for sustainable development, which represents another key contribution of this thesis. In Chapter Eight, the policy implications for macro and sectoral policies in Egypt based on the findings of the thesis were presented and proposed. Finally, at the end of this chapter (Chapter Nine), the findings and the links between the research and ongoing efforts designed to improve the national accounting system were established.

The policy conclusions which emerge from this study, for Egypt in particular and for developing countries in general are:

1. From examining Egypt's macro and sectoral economic growth and performance in the last three decades one may conclude that Egypt's debts are not only financial, but also demographic (a high population growth rate of 2.6%), social (insufficient investment in people), and environmental (exhaustion of natural resources and increasing pollution). Without drastic improvements, Egypt's development efforts will become increasingly unsustainable. An urgent change to an integrated, sustainable approach is vital.

2. Chapter Two also concluded that there are several areas of work for setting up a comprehensive system for Environmental Accounting in Egypt. It is important to start with environmental issues with policy implications of immediate relevance to Egypt. Therefore, in this initial stage, the following activities were proposed to be included in a detailed elaboration of a comprehensive methodological framework for environmental accounting, that can lead to integrated economic and environment accounting. Therefore, the depletion of non-renewable natural resources is accounted for first. The depletion and degradation of renewable natural resources is accounted for second.

3. Chapter Three also recommended an approach for integrating and incorporating the depletion and degradation of environmental resources in the UNSNA, for Egypt in particular and for developing countries in general, that is:

- aggregated,
- monetary,
- integrated, and
- gradual.

These recommendations stress that we should proceed without delay to incorporate the environmental depletion and degradation, however imprecisely, fully realising that such an approach will remain partial, but it is bound to be expanded gradually as knowledge of the facts is improved, and as more environmental concerns are brought "into relation with the measuring rod of money".

4. Chapter Four developed an environmental accounting model for Egypt. This model is a partial representation for measuring sustainable development in Egypt, because it only includes the environmental issues where there is available data. However, the designed model is flexible: to include more environmental issues; to the improvement of the data accuracy; and to the development of the applied valuation techniques over time. More importantly, the developed model could be used by other developing countries .

5. Environmental accounting allows for the calculation of environmentally-adjusted national income, an approximation of Hicksian income. In this case study of environmental and natural capital depletion and degradation in Egypt over the period 1981-1990, environmental accounting highlights the serious decline in domestic investment and genuine savings. Chapters Five and Six emphasised the necessity of keeping capital intact (man-made and natural capital) for proper income measurement, while distinguishing between renewable and non-renewable resources. To keep renewable environmental capital intact, provision should be made for its depreciation. This could be calculated by estimating the damage costs resulting from pollution, that could be looked at as a minimum social value of capital consumption allowance of these resources. On the other hand, depreciation or user-cost approaches could be used for depletable resources.

6. In accounting for the depletion of non-renewable resources in Chapter Five, two methods point out problems facing resource-dependent nations, and they do so in strikingly different manners. The two accounting approaches applied in this study differed in their implicit evaluations of oil and gas depletion. However, the two valuation methodologies produced oil and gas depletion adjustments of the same order of magnitude, following the same trends. Divergences occurred, however, in the size of cost of the adjusted income series. The user-cost and depreciation

methodologies suggested the same policy implication, apart from the size of the depletion allowance cost, with respect to Egypt's oil and gas exploitation. As evidence, both depreciation and user-cost approaches show that the average of environmentally-adjusted NDP was 6.01 percent lower when using NPI and 3.01 percent and 1.87 percent lower when using the user-cost approaches at discounted rates of 5 and 8 percent, respectively, for the 1972-1990 period. Therefore, regardless of the method applied the adjusted net domestic product measures, as shown in Tables 5.1 and 5.4, indicate that a significant percentage of Egyptian income over 1972-1990 period was actually consumption of natural resources.

Which natural resource accounting method is preferred by policy-makers? Discussions with individuals in the Ministry of Planning and the Institute of National Planning where the government long and short-term plans are prepared, and in the Ministry of Finance as well as in other government ministries indicated that the majority preferred the User-Cost Approach, particularly for its handling of resource discoveries. The erratic nature of indicators derived using the Depreciation Approach was considered as a significant deterrent to universal acceptance. More specifically, NPI in their opinion is an upper estimate for resource depletion and therefore it may result in a big drop in country income level because it considers all the net-rent as depreciation cost. In the present study, only user-cost estimates of depletion costs were deducted from the net value added of the oil and gas sector and thus NDP in order to obtain the first estimates of environmentally-adjusted net domestic product of the sector and EDP1 for the Egyptian economy.

7. Chapter Six was concerned with accounting for the depletion and degradation of renewable resources, and the total environmental depletion and degradation costs, for the 1981-1990 period. The value of environmental impacts by resource are: health impacts of water pollution (£E1,257 million or 42.92% of the total); health and physical capital impacts of air pollution (£E442.89 million or 15.12% of the total); agricultural output losses due to soil erosion (£E626 million or about 21.37% of the total); and finally agricultural land losses due to urban and industrial expansion (£E603.31 million or 20.59% of the total). The depletion and

degradation of just three natural resources, land, water and air, amounted to more than £E2.93 billion in 1990, almost 3.5 percent of GDP and 4.5 percent of NDP. Comparison with gross capital formation and fixed capital depreciation is more dramatic. The environmental assets degradation exceeded 17 and 23 percent of gross capital formation and fixed capital depreciation, respectively, suggesting that the conventional Egyptian System of National Accounts has been overstating net asset growth by ignoring the loss of productive natural assets. In addition, the Egyptian national accounting system, which does not account for the degradation and depletion of environmental assets along with man-made assets, has led decision-makers farther and farther from development choices that would have been economically and environmentally sustainable.

8. Chapter Seven incorporated the results estimated in Chapters Five and Six, for non-renewable and renewable natural resources, into the SNA framework to estimate environmentally-adjusted net domestic product (EDP), environmentally-adjusted domestic investment (EDI), and environmentally-adjusted balance of current account (ECA), for Egypt. These modified aggregates have provided more accurate and better estimates of the impact of environmental resource development in Egypt during the study period 1981-1990. The comparison between the conventional economic and environmental accounting indicators has revealed the significance of the omitted costs of natural resource depletion and degradation in the current approach to SNA. It also provided an alternative estimates of the GDP, GDI, and CA in Egypt over the study period.

First, the EDP estimate in this study shows that Egypt has been rapidly using up its natural capital. In just one decade, from 1981-1990, Egypt depleted and degraded its environment by more than £E35.07 billion 1990 (see Table 7.2). This sum exceeds half the average value of one years' GDP during this period. The implications of this loss for development cannot be determined with any precision, but at least as shown in the macro analysis, the capital loss averaging 5.15%[1] of GDP a year could easily have reduced the potential growth rate of GDP by 1.90% a year. Since the actual growth rate over this period averaged 4.65%, this would represent a 41% reduction in the potential economic growth. More importantly, as explained in the text, the individual annual change in the growth rate, which may convey a different message from the average, is a very important indicator in economic and growth analysis (see Figures 7.2 and 7.4). More importantly, EDP per capita, as a better measure of economic performance and welfare, on average, was twenty percent lower than conventional GDP per capita over the ten years study period. In addition, the average EDP per capita growth, over the ten year, was almost 80 percent lower than GDP per capita growth for the same period (see Tables 7.4 & 7.5). This confirmed the fact that Egypt's economic growth and development, in the 1981-1990 period, was highly reliant on and financed by the depletion and degradation of the environmental and natural capital.

Second, the EDI estimate shows more drastic changes in the investment accounts (see Table 7.6 and Figure 7.9). Natural resource depreciation averaged 23% of gross capital formation throughout the period 1981 to 1990. The conventional accounting framework thus overstated actual net capital formation in the Egyptian economy by more than 47% over the study period by ignoring the disappearance of Egypt's most productive assets-natural resources. An accounting system so misleading about an economic process as important as capital formation can be of no use for economic analysis, planning, or evaluation.

Third, Current Account of balance of payments, an important macroeconomic indicator, deteriorated significantly after removing the capital element of oil exports

[1] It has to be remembered that the user cost approach and degradation results are adopted in these analyses because, as argued earlier, they offer the more conservative estimates compared to net price I and degradation. Therefore the results of the user cost approach are more acceptable to authoritative people than NPI, which offers an overestimation for non-renewable resources depletion. Moreover, on the theoretical level, the user cost approach appears to be more defensible. The modification of national income accounts following a user approach would bring the system more closely in line with the proper economic definitions of production and capital consumption. It would separate the cost of environmental disinvestment from value-added and income.

from the current account. The ECA deficit was greater than 10% for five of ten years compared to only two years for CA. This in turn may have a great effect on exchange rate polices, such as appreciation and depreciation, which is wrongly determined from the conventional framework of national accounts. In addition, this may support the fact that the contribution of oil exports in foreign and net savings is not as great as shown by conventional SNA, and therefore policies that aimed at boosting savings by exporting scarce natural capital did not have the effect on net savings that conventional accounting suggested.

Finally, preparing environmental sectoral accounts, along with environmental macro accounts, has portrayed a detailed different picture for the macro and sectoral economy compared to the conventional one. From the analysis of these accounts, as shown in Tables 7.12 – 7.20, one can conclude that the environmental-economic sectoral accounts have indicated a quite different picture for sectoral performance and capital efficiencies. Therefore, establishing environmental sectoral accounts has to be looked at as an important step in environmental accounting analysis. This type of analysis would provide the useful information that is mostly needed for operational government policies.

9. The results of the study require a significant reassessment of Egypt's economic performance during the study period, and bring to light aspects of sustainability of Egypt's economic growth that would not be readily apparent from the conventional national income accounting framework. In Chapter Eight "weak sustainability" measures, proposed by Pearce and Atkinson (1993) and the World Bank (1995 and 1997), which assumes full substitution between the different types of assets (man-made, human, and natural) have been implemented to test the sustainability of the Egyptian economy for the 1981-1990 period. Even adopting user cost and degradation estimates, which reflect the most conservative estimates of environmental costs, all weak sustainability measures PAM, GSI and GSII have shown that the Egyptian economy was on an unsustainable path for more than half of the years of the study period. This confirmed the fact that the high growth rates of the Egyptian economy, conveyed by conventional SNA indicators,

were highly inflated and financed by the depletion as well as the degradation of natural capital. This study suggests that such an index was negative for Egypt for more than half of the study period, and in addition, taking an average value of genuine savings, for the same ten years study period, was negative. This was in part due to : (1) the need to make good pollution damage; and (2) the running down of natural resources not made good by compensatory investment.

