THE METHODOLOGY OF ENVIRONMENT AND DEVELOPMENT MANAGEMENT

C.
SURIYAKUMARAN

CRDS
ESTD. 1987

CRDS SPECIAL PUBLICATION

* Formulates for the first time, a management Methodology, making 'Sustainable Development' both sensible and attainable.

* A highly practical product, it replaces partial or purely conceptual exercises.

* Much of what it contains may not as yet be in standard literature.

* An essential Guide to the Subject.

- For Academics, Students & Practitioners,
  a basis for Research, Study and further development of the theme,

- For Governments, International Bodies and Agencies, and Administrators,
  a basis for Policies, Decisions and Actions.

THE METHODOLOGY OF ENVIRONMENT AND DEVELOPMENT MANAGEMENT

Prof. C. Suriyakumaran

Sri Lanka
- 1993 -
(July)

The Centre for Regional Development Studies, is a Non-Governmental Organisation devoted to the promotion of studies and activities on Devolution, Development and Environment.

CRDS Special Issue : No. 1

THE CRDS SPECIAL PUBLICATIONS

The CRDS 'Special Publications', is a new initiative, and follows the now well established CRDS Monograph Series which present concise studies, in popular professional form on issues of devolution and development in all their aspects.

'The Special Publications' are more extensive, in-depth studies on subjects that have assumed specialized importance, for one reason or other, and need special attention, and focus.

These can be a gap area, for example, a methodology for environment and development; a special event, such as a Year 2000 perspective; or of regional/global scope, touching on support to and experiences in special fields.

Many of them would also serve as Text-books, Handbooks, or References.

•

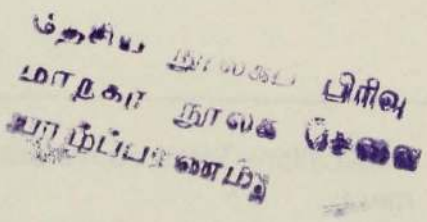
ISBN 955 - 95581 - 0 - 2

To

Our Generation

for

Future Generations



BY THE SAME AUTHOR

* *'Ceylon Beveridge and Bretton Woods' (Publ. Lake House Press, Colombo, 1946).*

* *' The Economics of Full Employment in Agricultural Countries' (Publ. KVG de Silva & Co., Colombo 1957).*

* *' The Environmental Dimensions in Development' (Co-Author. Publ. UN Asia-Pacific Devt. Institute, Bangkok, May 1979).*

* *'Environmental Assessment Statements' (Co-Author. Publ. UNEP Regional Office, Bangkok, March 1980).*

* *'Development Co-operation in Theory and Practice' (LSE, Restricted Publ. Dec. 1982).*

* *'Environmental Assessment of Development Projects' (Co-Author. Publ. UN Asia-Pacific Development Centre, Kuala Lumpur, 1983).*

* *'Management of Development and Social Change' (ICCDA 3rd Inter Regional Meeting, 1983, Publ. Amstm. 1984).*

* *' The Wealth of Poor Nations' (Spons. by LSE; Publ. Croom Helm and St. Martin's Press - London, Canberra, N. Y. 1984).*

* *'Nature of the Environmental Problem in South Asia' (The South Asia Journal, New Delhi, Lond., 1989).*

* *'Debts, Deficits and the Development of Developing Countries' (The South Asia Journal, New Delhi, London, December 1990).*

* *'Environmental Planning for Development' (The Autumn 1991 Lectures at the London School of Economics and Political Science. Publ. CRDS, Colombo, 1992).*

* *'The Earth Summit: Bench-Mark or Non-Event?' (Tata Energy Research Institute, New Delhi, Oct. 1992).*

N - Publications listed above are as on, or related to, environmental management.

Lectures, Articles, etc. not included.

CONTENTS

PREFACE

Writing this Preface, as I have done, upon the conclusion of this Volume, I feel even more struck by the importance of the Subject that it has treated, in the future concerns of environment and development, for professionals and practitioners, as much as for governments and our societies.

In a sense, its writing has represented a convergence, into a 'main-stream' thought as it were, of quite considerable strands of earlier thinking and effort, relating to the priority needs and purposes of Environment and Development for us as human beings. So far as this Book is concerned, these strands perhaps began from, and immediately after, the time of the Stockholm Conference in 1973. It is not the purpose of this Preface to record one's own advance in the work in this direction, indeed undertaken in collaboration with others as were there at the time, particularly during the writer's period in the United Nations Economic Commission for Asia, in UNEP, and the periodic visits during those times to various Universities in a number of countries. Some of these steps are referred to in the texts below in the course of dealing with substantive purposes.

A reason for mentioning the foregoing, however, is the important fact that, during these years, the subject of this book had never been frontally addressed - except by references to its need; by some excellent partial treatments as we shall see below (e.g. the excellent cases of Bartelmus & UNSO); and by our own attempts referred to - in order progressively, to enlarge thinking and formalise a comprehensive methodology, that would also be applicable at all required levels of environment and development management.

The book is thus also a confluence of various substantive contributions made at least by some collaborators over the years, in the various components of management, now set out and put together, in a common meeting ground of these flows.

Thus its content, as also its purpose, is not one of confrontation at one end, or exhortations, however well done, at the other; but of an unequivocal methodology, that is also applicable.

Since, therefore, it is a type of production which is being made for the first time with no equivalent work before hand, it must - while certainly affirming its readiness for immediate adoption and use - also be seen very much as a basis for further advance, refinement, study and collaboration amongst the concerned academic and professional communities.