10. Increasing the coverage of natural resources and pollutants in our calculations would decrease the estimated levels of genuine savings overall. As explained in detail in Chapter Eight, developing "greener" national accounts holds the additional promise of treating environmental problems within a framework that the key economic ministries (planning, finance, and environment) in any government will understand. Negative genuine saving is more than a theoretical possibility, therefore, and the evidence is that many years are being progressively impoverished as a result of poor government policies. For example, thinking about government expenditures raises the broader issue of consumption levels. Negative genuine savings rates imply by definition excessive consumption, whether by governments or households. Extreme poverty plays a role in this picture, because at the margin the poor have little option but to consume all their income and, often, to run down their assets. Reducing consumption expenditure by governments is one policy approach to boosting genuine savings.

11. Finally, if the environmental impacts of every sector in the Egyptian economy were monetized and incorporated in EDP and genuine savings estimates, this would for the first time provide a complete picture of the sustainable and environmentally friendly levels of economic growth for the nation. These EDP and genuine savings estimates would be lower than the current GDP and GDI. As noted earlier, up to now the economic growth of Egypt has been seriously exaggerated. As noted by Report Repetto in Chapter One, "a nation can exhaust its minerals resources, cut down its trees, erode its soil, pollute its aquifers and hunt its wildlife and fisheries to extinction, but its measured income would rise steadily as these assets degraded or disappeared". Egypt could head in the direction

outlined in that quote unless the real costs in each sector are recognized in planning and policy development. The incorporation of real costs, as shown in Chapter Seven, could change the priority of particular sectors, and provide a better guidance for investment. For example, as seen from environmental sectoral accounts, which involve measuring sectoral productivity and performance, both the performance and the productivity of tradable sectors such as agriculture, manufacturing, oil and gas, and construction have decreased when incorporating their depletion and degradation costs. But services sectors, which are less depleting and degrading, have shown the opposite picture. This, in turn, may emphasise the potential leading role for services sectors in the Egyptian economy.

12. Chapter Eight discussed attempts to "internalise" environmental externalities through the use of regulations, taxes, or other instruments. However, this will only lead to an improvement in economic efficiency if: (1) environmental damage is accurately measured; (2) those responsible for causing the damage can be unambiguously identified; (3) the policy instruments applied to get them to pay for the damage are accurately targeted; (4) the instruments contain incentives to continuous environmental improvement; and (5) there is an efficient flow of information, and no restrictions on market response, so that those to whom particular instruments apply are able to respond to them. Therefore, the most important policy and investment measures required to address the above issues are: greater use of subsidy-removal and pollution-related taxes as part of ongoing deficit reduction efforts; reducing spending on subsidized agriculture inputs and on energy use, combined with greater reliance on pollution taxes and user charges, which would benefit both the environment and the deficit. These reforms should be pursued simultaneously along with any more regulatory and enforcement measures and investment initiatives.

2. CONCLUSIONS

Still in its development phase, natural resource and environmental accounting is a field with important implications for policies for sustainable development. As governments attempt to match their actions to their rhetoric on achieving sustainability, the importance of environmental accounting will grow. As El Serafy (1991) noted, "to wait until everything falls properly into place will mean that we shall have to wait forever". To make everything fall into the right place faster, the issue of sustainable development measured through the implementation of environmental accounting needs to be addressed through research and experiments. In a developing country such as Egypt, which depends on environmental and natural capital for economic growth, failure to account for the resources depletion and degradation will result in providing policy-makers with wrong signals for the sustainability of economic growth and performance.

The study has shown that Egypt's economic growth, for the 1981- 1990 period, was financed to a large extent by the depletion and degradation of natural resources and environmental capital. However, being able to demonstrate this critical situation is not a sufficient condition to bring about policy changes. This dilemma in developing countries, such as Egypt, is about the choice between getting the most out of a country's resources for the present generations' survival and on the other hand, efficiently using a country's resources for the benefit of future generations.

The study demonstrated the feasibility of the implementation of environmental accounting in Egypt and also its limitations. Indeed, attention and action is required from the policy-makers regarding the use of modified accounts and accounting indicators in macroeconomic and sectoral planning and policies. The study also revealed many data gaps that had to bridged by assumptions and thus indicated the need for some guidance in identifying priorities for environmental data collection. For example, effluents and emissions of pollutants in air and water from economic sectors should be monitored on a regular basis and on nation-wide. A strong database would help to provide better accounting indicators as well as help taking more rational decisions in the management of natural resources and the environment.

Last but not least, environmental accounting permits nations to understand the economic cost of policies and practices which affect the environment. Clearly, Egypt has a long and difficult road ahead in terms of changing government policies and economic incentives which promote the inefficient use of natural capital. As well as highlighting these issues, this study has indicated a pressing need to change the current Egyptian SNA so that economic policy-makers no longer make misguided decisions based on inadequate and distorted information. Past failures to account for natural capital depletion and degradation have already undermined efforts at development and poverty alleviation. This linkage is still not fully recognised by policy-makers, who act as if natural resources were limitless or as if technology can always replace exhausted or degraded resources. Closer dialogue between policy-makers and scientists can overcome this simplistic view of the natural environment. An economic accounting system that reflects the true condition of natural resources would provide an essential tool for use in the integrated analysis of environmental and economic policies in every sector of the economy.

Environmental and natural resources are disappearing and degrading with increasing speed, but national policy-makers are not yet considering the implications for future economic productivity. The situation can be reversed if corrective environmental and economic policies are enacted. This is unlikely to happen unless leaders are provided with information that genuinely reflects the relationship between economic development and the natural environment and shows how the abuse of natural resources impoverishes the country. Egypt's natural wealth lies in its people, land, Nile River, oil and gas and the surrounding seas. The economic "development " programs carried out to date have impacted on all of these resources.

3. RECOMMENDATIONS

1. Brief reference is made above to the costs and benefits of doing environmental accounting. It is obvious that a lot of money could be spent on building green accounts, especially if an elaborate framework is adopted and significant effort is spent on valuing difficult things like willingness to pay for environmental quality or marginal abatement costs. But for the developing world, a modest effort to measure sustainable income and genuine savings rates could bring considerable benefits: any resulting policies to reduce government consumption, improve the management of the proceeds from resource extraction, or boost private savings will likely pay large dividends.

2. A modified System of National Accounting, as discussed above, can play a very important role in increasing environmental awareness as well as in injecting some rationality in decisions. As far as the natural environment is concerned, the research has shown that current national income accounts provide false signals to policy-makers. If the Egyptian government sees sustainable development, not just high growth, as an important aim of economic development, the government will need data systems that reflect the environmental costs identified in this study. An environmental accounting system can tell the policy-makers if the current progress is real or illusory, and what are the real costs of economic development. Conventional national income accounts indicators such as GDP, GDI, CA, and GDI have become important indicators by which people judge the economic performance of a government; environmental accounting, however, produces alternative accounts and indicators such as EDP, EDI, ECA, and GS that could be used to assess the ecological and economic performance of a government.

3. The environmental accounting model and approach developed for Egypt could also be used in other developing countries. The benefits of transferring the application would be considerable, since effective management of the natural environment will be crucial in achieving sustainable development in these nations. By using the model and approach developed here, these other nations will avoid

incurring costs of development for themselves. Egypt will also benefit from this type of application, gaining further experience for Egyptian researchers in policy and planning of environmental management for sustainability.

4. Economic planning and analysis would be helped greatly if the state of the environment, including the natural resources, are given adequate space in the nation's economic reports, and if physical indicators of environmental change are periodically produced. These indicators should include the reserves and life expectancy of various mineral deposits, the state and change of water (quantity and quality), air (pollutants), soil (erosion), land (loss), fish (extraction),.....etc. Based on these data the implications of approximate re-estimations of the accounts for income, savings, investment, and the balance of payments should be investigated as exercised above, so that sounded economic policies can emerge.

5. A co-ordinated national environmental information system needs to be established for regular collection and publication of data that are required to monitor, measure and to assess sustainability of economic development at both the national and the regional levels. Therefore, an official statistical agency in Egypt must take responsibility for organising data-bases, and a steady flow of information to them. For example, the methodology presented in this research can then be used to confront economic development issues realistically. Without consistent data-bases, it will be difficult to estimate the costs of development of environmental resources, and expansion in other sectors. The data series do not have to cover a wide range, but just enough to enable environmental accounting to produce EDP, EDI, ECA, PAM, GSI, and GSII estimates as performed here. This is an important consideration for Egypt which is just a developing country where personnel and budget are always constrained. However, a wider range of data on environmental resources could be part of a larger plan for the future, as personnel and budget resources expand.

6. Furthermore, the estimates of economic production net of environmental costs in a modified SNA framework, as proposed in Chapter Eight, could be an important

tool in comparing the efficiency in economic production between countries. Rather than rely simply on GDP, comparisons could emphasise resource use, and sustainability issues which relate to global concerns. This can help increase the efficiency of global environmental uses since the environmental damage now can be counted as a cost in economic production, and countries with low efficiency in environmental resource uses in one commodity (i.e., production net all costs including environmental costs) could be encouraged to shift activities to products where they have a higher environmental comparative advantage.

7. The environmental accounting model and approach, developed in this thesis, could be a part of the current revisions of the UNSNA. One reason is that it is now possible to link the environmental resources with economic activities, even in developing nations like Egypt. Furthermore, as sustainable development is a new aim of economic development, refinement of SNA indicators will become even more essential, creating greater pressure to change UNSNA. Even though changing the whole system of national accounting is not likely, the environmental accounting approach developed here, using readily available data and estimates is an important step toward the revision of overall national accounts. As yet, a universal agreement has not been reached on the concepts of integration between the environment and economy, but the integrated environmental accounting system as developed here can provide a framework for that agreement. In the meantime, the study has also shown that even without total revision of the UNSNA the impacts on the natural environment of particular economic activities in particular countries can be traced, so additional work in this approach is justified. Thus, environmental accounting holds the key to eventually redefining the "Gross Domestic Product" and "Gross Domestic Investment", so that environmentally sensitive and sustainable activities are measured by that term.

8. An important fact is that environmental challenges are both interdependent and integrated, requiring comprehensive administrative approaches as well as public participation. The various institutions facing these challenges in Egypt, however, tend to be independent, fragmented, and working to relatively narrow mandates.

Those responsible for managing natural resources and protecting the environment are institutionally separated from those responsible for managing the economy. Also, there is a failure to make the bodies whose policy actions degrade the environment responsible for ensuring that their policies prevent the degradation. If we are to address properly the environmental issues, then institutional reform is a must.

9. Egypt, as well as other developing countries, should start to encourage interdisciplinary research. This type of research mostly requires team work, which will allow different expertise from different areas of specialization to study the same phenomenon and to come up with one conclusion rather than fragmented opinions that are of little use in decision-making. Indeed, this type of work is urgently needed for the environmental issues in developing countries. This may require: first, reviewing the present educational research and training programs, as well as introducing new and integrated academic disciplines best suited for the multifaceted environmental problems; second, coordinating research efforts which are directly related to environmental and development problems, in universities and research institutions in order avoid duplication and to achieve optimum solutions for environmental and development problems, thus ensuring a better quality of life of present and future generations.[2]

[2]This view is supported by Proops and Faber (1994), they proposed two ways for encouraging the interdisciplinary studies. They write: "from our own experience the prime means of combating this isolation is through interdisciplinary conferences, symposia, and seminars. As such meetings are almost the only opportunities for interdisciplinary dialogue, they need to be held more frequently than in established fields. Second, we have suggested that successful interdisciplinary research requires researchers to have studied and internalised both economics and physical sciences, at least to some degree. For example, applying interdisciplinary training at graduate school level would help to establish a body of scholars whose orientation would be naturally towards interdisciplinary work".

4. SUGGESTIONS FOR FURTHER RESEARCH

This thesis set out to measure Egypt's sustainable income and economic growth by incorporating the environment and resource cost and sustainability dimensions of economic development through developing an environmental accounting model and approach for a developing country. It focused particularly on dealing with the urgent environmental issues for sustaining economic development, and has illustrated straightforward estimations routines, using available data, which can be a foundation for a new perspective on Egypt's economic growth and development.

1. Only the major and urgent environmental issues and problems were considered when accounting for the depletion and the degradation costs of natural resources. Therefore, the redefinition of EDP by economic sectors has incorporated part of the costs of environmental depletion and degradation. There are other impacts from these sectors that could be incorporated in a broader ranging study, which would lower GDP even further. Some of these impacts were discussed in Chapter Two, and include: fish depletion (overfishing); water diseases (other than bilharziasis); air pollutants (other than PM and SO_2); ground water pollution and depletion; minerals depletion (other than oil and gas); natural and cultural heritage deterioration; and solid waste The environmental costs of these issues have not been estimated in this thesis because of data and time constraints, but they too lower further the GDP of this broad sector. Recognising the scale of adjustments already made, as well as those that could be made if data systems were better developed, it is clear new perspectives are needed if environmental resources management in Egypt is to be effective and sustainable. Simply relying on the current estimates of GDP for the sector is no longer an adequate basis for planning and policy analysis.

2. One way the integrated environmental accounting approach[3] could be used to reshape the Egyptian industry development policy is by showing how growth of a particular sector will influence environment costs. In other words, industrial promotion policy, for instance, should not look only at the production value of the industry but also at its environmental costs. As seen from the analysis, although environmental costs for the manufacturing sector were not accounted fully, its importance in the economy is ranked lower than as measured by its GDP. The next step in this direction could be estimating the environmental costs for every sub-industrial sector. The results of this could then be incorporated into industry development policy, and so perhaps shift the focus of Egyptian development away from the high environmental impact sectors. Moreover, the estimated environmental costs from the analysis can be an important basis to assist the application of the polluter-pays policy in much the same way that taxation and effluent charges can reflect resource costs.

3. As stated in Chapter Seven, the possibility of extending our measures of economic welfare need to be examined, and to set these measures in a comprehensive empirical framework and data system which show not only the use of man-made assets but also that the environmental asset changes integrated in the national account are related to other aspects of economic activity. A change in one sector of the economy, of course, has repercussions through out the economy by changing relative prices and thereby changing incentives to produce and to consume various goods and services. A country heavily dependent on natural resources must have particular concern with the overall perspective of linking the economic system with the environment. Integrating natural resource and environmental capital within a Social Accounting Matrix (SAM) would make it possible to study some of the economic repercussions from natural resource depletion and environmental damage, and to examine the structural interdependence among the accounts contained in the Environmental-Social Accounting Matrix (ESAM). The analysis could show how the structure of

[3] Also, only the environmental damage resulting from economic activities has been accounted for, i.e., unrelated production activities such as natural disasters, naturally occurring erosion and so on have not been considered in the estimation of environmental costs.

production activities, income distribution, and environmental or natural resources are interrelated. For an effective analysis of development mechanisms and problems in different environment-socio-economic settings, it is important to construct an environmental-social accounting system. To construct an Environmental-Social Accounting System (ESAM) for Egypt, data are required from different sources. These include the Egyptian National Income and Product Accounts, the Input-Output tables, the Household Income and Expenditure Survey, and Environmental Accounting developed in this thesis. ESAM would provide a new and expanded data system for taking full account of the depletion and degradation of Egypt's natural and environmental capital, and their linkage to production. The ESAM will show how environmental asset changes can be integrated into a Social Accounting Matrix (SAM) framework.

4. Some of the common techniques in preparing national income accounts estimates have been used, interpolation between benchmark years and extrapolation from samples of limited coverage, in order to fill the data gaps in estimating environmental depletion and degradation. In terms of further research there are obvious refinements that can be envisioned, including treating soil degradation and expanding the country coverage of data on the marginal social costs of natural resource extraction and pollution emissions. The latter is particularly important for industrialising and rapidly growing countries: as countries develop there has been an increasing trend towards urbanisation and the development of problem levels of pollution in these urban areas. The improved data-bases could include for example: (1) periodical measurement of soil quality degradation resulting from different causes; (2) an estimation of the yearly agriculture land lost as a result of non-agriculture use; (3) periodical measurement of water and air pollution.

5. The attention given in this study to the proper measurement of macroeconomic indicators (GDP, NDP levels and growth, savings, investment, the current account, etc.) should not be taken as indicating an absence of need for a parallel movement aimed at: (1) improving economic analysis of projects to accommodate environmental concerns. Serious attention should be given to projects'

externalities, and to the correction for these by setting proper values on them and bringing them into the cost calculations; (2) the process of shadow prices inputs and outputs should be extended to environmental goods and services where the market fails to reflect their true scarcities in adequate prices.

6. As explained above, the depletion of natural resources is one of the major problems in most developing countries. This problem is further compounded by the fact that natural resources are exported from those countries at prices that do not reflect their full scarcity cost. Analysis of the effects of exporting natural resources on stimulating true economic growth in developing countries could provide an insight appropriate policies. In Egypt, for example, the contribution of oil exports to total exports, during the period 1981-1991, was approximately 50% on average which indicates the strong reliance of the Egyptian economy on exporting its scarce natural resources. Numerous studies have been carried out in developing countries to examine the role of the exporting sector in stimulating total economic growth. The aggregated economic growth models utilised in these studies (e.g., Feder's aggregate growth models developed in 1983) could be used to re-evaluate and compare the role of the Egyptian export sector in stimulating conventional economic growth (GDP) to environmentally-adjusted economic growth (EDP) resulting from this research. This is another of the areas the results of the study could be linked to.

APPENDICES

APPENDIX 2

APPENDIX 2.1

Table 2.16: Development in Egypt's HDI Rank Over the Period 1990 - 1995

Year	*Life expectancy*	*Adult literacy*	*Real GDP per capita*	*Human development Index*	*Rank*	*No. of countries included in the report*	*Level of human development*
1990	62 (1987)	45 (1985)	1357 (1987)	0.501	86	130	medium
1991	60.3 (1990)	44.6 (1985)	1930 (1985-88)	0.394	114	160	low
1992	60.3 (1990)	48.4 (1990)	1934 (1989)	0.385	110	160	low
1993	60.3 (1990)	48.4 (1990)	1988 (1990)	0.389	124	173	low
1994	60.9 (1992)	50.0 (1992)	3600 (1992)	0.551	110	173	medium
1995	63.6 (1992)	49.1 (1992)	3450 (1993)	0.613	107	174	medium

Source: *UNDP, Human Development Report, Oxford University Press, New York, Different Years.*

Technical Notes:

- *the high positive figure shows that the HDI rank is better*
- *since 1994 the World Bank have used Penn World table estimates as the main source of PPP.*
- *countries with a HDI below 0.5 considered to have low level of human development, those between 0.5 and 0.8 have a medium level and those above 0.8 have a high level.*

APPENDIX 3

APPENDIX 3.1

STRUCTURE OF THE UN SEEA

The following table gives the basic structure of the UN satellite System of Environmental and Resource Accounts, as described in United Nations (1992).