Needless to say, much of what is here is not yet in so called 'standard' literature - almost synonymous with 'Western' - save through the reports of some excellent initiatives, such as of the UNSO mentioned earlier, of some countries like Norway and the Netherlands in the same area, or France on resources balance sheets. There is also, of course, professional literature of very high quality, particularly in the U.S., on what we should call 'sectarian' aspects of environment management; that is, in the use of fiscal and financial devices to control environmental pollution and related manifests. Yet, available work so far remains a mixture of bits from the four management components set out in Chapter III, and expanded subsequently.

We may refer to three particular areas of thinking which show both the shortfalls in the past conceptualisations and the needed future. Firstly, an honest look at much of the work so far on environment and development management would show, compared to the past era of 'economic dominance', an advance on the "Concepts" behind environment and development respectively; and more recently, on the "Definitions" relevant to the understanding of environment and development, and the roles and relations betwen them. Commendable attempts, still incipient, to give economic valuations to environment needs belong to this phase. But, they do not yet provide us with "Methodology". The absence of 'Methodology' therefore produced 'system deficiencies' especially, for example, in relegating 'technology', or what we later explain as the 'basket' principle in looking at a given commodity as a 'fixed' environmental resource.

Our second illustration, which in fact began from before the previous one, is what one might call the persistent 'Special Interests' on definitions, views and approaches to environment, depending on whether one was an ecologist, sociologist, natural scientist, nutritionist, geographer, chemical scientist, physical planner, engineer, economist, or others else. Thus there were ever increasing, often highly commendable, 'partial analyses' - also with confusion of their micro and macro contexts - of environment or development. While there are several examples of course, a particular illustration of the micro-macro confusion has been the near limitless use of EIAs as "the" tool of environmental management and the instrument of policy dictat for economic management (only recently somewhat checked by the excellent UNSO initiatives, in the area of expanded environment economic national accounts).

The third illustration we have is major, more serious, not even properly recognized so far by the developing countries, and certainly not by the developed countries. This, as this book elaborates later, is the fact that all environment-management policy making, so far has virtually been confined to the area of what I describe below as the 'Qualitative' management of the environment. The 'Quantitative' management of the environment, involving truly massive increases in the use of resources for development, contrary to the normal catechisms of reduced, constant, or at best slight increases in resource use levels, has not been a pre-occupation of either the academic communities, or our government 'leaderships'.

The phrase 'sustainable development' itself is now so universally used, that we begin to draw comforting conclusions that its very use is enough clarification of the subject and of us. The reason for the difficulty in going beyond is primarily the lack of a comprehensive Methodology of environment and development management. It is interesting that the concept of sustainable development itself has a long history, perhaps beginning with Adam Smith's distinction between gross revenue and 'neat' revenue; in Hicks' distinction between Capital and Income; through Marshal, to Keynes'

user cost concept. The concept of the 'Social basis' of Demand in economics that I argue in Chapter I, is itself example of potential 'inherency' of Sustainable Development in Economics. As a phrase, Sustainable Development was also used more recently by others (UN, GA; W.C.S.; etc.) well before Bruntland gave it 'coinage' as I said elsewhere.*

It is now necessary that all these concepts and concerns must be sought to be translated into a methodology of management. As we said on the occasion referred to above, "The environment as a topic is a 'top draw' now worldwide, the new Goddess, and our ticket to the new 'harmonising culture' that we want to claim for ourselves, for all the trespasses that we committed in the past. A goddess it seems, understood by some, not understood at all by many and, as for all goddesses more worshipped than followed. As for Development, we still continue to live in our own ways, with the 'Holy Grail' of 'steady state' growth, as elusive as ever."

It remains for me to thank the many personal collaborators down the years, who by participation and contribution in many ways contributed to this writing. Among them in particular I should recall Dr. D. V. Ramana, Development Economist of the U.N. Asian Institute for Economic Development and Planning (BKK & KL); Prof. R. Pitchai, Head, Dept. of Environmental Sciences, Anna University (MDS); Prof. R. Bharadwaj, University of Bombay; Dr. Dhira Phantumvanit, Thailand Development Research Institute; Mr. C. R. Inglis, Dept. of Environment, South Australia; and the late Dr. S. Ramanathan, former Director, Dept. of Environment, Govt. of India.

Thanks are due to the Director (Programmes) of CRDS, Ms. Princy Dharmaratne and to my personal Secretary Ms. Manjula Rudrakumar for their assistance in checking and arranging the list of References, and for other support and assistance. Special thanks are due to Mr. M. A. Amsar for patiently undertaking all dictation, transcription, re-typing

---

c. f. Author's Autumn '91 LSE Lectures on 'Environment Management for Development' (publ. '92).

'Sustained development' as a phrase was used by this writer as early as 1980. (See chapter VII).

and final setting of the manuscript through its various stages of completion ; and to Mr. S. Maheswaran, Manager (Operations) for patient proof - checking and chasing the Printers, themselves beyond reproach.

A different, though special type of thanks goes to Mr. Neil Fernando, former Secretary of Sri Lanka's Ministry of Environment, for reminding me that this Book must now be written!

Finally, one should mention that this Book is being launched as a "Special Publication" of the Centre for Regional Development Studies (CRDS, Sri Lanka), an Institution set up for the promotion of ideas and activities in development, governance, devolution, environment and management; a task in which the Organization has now come to occupy a unique position in the country; and has begun to attract attention from International sources for participation and collaboration. It was the Centre for Regional Development Studies' conviction that such a production had to be made, particularly from a developing country standpoint, that led to its being produced.

THE METHODOLOGY OF ENVIRONMENT AND DEVELOPMENT MANAGEMENT

I. The Environment-Development Background

Environment itself, as a subject, is still not comprehensively understood, whether by practising environmentalists or by other professionals. Despite their confidence to the contrary, it is not certain that Development too, as a term, is correctly understood, whether by development economists, or other specialists, including sociologists, environmentalists and political scientists. Much less, therefore, one must presume, may a phrase such as the Environment-Development Background, chosen as the title to this chapter, be considered to be adequately understood. As we shall see below, the whole attempt to do so, has been (a) of recent origin, and (b) still not what one might call, 'an available body of knowledge'. The numbers who have given attention to this seriously and cohesively are indeed still extremely few. Let us look at these concepts briefly.