Table 3.5: The Basic structure of SEEA

		Economic Activities					*Environment*
					Economic Assets		
		Production (1)	Rest of the world (2)	Fnal consumption (3)	Produced Assets (4)	Non - produced natural assets (5)	Other non-produced natural assets (6)
Opening stock of assets	i				$K0_{p.ec}$	$K0_{np.ec}$	
Supply	ii	P	M				
Economic uses	iii	Ci	X	C	I_g		
Consumption of fixed capital	iv	CFC			-CFC		
Net domestic product	v	***NDP***	***X-M***	***C***	***I***		
Use of non produced natural assets	vi	$-Use_{np}$				$-Use_{np.ec}$	$-Use_{np.env}$
Other accumulation of non-produced natural assets	vii					$I_{np.ec}$	$I_{np.env}$
Environmentally adjusted aggregates in monetary environmental accounts	viii	***EDP***	***X-M***	***C***	$A_{p.ec}$	$A_{np.ec}$	$-A_{np.env}$
Holding gains/losses	ix				$Rev_{p.ec}$	$R\,ev_{np.ec}$	
Other changes in volume of assets	x				$Vol_{p.ec}$	$Vol_{np.ec}$	
Closing stock of assets	xi				$K1_{p.ec}$	$K1_{np.ec}$	

Key:

$KO_{p.ec}$ = opening balance of produced economic assets

$KO_{np\text{-}ec}$ = opening balance of non-produced economic assets

$K1_{p.ec}$ = closing balance of produced economic assets

$K1_{np.ec}$ = closing balance of non-produced economic assets

P = production (output)

Ci = intermediate consumption

CCF = consumption of fixed capital

NDP = Net Domestic Product

EDP = Ecological Domestic Product

M = imports

X = exports

C = consumption

Ig = gross investment

$A_{p.ec}$ = net accumulation of produced economic assets

$A_{np.ec}$ = net accumulation of non-produced economic assets

$A_{np.env}$ net accumulation of non-produced environmental assets

Use_{np} = use of non-produced assets (i.e. depletion plus degradation)

$-Use_{np.ec}$ = use of non-produced economic assets (i.e. depletion)

$-Use_{np.env}$ = use of non-produced environmental assets (i.e. degradation)

$I_{np.ec}$ = transfer of non-produced natural assets to economic assets

$-I_{np.env}$ = corresponding reduction of non-produced environmental natural assets as a result of transfers

$Rev_{p.ec}$ = holding gains/losses on produced economic assets

$Rev_{np.ec}$ = holding gains/losses on non-produced economic assets

$Vol_{p.ec}$ = changes in the volume of produced economic assets

$Vol_{np.ec}$ = changes in the volume of non-produced economic assets

Row (vi) is related to the use of non-produced natural assets. An additional element ($-Use_{np}$) has been included in the column for production. This element reflects the use of non-produced natural assets; it is the sum of counterpart items in column (5) and (6) representing, respectively, the use of non-produced natural assets that are economic assets in the SNA sense ($-Use_{np.ec}$) and the degradation of other natural assets that are not economic assets($-Use_{np.env}$). The use of non-produced economic assets ($-Use_{np.ec}$) includes the depletion of minerals, the extraction of timber from forests that are economic assets and the effects on productivity of those forests and agriculture land, of soil erosion, acid rain, etc. The deteriorating effects of air pollution on buildings and structures and the effects of soil erosion on roads and other degrading effects on produced assets are not included as they are assumed to be reflected in consumption of fixed capital (CFC). The use of natural assets that are not economic assets (-Use $_{np.env}$) covers the non-sustainable extraction of fish stock from oceans and rivers, extraction of firewood and lumber from tropical and other virgin forests or hunting of animals living in the wild and also the effects of emission of residuals on the quality of air, water, soil and the effects of the other economic activities (agriculture, transport, recreation, etc.) on eco-systems and species habitat.

Row (vii) records the transfer of assets from non-produced environmental assets to non-produced economic assets, for example new discoveries of oil and gas. The quantity or the value appears as a positive entry in column 5, and as an equal but negative entry in column 6. The entries in this row will sum up to zero. The entries in row (vi) and (vii) and columns 5 and 6 can be expressed in physical or monetary units. If they are expressed in physical units , the SNA monetary aggregates will remain unchanged. If they are monetized , the conventional SNA aggregates can be modified to reflect the use of environmental assets (depletion and degradation).

If the additional SEEA elements are valued in monetary terms, the incorporation of the use of non-produced natural assets(Use $_{np}$) as additional cost in the column for production results in an EDP, presented in row(viii), which is lower than NDP. The elements in row (vii) for other accumulation do not affect EDP. If additional SEEA elements are expressed in physical terms, row (viii) is not relevant; in that case the additional information in rows (vi) and (vii) is only used to supplement NDP with information on environmental cost caused by economic activities.

The main modifications introduced in SEEA can be summarised in the following way: (1) SEEA includes a wider asset boundary, covering not only produced assets, but also non-produced natural or environmental assets. Thus the SEEA includes imputations for additional expenditure items that are related to depletion and degradation of non-produced assets. (2) SEEA incorporates modified concepts of net product or value added, which are derived by deducting not only the traditional cost items, but also imputed items that correspond to environmental cost of depletion and degradation. (3) SEEA changes the concept of capital formation as used in the traditional analysis of SNA and introduces a new concept of capital accumulation, which takes into account not only changes in produced assets as a result of production and depreciation, but also changes in the stock of non produced assets resulting from new finds of non-produced assets and deterioration of non-produced assets as a consequence of economic activities.

APPENDIX 3.2

Table 3.6: Priorities for Implementing the SEEA

Environmental issues	Physical Accounting		Monetary Accounting	
	Developed Country	Developing Country	Developed Country	Developing Country
1. Use of natural assets (except discharge of residuals)				
Depletion of				
1.1 Biological assets	+	++	+	++
1.2 Subsoil assets	+	++	+	++
1.3 Water	0	++	0	++
Degradation of land (Landscape)				
1.4 Restructuring urbanisation (changes in land)	++	++	+	+
1.5 Agriculture use (soil erosion)	0	++	0	++
1.6 Recreational use	+	+	+	+
2. Product flow analysis	++	+	+	+
3. Degradation of the natural environment by discharge of residuals				
3.1 Waste and land contamination	++	0	+	+
3.2 Waste water	++	+	+	+
3.3 Air pollution	++	+	+	+
4. Actual environmental costs				
4.1 Environment protection activities			++	+
4.2 Damage costs			+	0

Note:
1. *Two Plus Signs (++) indicate high priority*
2. *One plus sign (+) indicates medium priority*
3. Zero plus signs (0) indicates low priority

APPENDIX 5

APPENDIX (5.1)

Figure 5.7: development stages of Egyptian oil and gas sector, 1955-1995

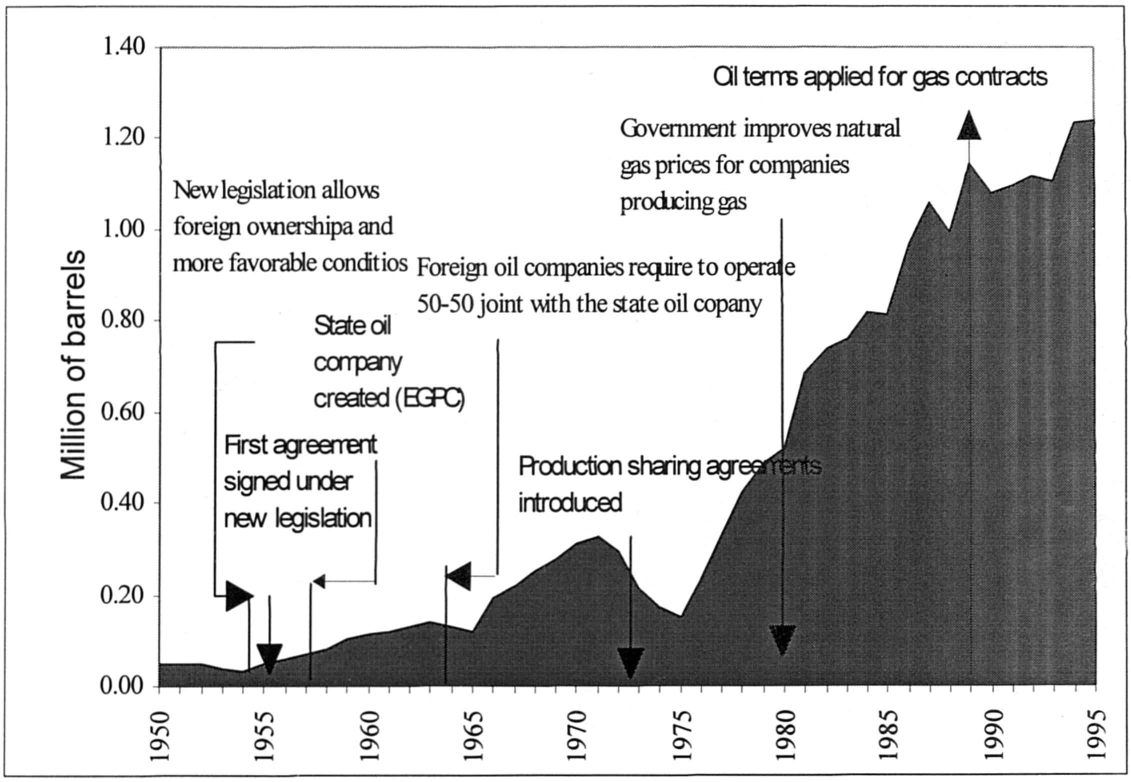


Table 5.5: Balance sheets for oil and gas, 1972-1994 (000s barrels of oil equivalent).

Year	*Opening balance*	*Extraction (Depletion)*	*New discoveries and upward revisions*	*Net changes*	*Closing balance*	*Life span*
1972	1536	119	49	-70	1466	13
1973	1466	108	35	-73	1393	14
1974	1393	78	336	258	1651	18
1975	1651	62	367	305	1956	27
1976	1956	54	-59	-113	1843	36
1977	1843	85	100	15	1858	22
1978	1858	120	569	449	2307	15
1979	2307	155	-19	-174	2133	15
1980	2133	177	135	-42	2091	12
1981	2091	189	978	789	2880	11
1982	3973	250	1458	1208	5181	16
1983	5181	269	422	152	5333	19
1984	5333	277	-159	-437	4897	19
1985	4897	299	-219	-518	4379	16
1986	4379	297	695	398	4777	15
1987	4777	352	570	218	4995	14
1988	4995	386	671	285	5280	13
1989	5280	363	553	190	5470	15
1990	5470	417	464	47	5518	13
1991	5518	395	598	204	5721	14
1992	5721	400	334	-66	5655	14
1993	5655	407	417	10	5665	14
1994	5665	403	2183	1780	7445	14

APPENDIX 6

APPENDIX (6.2)

Table 6.31: Concentrations of air pollutants in Cairo (μg/m3)

Pollutant	*Cairo*		*US standard*		*WHO guideline*	
Sulfur Dioxide	40-156	am	80	am	40-60	am
Particulate Matters	349-857	am	75	am	60-90	am
Nitrogen Oxides	90-750	hm	100	am	320	am
Carbon Monoxide	10,000-18000	hm	40,000	hm	10,000	hm
Lead	0.5-10	am	1.5	qm	150-200	hm
Ozone	100-200	hmax.	235	hmax	150-200	hm

Notes:

am = annual mean; hm = hourly mean
hmax = hourly maximum; qm = quarterly mean

Figure 6.1: Main Governorates With Industrializing Potential, 1990.

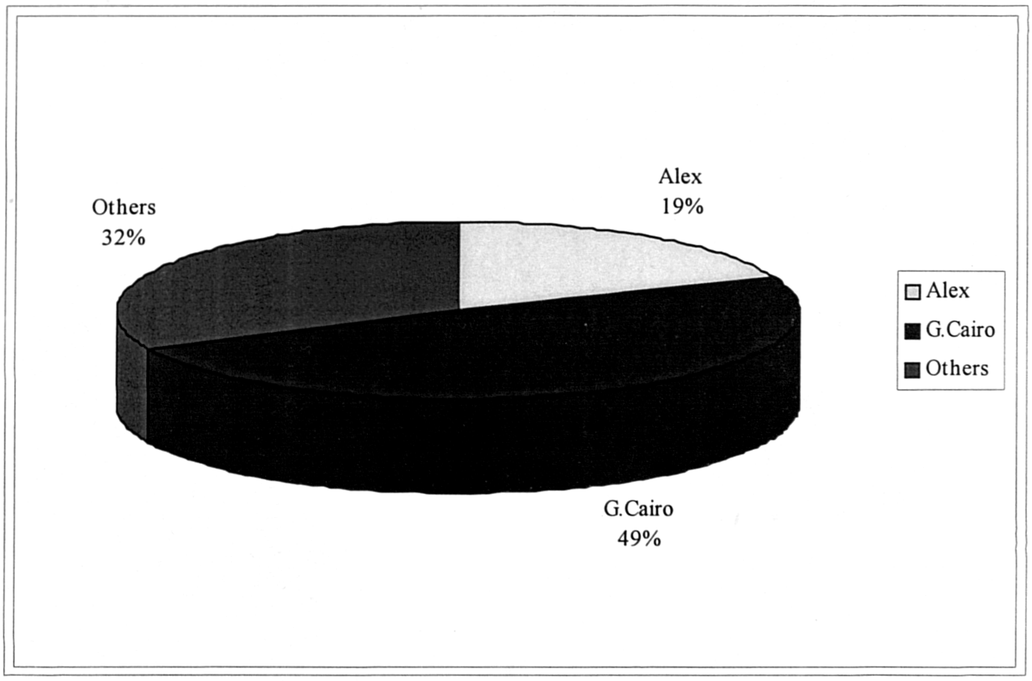
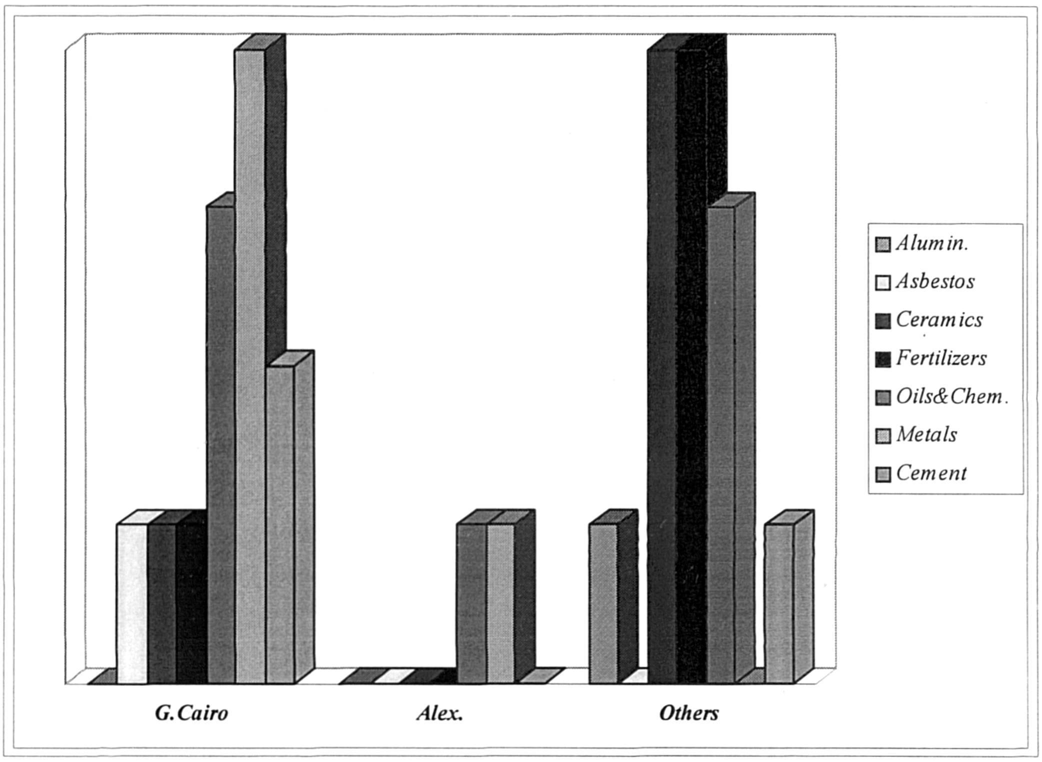


Figure 6.2: Sites of main polluting industries, 1990



Source: EEAA (1992) "National Action Plan".

APPENDIX (6.3)