Today, environmental concepts have edged grudgingly - grudgingly one must say - to more relevant relations with development. But in its origins, the environment content was quite different. It is very important to understand this because, it seems that factor still influences the present situation; as also influencing the attempts being made at solutions. For example, at all the stages leading to the World Conference on Environment and Development (UNCED), there were the same mental blocks in trying to find meeting grounds between environment and development.

The original concepts had two characteristics. There have been many descriptions given, but basically they boil down to two essential characteristics in their original contexts. One was, if one might use captions, as an 'esoteric', and the other as a 'specific' characteristic. The esoteric character was of environment as 'conservation' - and exotic of luxury, where even concepts of wildlife and the conservation of rare species were originally mooted by those who were well off, who

enjoyed the luxury of looking at these things from their perspectives and their points of view. The specific characteristic was the old view of environment as pollution out of development. We shall come to the other pollution, out of poverty, later on. But this was the pollution out of development. It was, of course, at the time, a total irrelevance to those who never had any development to talk of.

This indeed was the old concept of environment with which the environment movement was launched. It is, therefore, only much later, out of the clash with development lobbies and with the development imperatives, that the environment definitions became widened and then the environment think tanks, or enlightened groups within environmental circles led a new type of thinking. This came out with concepts like the resources of the environment are the resources of development; that the environment is the source of all resources as well as the sink of all wastes; and that pollution from poverty is sharply distinct from the pollution from affluence.

But a more interesting facet of the relationship or clash was that development too became accepted as essential. This was not something that was there before. Early on, the phrase 'eco-development' caught on. Nobody really defined properly what eco-development was, but everybody was satisfied to use this phrase because it avoided clashes between the two disciplines. A little later, the phrase 'development without destruction' emerged. Again there was no precise definition of what this development or destruction was meant to be. Finally, of course, with the Bruntland Commission, which set the whole thing rolling as of now, the phrase 'sustainable development' became 'coinage'. This, again, was never defined - least as methodology[1] - but the

1. Long before, from around the early seventies, some of us had already used the phrase, "use of all resources alongside sustained maintenance of future resource levels," and outlined the beginnings of a methodology, but were not placed to attract World attention. (see esp. UNEP/APDC, Environmental Assessment of Development Projects. BKK/KL. publ. 1983.) We shall be referring to this later, as well.

phrase was there. Thus, after the early beginnings, there was an approximation towards acceptance of development by the environmental thought systems, and an attempt to formulate phraseology, captions, titles, linkages which described how they had common ground.

Now the whole defect of this was that, while there was linkage, there was no methodology, the only 'methodology' being the Environmental Impact Assessment Tool which, as we shall explain later, suffered from serious defects.

The result was that there were some muddled concepts of the development concession, that is, the concession to development that environment made. One of these concepts was that development is elimination of poverty; that it is an anti-poverty programme, and not much more than that. At least, it was implied that it was not much more than that. There was a moral tag attached to the degradation of proverty, and the whole purpose of development was to eliminate poverty. So, there was very little thinking about going beyond the stage of poverty, into a higher stage of development. Again, we shall come to this later on.

There was another phrase which arose out of this concession to development, that development, equals 'better' but not necessarily 'bigger'; that is, not bigger output. This, of course, is a very fine idea, because it is nice to say this. One does not have to be bigger all the time in order to be better, whether for persons, or societies, or economies. So development was with some self-satisfaction, conceived as being better but not bigger. Nobody denies that development has to make things better. But to place both these as opposites and exclusive, as we shall see later, reflects an ignorance, of both these concepts. The catch was that there is, what may best be called, 'a low level equilibrium trap'. This indeed is the 'Achilles' heel of both the concept of 'sustainable development' that the Bruntland Commission had, and this concept that development should be 'better but not bigger'. It was presumed that "sustainable development" would be an utopian satisfactory development. But in reality, and we know,

from the days of Keynes, that as in economics, so in the environment-development relationship, one could have a perfect equilibrium situation in a 'low-level' equilibrium trap. That is, a lower income level than one need have for a sustainable eco-development situation, or an environmentally sustainable developmental equilibrium situation, could be advocated to the detriment of development potentials and benefits.

It was no surprise then, that when the environmental world decided to march 'forward', particularly with the United Nations World Conference, and figure a way out to have a programme for the Year 2000, it could call it only a United Nations Conference on Environment "and" Development, not on Environment "for" Development. In other words, there was an 'Environment programme for Conservation'; we have had this for twenty years from Stockholm. But there was no concept of an 'Environment programme for Development'.

So much for the environment. Where does the economic view of all this stand? The classical definition of economics, of course, was of 'unlimited ends and limited means'; really of resources also as unlimited, and technology and capital as limited; and that the function of economics was to maximise productivity of the scarce factors. This is nothing new. It is all known, namely that we try to increase scarce factor supplies.

But there were some doubts that naturally entered, at a certain stage in the environment-development process, when this theory of resources as unlimited was questioned, and we think quite rightly. When the doubts entered, and resources were seen as the limiting factor, the reaction itself yielded two different schools. One was what one might call the 'chemical/engineering school'; and the other, a school that tried to 're-define' development. The chemical-engineering school, basically, was that if resources run short in supply, science and technology could always find means of discovering new resources and alternatives, through synthetics, and so on. And therefore, there was no real limitation. Environmentalists thus took a static view and not a dynamic view of the limitation of resources.

The second view, of course, was to take a more sympathetic attitude and, as economists, to try to redefine development. This was to see how the re-definition of development affects or should affect presentation of economic planning as much as environmental planning.