Figure 6.3: Bilharziasis prevalence rates in Egypt, 1984-1990

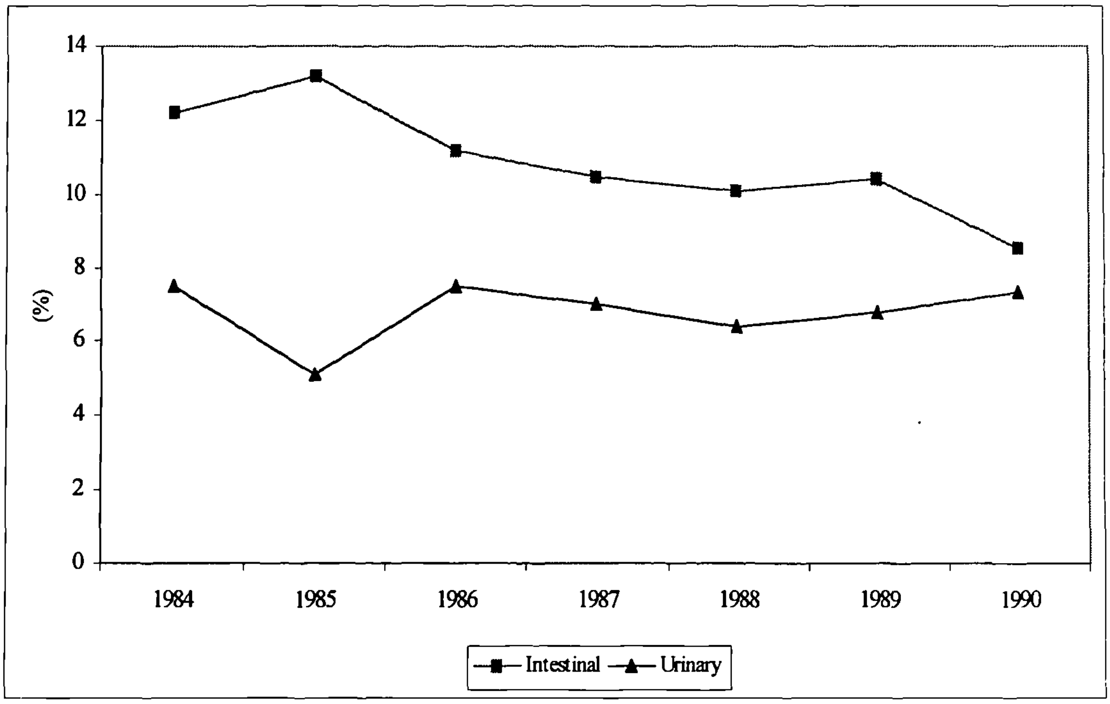


Figure 6.4: Bilharziasis death numbers in urban and rural areas, 1980-1990

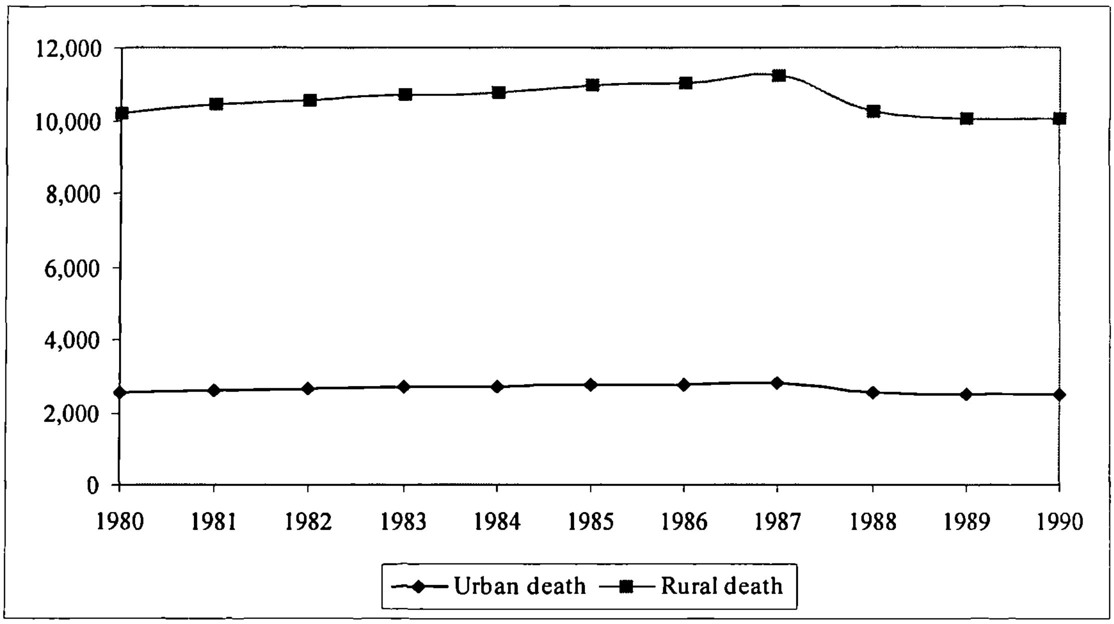
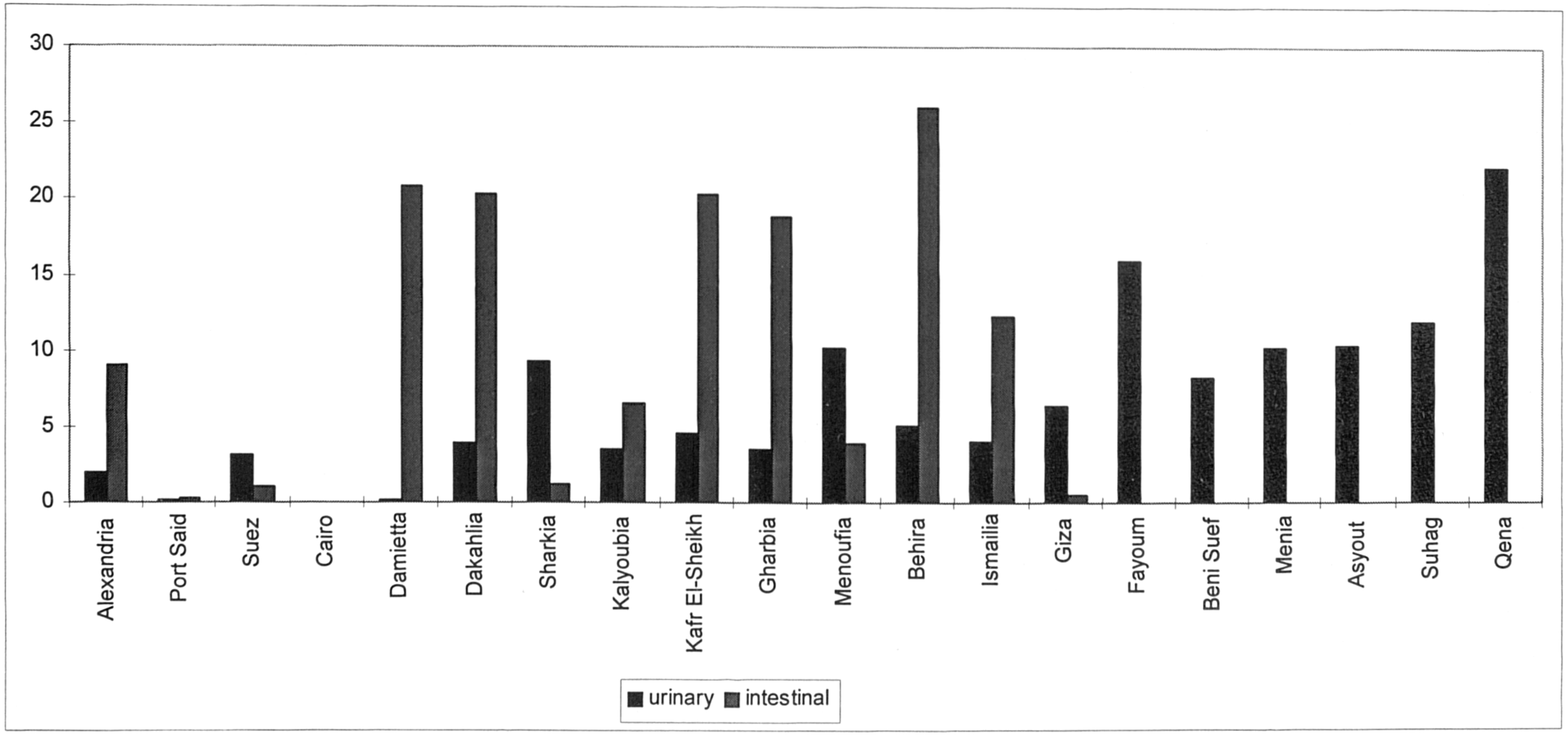


Figure 6.5: Bilharziasis prevalence rates in governorates, 1990



Source of data: Ministry of Health, 1990; 1992 and CAPMS, 1990

Table 6.32: Bilharziasis prevalence rates in governorates, 1990

Governorate	1984		1985		1986		1987		1988		1989		1990	
	urinary	intestinal	urinary	intestinal	urinary	intestinal	urinary	intestinal	urinary	intestinal	urinary	intestinal	urinary	intestinal
Alexandria	1.90	5.10	1.30	6.60	3.40	9.00	1.30	3.00	0.90	2.60	2.70	1.80	2.00	9.10
Port Said	2.40	2.40	1.70	1.60	2.10	1.70	1.80	1.10	1.70	1.30	5.40	0.30	0.10	0.30
Suez	10.70	4.10	11.50	-	7.80	2.70	7.10	2.50	4.70	9.20	4.40	1.50	3.20	1.10
Cairo	9.10	1.20	9.80	1.70	6.60	0.80	7.70	0.90	7.70	1.10	-	-	-	-
Damietta	2.00	23.30	1.70	22.20	1.20	22.50	0.90	18.90	1.10	28.20	0.20	24.50	0.10	20.80
Dakahlia	7.80	18.50	6.70	15.90	7.70	12.10	6.90	13.20	6.40	13.40	5.90	20.10	3.90	20.30
Sharkia	9.50	10.80	11.30	11.40	9.20	12.40	7.40	5.40	13.20	6.60	8.60	13.50	9.30	1.20
Kalyoubia	9.10	10.30	7.50	6.90	6.90	3.50	5.70	3.50	5.60	3.00	5.10	5.60	3.60	6.50
Kafr El-Sheikh	3.80	25.00	4.10	28.90	7.20	21.90	5.20	14.30	6.20	6.40	5.40	28.80	4.60	20.30
Gharbia	3.80	10.50	8.00	11.70	30.70	54.80	6.00	17.00	5.40	8.50	11.30	17.30	3.50	18.90
Menoufia	16.60	3.60	13.80	4.20	12.30	4.30	10.20	1.70	8.20	1.40	10.60	4.10	10.20	3.90
Behira	8.80	19.70	9.00	1.00	8.40	18.60	25.20	28.70	8.10	15.50	5.40	25.30	5.10	26.10
Ismailia	4.70	8.30	3.80	10.00	9.00	10.20	7.20	10.10	9.60	19.70	6.80	13.60	4.10	12.30
Giza	8.50	0.20	10.30	0.90	8.90	1.00	7.00	0.60	6.30	0.40	7.20	0.50	6.40	0.50
Fayoum	13.60	-	15.10	-	14.70	0.10	15.60	-	16.20	0.03	17.40	0.07	16.00	0.03
Beni Suef	14.80	-	9.10	0.03	8.00	0.03	7.60	-	7.80	0.03	7.80	-	8.30	0.04
Menia	26.80	0.03	0.10	-	10.80	-	10.60	-	8.60	-	9.30	-	10.20	-
Asyout	19.00	-	14.60	-	13.90	0.02	13.50	-	15.20	0.04	13.90	-	10.30	-
Suhag	18.40	0.01	1560	-	13.60	0.03	14.00	-	15.10	0.10	14.80	0.01	11.90	0.03
Qena	32.50	0.01	19.40	0.03	19.20	0.08	17.80	-	18.70	0.30	22.50	0.02	22.20	0.04
Aswan	11.90	0.03	5.90	0.03	4.90	0.03	3.80	-	4.40	-	-	4.90	-	-
Total	12.20	7.50	13.20	2.10	11.20	7.50	10.50	7.00	10.10	6.40	10.40	6.80	8.50	7.30

Source: Ministry of Health, 1992

APPENDIX (6.4)

LAND CLASSIFICATIONS

Class A

This type of land is characterized by having high productivity, its soil deep and fertile, and which is suitable for all types of the country's crops. To conserve this type of land, what is needed is to follow the normal ways in conserving agricultural land.

Class B

This type of land is characterized by having moderate productivity, its soil is deep and fertile, and suitable for the most of the country's crops. Conserving this type of land requires some more attention such as improving the drainage system networks.

Class C

This type of land is classified by having a lower productivity; its soil is deep but not suitable for most of the country's crops. Therefore, conserving productivity of this type of land requires applying high rates of chemical and organic fertilizers and improving drainage system networks.

Class D

This type includes the soils with a weak productivity, which is normally lower than class C. Most of this land is salinized and its drainage system is very weak. It requires an increase in irrigated water and applications of high rates of chemical and organic fertilizers in order to wash up the salinity and to allow cultivation.

Class E

This type includes salinity and water-logging land, to conserve this type it needs to be reclaimed and cultivated by increasing the irrigated water as in class D. Conserving this type of land requires establishing drainage networks, selecting the type of crops that can survive in high salinity, and applying a very high rate of chemical and organic fertilizers.

Table 6. 33: Annual use of different types of fertiliser in Egypt, 1960 to 1991

Year	*Nitrogen*		*Phosphate*		*Potash*	
	Actual (1000 tons)	Index (1960-61=100)	Actual (1000 tons)	Index (1960-61=100)	Actual (1000 tons)	Index (1960-61=100)
1960-61	192	100	48	100	2.0	100
1965-66	314	164	43	90	0.7	35
1970-71	325	169	46	96	1.6	80
1975-76	428	223	66	138	2.8	140
1980-81	568	296	104	218	2.9	145
1981-82	626	326	134	279	3.6	180
1982-83	660	343	143	296	3.0	150
1983-84	746	389	160	333	5.5	275
1984-85	639	333	164	342	7.5	375
1985-86	775	404	183	382	7.6	380
1986-87	777	405	185	386	n.a	n.a
1987-88	791	412	190	396	n.a	n.a
1988-89	805	419	195	406	n.a	n.a
1989-90	833	433	196	408	n.a	n.a
1990-91	835	435	199	414	n.a	n.a

Source:

1. *Environmental Research Council (1986) "Erosion of irrigated arable land and its association with polluted factors", Academy of Scientific Research and Technology, Cairo, Egypt.*
2. *Arab Organization for Agricultural Development (1994), "Arab agriculture statistical yearbook", Khartoum, December.*

Table 6.34: Agriculture Land Classifications, 1985 -1990.