The traditional obstacle that economics had was also - this is not new for those who are economists - that it was essentially 'micro'. It was, therefore, not only that 'environment', through its environment impact assessment tool (EIA) started as being micro. The classical view of the firm, as we know, was that in which ability to meet demand was determined by the capacity of the 'firm'. Supply was an externality with near infinite capacity, determined by the market and given prices, over which the indivdual firm had little control.

And, therefore, it is fair to say that in a milieu of economic 'constraint', when it came, it was the environmental 'constituency', for all its defects, that brought to the intellectual forums of the world, the factor of what is now called 'global resources'. The problem, therefore, was that the way the environmentalists formulated this very important complement to a system of thinking, created an obstacle to the economists, who naturally, 'reacted', rather than thought through the process. And this was unfortunate.

Here we may look at something which is very interesting. Significantly, those who are economists may not have even thought about this. As one knows, in the past, economics has always assumed demand to be subjective, and non-economic. While economics may analyse demand as a process, it assumes demand itself to be subjective and non-economic. And it had, historically, almost always reacted to such expressed externalities as alterations in demand, whether they were expressed through 'individual' demand (which was rare), or more likely as 'socially determined' demand, or thirdly, as 'legally inspired' conditions of demand.

For example, slavery was abolished, child labour was abolished, working hours were shortened, fair wages were introduced. We know what that means. It is that the supply

of labour was reduced immediately. And by strict economic logic, this is insane. All these were changes for which there was nothing in economics to say that they had to be made, or not made. All these were socially induced changes. One could even say that the whole phenomenon of capital intensive versus labour intensive approaches to developing societies, was an externally induced prescription, which then affected supply and demand, rather than inherent in economic analysis, and therefore, a conclusion from it.[2]

So supply was always based on this assumption, and collaterally one has people like Kindleberger, the American economist, talking of "public goods" and Amartya Sen, the Indian, talking of "public benefits," in discussing the situation in India. It was that public entitlements, and benefits are assumptions, and that the `commodity stream' in an economy should consider these things as `inherent'.

Now all this has nothing to do with economic analysis though it has with social effects. Here is a situation which has very close parallel to 'the environmental priority' on resource views 'as a global resource'. Thus, there should have been an opportunity for economics and environment, even at that stage when this arose, to 'meet' - that was about the late seventies or early eighties. But here again, it was the way that things were put across, and importantly, the lack of any Methodology, that created such a situation.

What is the real situation now? On the side of 'Environment', rather than a phrase such as of being 'a source and a sink', a more useful approach is to classify it under two "Truths". One is what may be called the "Resource Truth". Under the resource truth, there is no doubt of the environmental basis of all our living, whether from Mohenjodaro, or Mesopotamia, or now, or by the Year 2000 and beyond. One of the most telling illustrations of the Resource Truth is a little

---

2. C.f. "My Economics of Full Employment in Agricultural Countries" (KVG de Silva & Co., Colombo, 1957) & A. K. Sen's "Choice of Techniques", (Oxford, 1967), for a more 'economic' analysis of these, and for references to other writers of the day.

statement about the 'Plant', which a distinguished Indian scientist, once propounded on Environment Day in Delhi. "In this whole Universe" he said, "the Plant is the only organism that manufactures its own food. Every other organism either lives on plants, or on other organisms that live on plants". From this, flows the essential indispensability, and the fundamental importance of soil, water, air, and the related phenomena which we call the Environment. From these come all the strata of the environmental scenario - the rangelands (and forest), grasslands, croplands, lowlands, coastal areas, offshores and seas; or the oceans, deserts and global commons. So this is the heart, as inescapable as true, and it is time that we embrace it into our economic conceptualisations and thinking.

The 'Limits Truth' is best defined in a UNESCO description of some years, which still bears using. It is what are called the 'four Eco-system Principles'. The first is the 'ecosphere principle', where every element in the universe, or ecosystem, is inter-related to, and inter-acting with, the other. The second is the 're-cycling principle', where every component in the eco-system is 'cycling' and re-cycling constantly. The third is the principle of 'carrying capacity', where any ecosystem has a given carrying capacity, beyond which it will not be able to sustain itself. And the fourth is the principle of 'human inter-action', where human beings, perhaps more than any other, and for better or for worse, inter-act with the environment.

As for the development response on all this, to start with, there was a very clear recognition of the resource basis by all economists. It is simply that we cannot afford any longer to deny the very basis on which development depends. But equally clearly - and this is something that environmentalists have failed to observe - this is not the whole truth, especially put in that form. The reason is that development has, at the same time, through history, vastly 'expanded' the available resources, and in doing so, also, Welfare. It has achieved this by technology, discovery and invention, moving us from the stone age to the wheel, and to the discovery

of new raw materials and, importantly, in the Social spheres, to the provision of something which never could have existed otherwise, namely the welfare needs of the masses. These mean, mass needs in terms of education, health, housing, food and others. It is a process which only development has certainly engineered and made possible. If it is to be captioned, it has to be as having shown capacity to 'expand' resources, while still depending on the natural eco-system.

Now, this is also the means to the future, for example, in energy, through solar or hydrogen sources. For example, not long ago an Oxford University breakthrough was announced on fusion. It might really take fifty years for full economic use; so it is not a break-through yet. But the fact is, we would never have arrived at this stage if there had been no hard-nosed economic development, which provided the technology, the knowledge, the resources, the means and the education, to discover these potentials.

There is also a lesson for the developing countries, not very much conceded in the North. This is that 'development' is not a simple matter of an anti-poverty programme. There will be no breakthrough, otherwise, even on 'poverty; or on 'population', or environment. It is significant that a UK White Paper, as long ago as the early seventies, declared that development is the only means to meeting most, if not all, of the environmental concerns themselves. The Chinese had a nice phrase again, about the same period, that it is within the development process, and not outside of it, that solutions to the environmental problems have to be found.[3]

---

3. At the same time, readers must be reminded that the Chinese had taken one of the most enlightened world views on environment and development, when they emphasised recently that they do not see, or intend to see, every Chinese having a car, for that would be the end of the world; How many others have anything like this to show, amidst their 'profound' studies, statements, views and "movements"?

   In an Annex here, we reproduce a 'Scenario' of a 'city without cars; something that must command attention with cities around the world increasingly banning cars now and then, or as in Amsterdam, envisaging a future without them.

Yet, while saying these, let us also remember that development has produced 'careless' development. This is firstly, the profligate resources use by the rich countries. The poor countries again, unfortunately, in what is best called 'enclave' development, created poor imitations of development, in eye-sores of consumerist, mercantilist and commercial conurbations. We have cities round the world, in the poor countries, which are putrid - not out of poverty, but out of so-called 'development'.

Simultaneously, development has been guilty of non-use of opportunities. We shall come back to this later in connection with specific illustrations. We are madly producing more and more 'goods', but we are not using the opportunities for a proper view (or 'methodology') of resource uses. This is the reason why environmental concepts are, justifiably, still anti-developmental; and the economic concepts reactive.

What it means is that we have an interesting feature, namely that the environment-development conflict now is not so much one of definitions, but of 'dynamics'. It is not the concepts anymore. There is a concession, on both sides, of the development imperative and of the environmental necessity. It is on the 'process of application' of all this to reality. to mutual benefit, that there is a wall. This is really now the stage at which we are.

Let us take a few moments, therefore, to look at this 'dynamics', to round up our views as it were. Firstly, development creates a 'livable environment', but it also creates an unlivable environment. Yet, it is within the development process that answers to both have to be found. Outside it, is poverty, the worst offender of both development and environment. It is desolate and debilitating, and will obliterate, in the end, the Environment, as much with a whimper, as thoughtless Development will obliterate the World with a bang. Thirdly, as we saw, development is not merely the 'cause of resource use' or resource depletion, but also the 'means to resource sustenance'. Out of these, there are two things that

emerge as simply paramount. That is, put very simply, we have now jointly to 'think through' the development process; and secondly, an 'environmental programme', or resources management programme, 'for Development' itself is an absolute necessity. The more these things proceed in isolation, the more infructious, abortive and unproductive that everything that we do in our Societies is going to be. The great threat of 'global warming' and collapse of the eco-system is no idle threat. At the heart of it is, the necessity to undertake these two things.

The 'great impeding factor' lies in a strange paradox that has befuddled the environmental world up to now. It is a very simple thing, implicit in what we have discussed so far, but it has existed as a paradox. This is, that of the two types of environmental management essential to a true environmental programme only one, the 'Qualitative' management of the environment has been addressed by the Developed world. The other, which is the 'Quantitative' aspect of the environment, has received little recognition, and even less implementation. By quantitative, we mean not only the question of excessive resource use by the North, but the massive resource need by the South. In other words, for the South, environmental management requires not simply less resources, nor even the same level of them, but many times the resources they are using now. But we do not find this in the 'catechism' of environmental programming at the moment; and the economists, unfortunately, have been going around with 'slogans' and not with methodologies, which, like the environmentalists, they have still to find. The reason is, of course, that the environmental programme and its ideas started in the North; and now, it has been an imposition of them on the South, to the detriment of the South. Unfortunately, no matter, because the South is going to end up using more resources!

In the meantime, what we have had out of this past historical situation, and the neo-historical recent situations, is an 'asymmetrical' policy prescription, one for the North and another for the South. There was, what once a Spanish writer

called, 'the vertical invasion of the masses' in Europe, during the industrial revolution, when Europe used, not less resources, but far more resources. Also, the population increases accompanied, or followed, did not precede, as they have in the South. But now, the South is being furnished with advice which is the opposite, namely to use less resources, or to contain resource use, - the 'asymmetrical' policy prescription we talked of.

Herein, therefore, is the problematique that we have, of the 'intersection of environment and development'.[4] Too much resources for the North, and success in Qualitative management by the North, although there is a lot more to do; but a complete forfeiture of the Quantitative side of the management. For the South, too little resources, with also failure on Qualitative management and soon, whether we like it or not, an enormous increase in resources, due by the Year 2000, without the means, the wherewithal and the intellectual preparation, for a fusion of environment and economic management in terms that we have seen here to be so vital.

---

4. A phrase introduced and developed in the early Eighties by Philippe de Seynes, former Under Secretary-General for Economic and Social Affairs of the United Nations. As he says, "ecology became a concept of such philosophical breadth that as soon as it gained the right of city in the political arena, it expanded into a comprehensive, though vague and not very coherent, system of values pertaining to the most important aspects of Society.

II. The Policy Framework

We saw in the opening chapter, that there was a distinct demarcation between developing country priorities and those of developed countries, in the environment-development relationships. Considering the rather disjointed presentations often made available to developing countries, whether as policy advice, or other offerings, a clear idea of the Policy framework that would be relevant to developing countries per se, for sound environmental management in development, becomes essential. In this chapter, therefore, we set out an important presentation of concepts, definitions and content, that must guide our policy designs for Environmental Management. For purposes of coverage and emphasis, this framework is set out in two components, with a prologue on the over-arching ideas, proceeding thereafter to a concise presentation of the concepts and contents.

The subject of the prologue itself is extensive, and the descriptions do not seek to go into all of its aspects. Rather, we take a look here at the foundational concepts that serve as the major physical bases for organised management. These are of Resources, Population, and what may be 'Limits to growth'. Although separately classified, they are of course, inter-related; and the descriptions here reflect that.[1]

Limits

Let us begin with the third, that is, the limits to growth. We shall not be discussing the first component, namely Resources, separately, in the same way as we shall touch on population, since the former is integral to the entire discussion, and therefore figures accordingly.