Productivity Class	*1985*		*1990*	
	Area (000s feddan)	*%*	*Area (000s feddan)*	*%*
Class A	3162	52.8	791	12.49
Class B	2107	35.2	2959	46.72
Class C	487	8.1	1828	28.86
Class D	181	3	549	8.66
Class E	56	0.9	207	3.27
Total	5993	100	6334	100

Source: *Research Institute of Agriculture Economics, Agriculture Research Centre, and Ministry of Agriculture (unpublished data).*

Figure 6.6: Annual average use of fertilisers per feddan in Egypt, 1960-91

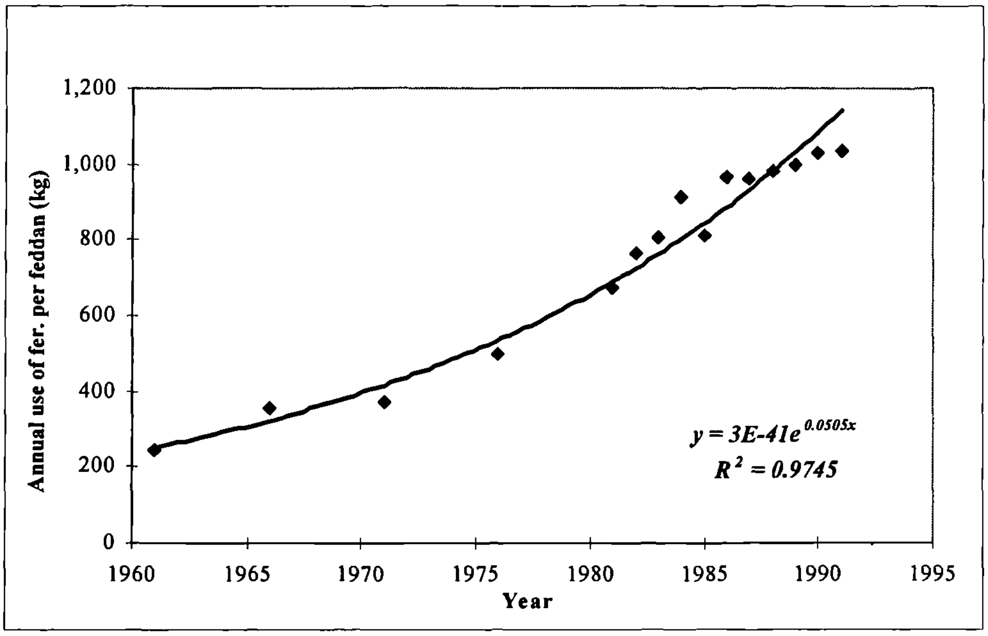
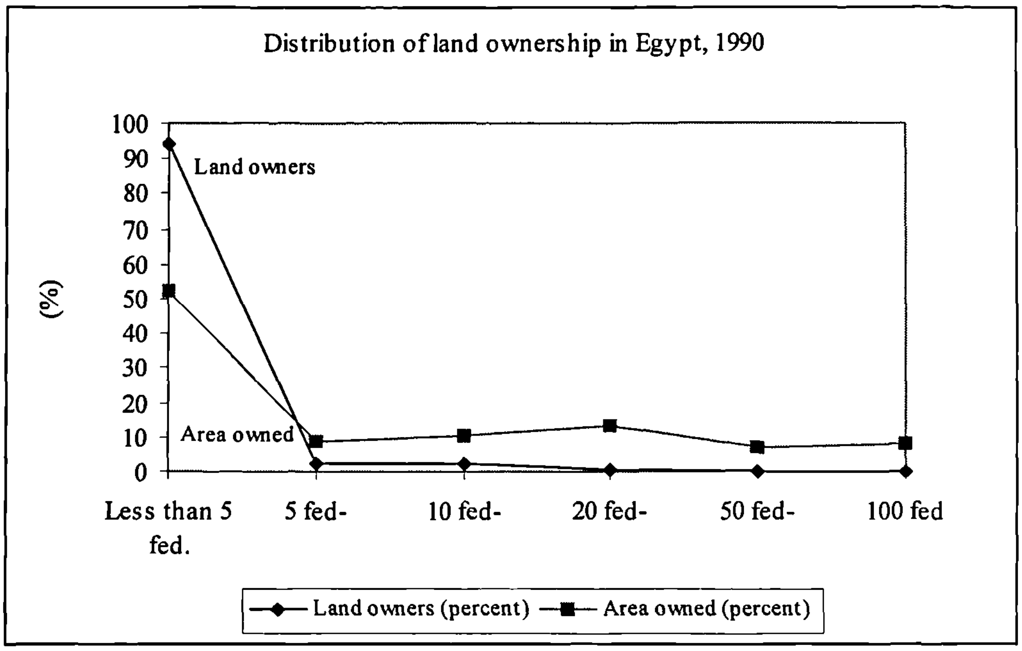


Figure 6.7: Distribution of land ownership in Egypt, 1990.



APPENDIX (6.5)

Table 6.35: Annual agricultural land losses due to urbanisation (urban and rural expansion) and construction, 1962-1990.

Year	*Feddan lost (Urban)*	*Feddan lost (Rural)*	*Feddan lost (Population)*	*Feddan lost (Buildings)*
1962	9,422	4,251	13,673	12,322
1963	9,659	4,328	13,988	12,805
1964	9,903	4,407	14,310	13,562
1965	10,152	4,487	14,640	15,068
1966	10,925	4,569	15,494	15,713
1967	11,022	4,908	15,930	17,928
1968	11,309	5,002	16,311	18,036
1969	11,603	5,098	16,701	18,204
1970	12,532	5,296	17,828	19,177
1971	12,858	5,397	18,255	19,703
1972	13,192	5,501	18,693	19,773
1973	13,535	5,607	19,142	20,268
1974	13,887	5,714	19,601	20,669
1975	14,248	5,824	20,072	18,660
1976	15,462	8,502	23,964	19,208
1977	15,887	8,736	24,623	19,703
1978	16,324	8,976	25,300	22,703
1979	17,234	9,476	26,710	23,366
1980	17,708	9,737	27,445	26,214
1981	18,195	10,005	28,200	25,621
1982	18,695	10,280	28,975	25,450
1983	19,209	10,563	29,772	29,955
1984	19,187	11,596	30,783	29,428
1985	19,160	11,199	30,359	30,536
1986	19,658	11,507	32,165	35,489
1987	22,169	11,824	33,993	36,620
1988	23,694	12,149	35,842	41,343
1989	24,232	13,483	37,715	43,320
1990	24,784	14,826	39,610	46,612

Table 6.36: Capital consumption allowance for land loss in 1990 (Average Approach) (in million)

Average Approach	*POP*		*BU*	
R	SP	LR	SP	LR
5%	809.914	776.356	942.495	922.918
8%	500.571	485.223	570.997	589.059
10%	400.245	388.178	471.247	456.797

Table 6.37: Capital consumption allowance for land loss in 1990 (Marginal Approach) (in million

Marginal approach	POP		BU	
R	SP	LR	SP	LR
5%	1079.424	1046.326	995.855	965.319
8%	674.640	653.954	622.410	603.325
10%	593.742	523.130	496.917	428.659

Figure 6.8: Arable and crop area per worker and per capita, 1960-1990.

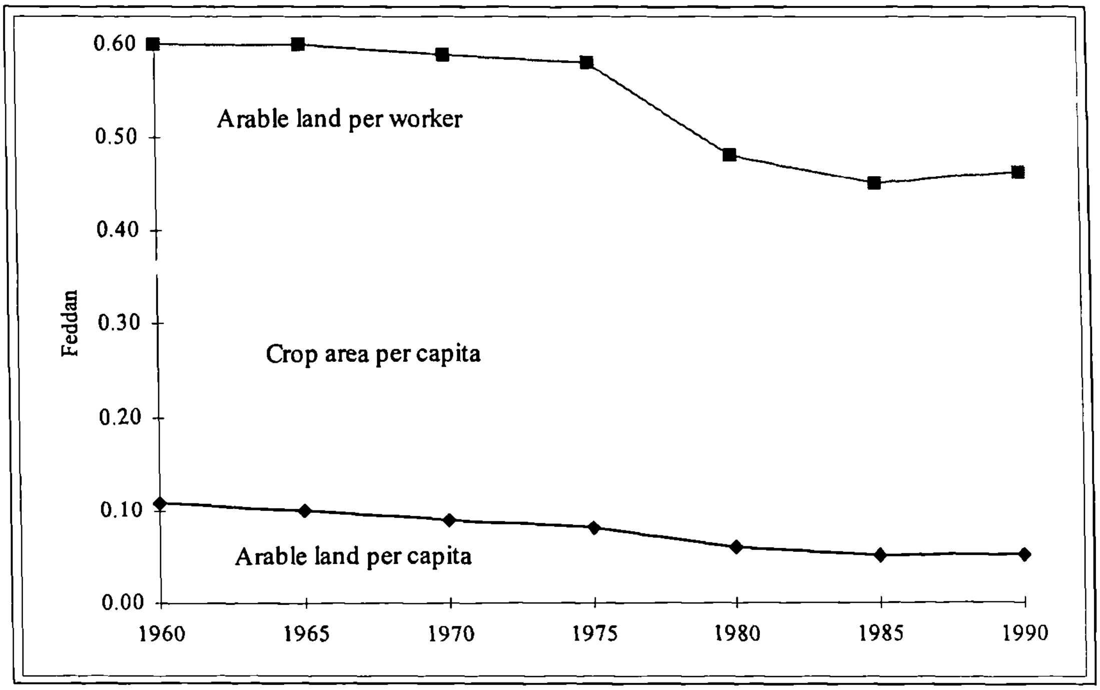


Figure 6.9: Capital Consumption Allowances for Agricultural Land in 1990 (Marginal Approach)