---

1. This chapter, and much of chapters 4 & 5 have drawn freely on the author's previous writings, in particular, The Wealth of Poor Nations. (LSE, Croom Helm, St. Martin's Press, Lond., Canberra, N.Y. 1984); and the Economics of Environmental Planning (E. W. C. Lecture, publ. E.W.C. 1979).

Regarding the last component, we could talk of two 'Limits' which have to be managed. One of them is the 'Outer' limits to growth, and the one more often talked about. The other is the 'Inner' limits to growth, and this we shall also deal with. In both these, of course, it is important to note that human beings are as much the determiners, as receivers of resources and endowments. Both limits rely on and relate to resources, environment and development. The resources of the environment are the supply side of any economic development planning process. Thus, they constitute the first obvious linkage between resources and development. Development cannot afford to destroy the very resource base on which it depends. Unfortunately, it seems it is doing precisely this in many ways today and threatens to do so even more in the coming years. At the same time, as we stated before, development is in fact the key to solving many of the environmental and resource management problems themselves. Thus, here we have the very simple and practical nexus between environmental or resource management and development management. The resources of the environment can be restored, maintained, enhanced. In the words of a very remarkable observation, 'development means, the creation of a livable environment'. [2] Thus, environment management is the sustenance of this development, from 'conservation of resources' to 'conservation of development'.

Without being long or tedious, one might settle for the concept of 'Inner' limits as referring to a set of bottom line human needs, the absence of which would make nonsense of any social or economic organization; and which are, in fact, an essential foundation for growth itself. These mainly pertain to satisfying the basic needs of consumption of food, clothing, shelter, and a set of minimum conditions of living that may provide for meaningful social and cultural lives even at that level of subsistence incomes. This is no idle identification, since as of now, proverty is the prime malaise in many

2. The King of Thailand in discussion with the Executive Director of UNEP, and this writer in the late Seventies.

countries of the earth. Also, from the point of view of managing resources, grinding proverty is a major cause of the enormous degradation of natural resources which we have seen and continue to see around us. In any 'catechism on environment' if one had it, the first pollution would be the huge resources irrationally exhausted, depleted, destroyed, unused, in the production process in all countries. Only the second pollution is the effluent - solid, liquid, or gas - which we allow to affect our surroundings, but even here are still too slow to treat as a 'resource' to be converted, rather than a pollution to be abated.

The 'Outer' limits to growth refer to the opposite end of the spectrum, namely, the limits created, one way or another, to the supply of resources, by their over-use or mis-use or both. It could have two premises in thinking. One is as an aggregate total exhaustion of resources worldwide, by an over-consumptive humanity. The other could, in a situation of global availability, be as localised over-use or mis-use. In history, the collapse of Babylon and Mesopotamia, for example, has been attributed to the failure to manage this second outer limit, specifically the carrying capacity of the soil resources of those lands. There are innumerable modern examples around us which, however, with better awareness, technology and determination are being handled in many cases with vigour and expectations of sounder management. One country in the Asian region has been losing arable soil at the rate of 20 hectares a day. In another, the washaways down its slopes have been so intense that soil has been called 'its largest export'. A leading scientist had predicted the exhaustion of all arable soil in one large country in the region by the year 2000 - fortunately for the country, due to be proved wrong!

There is, indeed, a time-frame in such questions of 'Order' limits. Since, as has been said, in the long run we are all dead, there is a great tendency to discount the future, a characteristic that has been in the armoury of economic analysis, but seems to be quite the opposite of what may be needed in sustained resource management.

But the most important distinctions between the Third World and the Developed World on resources limits are even more fundamental. Put briefly, for the developed world, their future horizons lie in new frontiers of space, the moon, and ocean depths. There, the concerns or limits lie in the ozone layer, the green-house effect from combustion of vast fossil fuels in the new energy configuration, and effluent management from the vast production capacities that will be created.

The Third World concern on 'Outer' limits is simply the great need for known resources, which, for the present at least, mean almost certainly the conventional sources and means of access to them. Their non-availability or limitations in their availability, for one reason or another, as is already the case on occasions, will be their outer limit to growth.

Thus, we have perhaps two sets of goals and two sets of management approaches for outer limits and growth, rather than one global approach. On the one side, are the very well endowed rich societies, whose capacity has enabled natural resources to be already consolidated, where the concern is with new high-technology frontiers and with handling scales and types of effluent that might threaten our very life systems, let alone development. On the other side, we have countries which have two phenomena at the same time, (a) a massive degradation or deterioration of various natural resources due to poverty conditions; and (b) a massive need for a wide range of the right natural and human resources of development.

For the purposes of our consideration here, we have to leave questions, quite relevant for all of us globally, of the ozone, world climatic conditions and so on. For developing country situations, we would rather need to address ourselves to one of two precise questions, namely, (1) The scale and nature or resource needs; (2) What may be the major natural or human resource limits to developing countries for their growth; and (3) How these resource needs may be met without transgressing their outer limits and affecting permanently their future availability.

Undoubtedly of great interest and value, these do not yet give us solutions, particularly guidelines for practical actions which may form something like a Plan and Programme Frame for countries. In talking on these limits we could, it seems, look at three types, namely (a) Natural resource limits; (b) Human resource limits; and (c) Management limits.

It would seem that realizing the potential of one could not be successfully achieved without the other, and one of the most important conclusions we may see is the utmost priority for inter-linkages and need for developing an integrated framework of action. However, let us look at these three a little in their contexts since their understanding is essential for their integration.