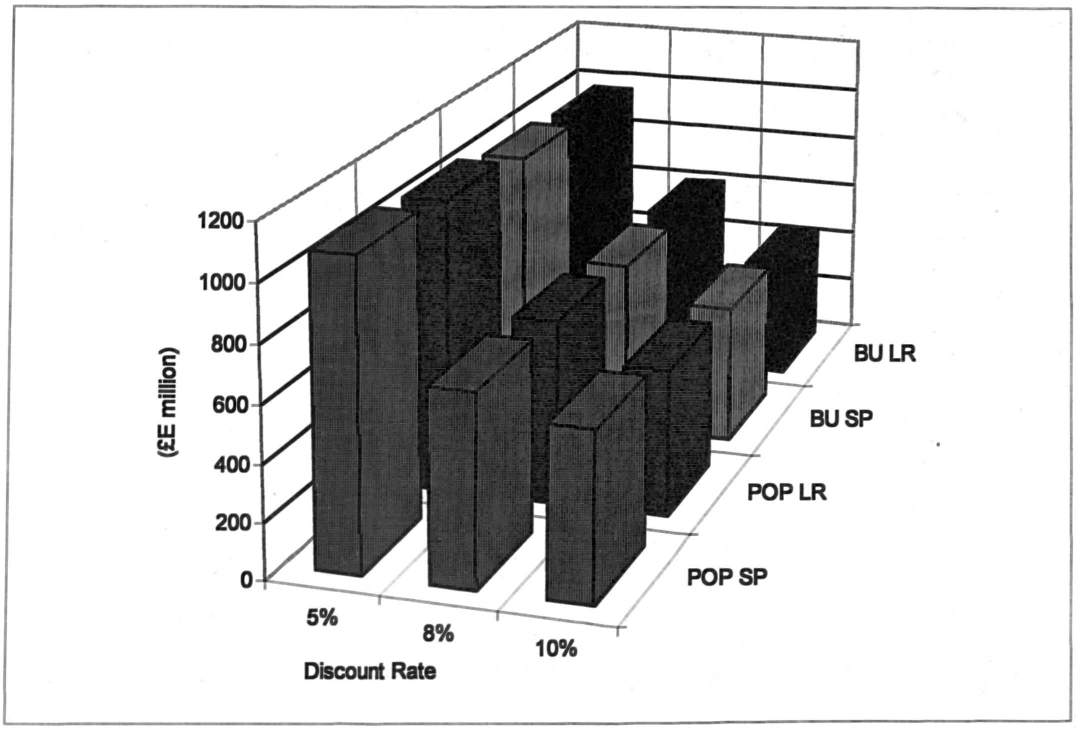
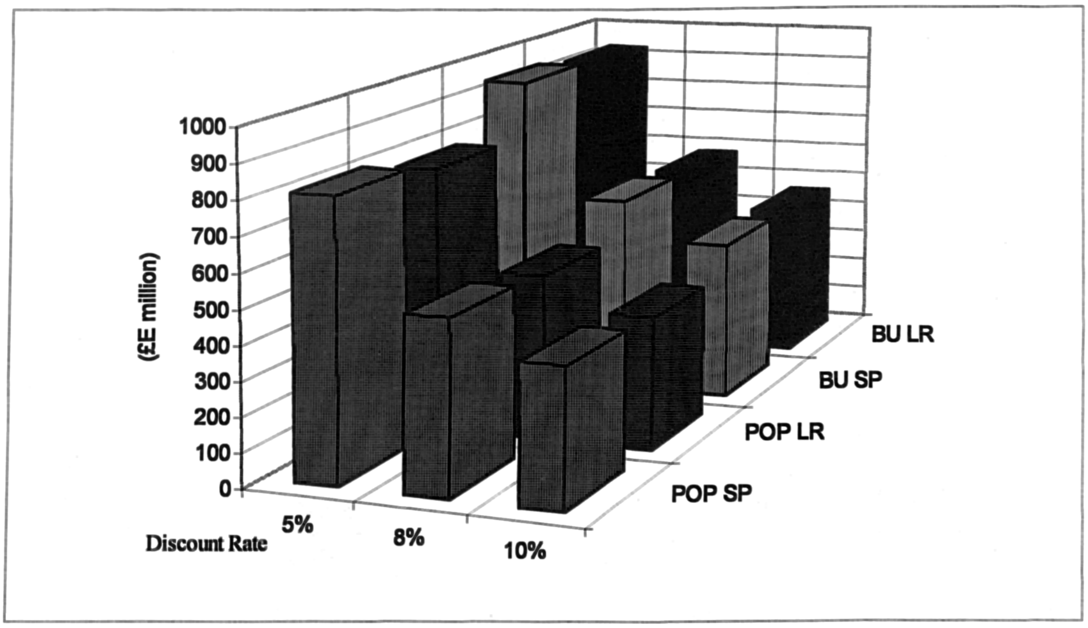


Figure 6.10: Capital Consumption Allowance for Agricultural Land in 1990 (Average Approach)



APPENDIX (6.6)

A NOTE ON THE ESTIMATION OF AIR AND WATER POLLUTION COST FROM 1980-1990

6.6.1 Air pollution for Egyptian Urban Regions:

6.6.1.1 Human Capital Cost

Based on calculating the cost of air pollution for G.Cairo in 1990, it is possible to estimate the cost of air pollution for the Rest of Urban Areas (RUA) for the same year first. This will be followed by estimating the total cost for Egypt for the 1981-1990 period, as follows:

- Estimating the average human health cost per capita (AHCP) for the population of G.Cairo.

$$\text{AHCP}_t = \frac{TC(Morb.+Morta.)_{G.C}}{POP_{G.C}} \qquad (6.6.1.1)$$

Where:

AHCP = average human health cost per capita in G. Cairo.

TC = total cost of morbidity and mortality

POP = number of population in G.Cairo

- Estimating the percentage of the average of human health cost per capita (PC_t) to that of average annual income per capita (AAIP) in G.Cairo (see Table 6.38 below).

$$\text{PC}_t = \frac{APC}{AAIP_{G.C}} \qquad (6.6.1.2)$$

Based on the data provided by the Environmental Monitoring Center regarding air pollution in urban areas, the levels of PM were close to or even higher than G.Cairo levels for the 1978-1990 period (see Figures 2.8 & 2.9, Chapter Two). This, therefore, allows us to assume that the human health costs are equal to the cost in G. Cairo. This also allows us to apply the PC of G.Cairo to other urban areas.

Table 6.38: Cost of human capital as a % of average annual income per capita in G.Cairo, (£E 1990)

Economic consequences of morbidity		
	Medical treatment costs	144,171,495
	Loss of earnings	24,421,841
Total cost of morbidity		168,593,336
The cost of mortality		1,857,647
Total cost of morbidity and mortality		170,450,983
Average cost per capita in G.Cairo		18.07
% of average human capital cost per capita of average annual income per capita		0.55

- Calculating the total human health cost of air pollution for Egypt (G.Cairo and other urban areas) in year t (TCE_t) using equation (6.6.1.3) below.

$$TCE_t = \{PC \ X \ AAIP \ X \ POP\}_{G.C} + \{PC \ X \ AAIP \ X \ POP\}_{RUA} \qquad (6.6.3)$$

6.6.1.2 Physical Capital Cost

From the same previous set of data, which is used above, the levels of SO_X and NO_x in urban areas were close to those in G.Cairo (see Figure 2.9 in Chapter Two). However, a conservative assumption is made, that is, the cost of cleaning houses in other urban areas is half the cost assumed for G.Cairo, which is 0.25% of the average annual income. The estimates for physical capital costs, for the 1981-1990 period, are presented in Table 6.39 below.

Table 6.39: Cost of physical capital damage, 1981-1990 (£E million 1990)

Year	*Total urban population* (1)	*Cairo population* (2)	*Other urban areas POP* (3) = 1-2	*Estimated number of houses* (4)=(3)/4.5	*Annual average income per capita* (5)	*Total cost (£E 000s)* (6)= (4) x (5) x 0.25%
1981	17124	7564.245	9559.755	2124.39	963.0	5114.469
1982	17569.22	7768.479	9800.745	2177.943	1193.9	6500.616
1983	18026.02	7972.013	10054.01	2234.225	1349.5	7537.715
1984	18494.7	8188.055	10306.65	2290.366	1466.0	8394.190
1985	18975.56	8427.147	10548.42	2344.092	1545.1	9054.643
1986	19468.93	8666.478	10802.45	2400.544	1854.1	11127.12
1987	19975.12	8919.539	11055.58	2456.796	2116.8	13001.36
1988	20494.47	9171.962	11322.51	2516.113	2379.5	14967.73
1989	21027.33	9433.363	11593.97	2576.437	2719.4	17515.91
1990	21574.04	9664.48	11909.56	2646.569	3260.2	21570.86

Note: the average family size for other urban areas, from CAPMS Annual Statistical Yearbook, is about 4.5 persons.

6.6.2 Water Pollution for Urban and Rural Areas.

To estimate the cost of water pollution for the 1981-1990 period the followings steps have been applied.

- Estimating the average human health cost per capita for urban and rural areas

$$\text{AHCP}_t = \frac{TC(Morb.+Morta.)_{UR/RU}}{POP_{UR/RU}} \qquad (6.6.2.1)$$

- Estimating the percentage of the average human health cost per capita (PC) $_{UR/RU}$ to that of average annual income per capita for urban and rural, respectively (see Table 6.40 below).

$$\text{PC}_t = \frac{AHPC_{UR/RU}}{AAIP_{UR/RU}} \qquad (6.6.2.2)$$

- Calculating the total human capital cost of water pollution for Egypt in year t (TCE_t) using equation (6.6.2.3) below.

$$\text{TCE}_t = \{PC \text{ X } AAIP \text{ X } POP\}_{UR/RU} + \{PC \text{ X } AAIP \text{ X } POP\}_{UR/RU} \qquad (6.6.2.3)$$

Table 6.40: Cost of water pollution as a % of the average annual income per capita for urban and rural areas, 1990

	Medical cost	*Wage losses (£E 000s)*	*Death cost*	*Total morb. and mort. costs*	*Population number (000s)*	*Average cost per capita (£E)*	*Average annual income*	*Cost as a % of aver. income per capita*
Urban	16,395	293,962	47,484	357,841	21,860	16.36966	3260.2	0.502106
Rural	95,487	723,758	80,270	899,515	31,829	28.26087	1,378.10	2.050713

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