Natural and human resources, though separately mentioned, are in fact part of resources as a whole. An alternative classification of these would be as physical resources and socio-economic resources. They are both needed together. Without adequate knowledge of the former, the latter is empty; and without the latter, the former is blind.

The natural resource base was already described earlier as dealing with, (a) the 'eco-sphere' structure, (b) the 'recycling' principle, (c) the concept of 'carrying capacity', and (d) the element of 'human interaction'.

The socio-economic resources rely on the sum total of this knowledge of natural resources, which therefore precedes any social management for growth. It becomes the basis in environment development planning. In this role, it must become the means for determining what one shall see later[3] as the 'effective supply' of resources, as against market determined, 'physical' or exploitative supply, which may exceed the limitations of rational use. These planning actions

---

3. At Chapter 4.

constitute the core of outer limits management in the socio-economic professionalism, the only basis for yielding a meaningful and socially acceptable "translation of biospheric environmental knowledge into effective resource use patterns and sound developmental actions".

Any such resource management, extending resource use capacity to highest sustainable limits, obviously involves, at the least, full deployment of a renewable, re-usable and residues conversion strategy, as opposed to waste treatment and disposal methods; and with this, a powerful drive towards use, adaptation, development of all feasible technology to the purpose of such a resource conversion philosophy. It is a policy that is needed as much for arresting and reversing the constricting limits imposed by the past resource degradations through poverty, as for breakthroughs in meeting rising needs for development resources as a whole. Thus, it is a 'Sin' to over-use resources, or to use wrong resources; but also a 'Sin' to fail to use the right resources. We know already that a universe of renewable resources and residues have capacity to yield large and economic supplies to national economies - of food, fodder, fuel, fertilisers, and industrial and infrastructural materials of various types.

The advanced countries have additional leverage, which they would use, sometimes even leading them to discount the 'residues conversion' approach we have talked of. It has not been uncommon to find a view of virtually 'no limits', based on faith, as we saw, in the power of chemical science and engineering, always to find a way, an alternative, to a depleting resource. It is an important world issue that has to be seriously analysed and verified in coming years. The issue, in a sense, is one of 'ecology vs. chemistry'. one would think that it should be both, not either, if the horizons for sustained resource use are to be pushed to their widest outer limits.

This brings us to an oft-treated aspect of human resources, namely that of Population - the so-called second foundational concept we referred to at the outset - and its implications on managing the outer limits. We do not intend

to go back to Malthus. But it does not mean that we have a balanced view at all today of this question. Population growth in the Third World has been taken up as if it were a single agent of destructive resource use. The multiple interrelations between population, resources,environment and development are much more complex than that. It is quite legitimate that population be a centre-piece in any concern of outer limits management; but it is more than counting numbers, or of the developing countries alone.

People are the beginning and the end of most of our intellectual and other pre-occupations; their cause and their purpose. The problem caused by this has been with us for a long time. In some ways, it looks simple and has been even interpreted in simplistic terms, as a question of numbers: that the population question is one of the expanding numbers of people - men and women and children in this globe - whose growth has to be contained. But it is as complex, if we might say, as it is simple. Just as an example, if there were no problem of income differentials in a population structure, then there is no population problem. The best way of looking at the question itself seems to be in terms of two time scenarios, the perspectives for the nineties and thereabouts, being the first.

The second is the 21st Century scenario, in which a very simple implication is that the world cannot take an exponential growth rate. This is simply a game of space and numbers. There has been one computation some years ago, to say that if the population grew at the rate posited at that time in many countries, by the year 2500 there would be only standing space in the world. One would not want to labour with examples like this, where it is of course easy to see the implications of such progress. One could well state one thing very clearly, namely that this sort of situation would never occur for the simple reason that people will just exterminate themselves even before it reached this point. Yet, the spectre of this type of exponential growth is there and this is the biggest factor in the so-called 21st Century perspective.

Therefore, right from now - and this is the first component in population strategy - every policy, every acceptable means, every break that can be applied in terms of containing the unrestrained growth of population, must be so applied. There is no doubt that at some time the world must realise a 'standstill' growth rate as we have it in some developed countries. Otherwise, we may simply reproduce ourselves out of existence.

But in the application of this type of family planning and policies, we need also to be a little cautious and be sure we look at the total picture. Are we right in assuming that straightforward, mechanical, demographic and family planning policies are the totality of tools and instruments for meeting the population problem? We could answer this for the time being in the form of a question: Is that how countries which are presently having stable populations achieved this stable rate and solved their population problems? This is a historical question with evidence right here today. Let us take this up with the second scenario, of the shorter term, that we mentioned.

As far as this Century's[4] problem was concerned, one could not slot it into the type of solutions that are relevant for the 21st Century. There are at least two types of factors relevant to this. One is what we called the historical question. Is there, or is there not, a lesson to be drawn from historical experience of those countries which are today having stable population growth rates or stationary rates, but which had a high growth rate in the past, say, a hundred years, fifty years, or twenty-five years ago? If they did not achieve this by what are called today family planning approaches, how did they achieve this?

•

The second factor is that there is an existing vast population in any case, with a compulsive need to meet the basic needs, and more, of this population. It is nothing more,

---

4. For convenience, shall we say up to 10 years or so, of the next Century.

or nothing less, than the challenge of providing the resources and providing the means to development for this vast population. So, as opposed to the '21st Century', we have a counterpoise and a different type of priority for the '20th Century' - viewing, of course, the latter as going into some years thereafter as well.

As we know, world population will, we are told, by the year 2000 be 6 billion. The population of Asia is expected to be 3.5 billion by the year 2000. That is the broad canvas. Within this, we have been told that the developing countries are generally considered to be over-populated. In fact, this is considered the problem. Now if what we have been saying earlier about the immediate scenario is true, then the fact of developing countries being given a blanket classification as being over-populated, it seems, needs a little closer look. There seems to be something more than the figures behind the over -population definitions and concepts. For example, if we talk of density per square kilometre, say in 1977, we could take a few country cases. This density in Belgium was 325, West Germany 247, Netherlands 339, and, one more on this side of the world, in Japan 306. There are more cases. Against these, the population density per square kilometre in India was 190, Malaysia 38, Nepal 93, Pakistan 94, Philippines 150, Sri Lanka 213 and Thailand 86.

The question we may ask is 'How is it that a high figure in one case is classified as over-population and in another case as not over-population? Or, conversely: How is it that a low figure in one case is not considered as under-population and in another case it is considered so? What we are thrown back on is a very important fact. As a picture of the population dimension, for the future as for social and political stability, there is something wrong with these figures or something wrong with the interpretation of these figures. The statistics are sound; so there is something wrong with the interpretation. It is obvious, therefore, that the analytical problem is not simply population, but population plus resources.

As we recalled earlier, during the Industrial Revolution in Europe, the population in Europe shot up, if we may talk in round figures, from 100 to 300 million. What happened at that time were two things. Firstly, alongside the enormous increase in the population, there was an increase in the harnessing and in the use of resources. This was fundamental. Secondly, when the stage of development had reached what is today called 'the take off stage' and the 'high mass consumption stage' there was automatically a levelling off; ending finally after the last World War, in a standstill demographic growth picture.

This was the situation and the historical experience that we had. The same historical experience stands repeated in the case of Japan, although one country cannot be compared exactly with another. Thus, if there is an over-population problem in most of Asia, it is also because of a resource problem. It is not an over-population problem per se. It is also because resources have not been sufficient. Such a poverty problem has an interesting analytical meaning, because it means that, while we are pursuing family planning policies, demographic analyses and actions, we should, equally, push for the development and the use of more resources. It has another potential value in that if we do this and raise the per capita incomes of the peoples from poverty lines, the chances are that this as much as mechanical family planning policies, perhaps more in some cases, would help to level off and to reduce the rate of growth in the population. In these situations, the 'Outer' limits are not human congestion, but resource privation.

If, for developing countries, the core issue in resource management for maximum growth is resource availability, then past socio-economic conditions under which resources were exploited need serious re-consideration. First, the poverty situation itself has to be reversed sharply and urgently - even in order to arrest the vast degradation, depletion and loss of vital developmental resources. Secondly, it means utilising at least twice, perhaps three or five times more resources than the populations of the Third World are

utilising today. The management challenge is not to conserve resources - as must be relevant to the developed world - but to use more resources and to find out how to tap these resources without affecting outer limits and future availability. As of now, the big resource users are not in the Third World, but in the developed contries. With anything between 20 to 40 times the consumption per capita of resources by an individual in the developed world, compared to that in the developing world, one way of looking at the resource, population and limits relationship is to consider that the population of Europe, if say 400 million in round figures, is at least 8,000 million in resource use terms, if not more. Beside such a figure, a population of 800 or 1,000 million in India or China, pales into relative insignificance and falls into a much better perspective. Given the historical rate of use of world resources so far, the past centuries of exploitation of natural resources, and the lack of any signs of alternative lifestyles in the developed countries, the Third World has to plan out vigorously against possible limits to resource availabilities in pursuit of undisputed growth imperatives. As we emphasised, and we need to repeat, Third World resources have been vastly degraded in poverty conditions and now they are vastly needed in enormous quantities for development.

Management

It is necessary to understand therefore, that resources are not to be obtained simply by market means. The first challenge in outer limits management for growth, therefore, is to introduce into resources planning the three dimensions which we mentioned in passing before, but which we shall discuss briefly now. These are resource 'restoration', resource 'maintenance', and resource 'enlargement'.

Whether under poverty or development conditions, unattended exploitation of resources creates deterioration, depletion, even exhaustion. Many of these can be restored, sometimes to serve their original purpose, often for alternative new economic purposes, also enhancing economic development. Mine-tailings rehabilitation into pasture or agrarian

use, reforestation including social and village forestry, are two examples of types of 'resource restoration' against past depletion or exhaustion.

'Resource maintenance' is the use of all practicable methods in maintaining economic resources while utilising them to their optimum. In one sense, these are not new, even very old. For example, sound soil and forest management programmes, even excelling existing standards in some countries, have prevailed for centuries past. These, plus a whole range of practices, combining chemical and biological devices - in agriculture, animal husbandry, fisheries, industry, health and human settlements - are key components that must figure in any programme of an integrated management of outer limits for growth.

'Resource enlargement' may be the least defined, though unconsciously practised. It refers to the use of renewable and re-usable resources, and residues and wastes, as economic product. Under this management approach, as we noted, 'wastes do not remain an effluent to be treated, but a resource to be converted'.

The energy crisis has induced a range of initiatives, involving the application of science and technology to renewable and re-usable resources and to use of wastes in conversion. These are nothing else if not the needed management approach in inter-linking outer limits and growth. It is a process in which the outer limits horizons, by sound management, are made to recede, permitting a growth process which could otherwise not have taken place. So far, this approach has had to await the energy crisis in order to emerge in any substantial scale. It is almost certainly inevitable that the same crisis would overtake us in coming years in other areas, during the nineties and certainly past the year 2000. It is unfortunate that the present climate of thinking and strategies is such, that countries appear to be waiting for the next crisis, before such a management approach gets adopted. One should hope that a major social goal among countries should be to reverse this current standstill in development management among people's thinking.

The world's resources, in one way, are simple to classify. Beginning with the sun, they are the air, soil and water as 'basic resource foundations'. From them flow 'the other resources', forests, grasslands, croplands, minerals, fisheries; and, as 'the big complementary resource', as well as end purpose, the human resource. All of them are in a 'habitat'. 'As much as natural resources require a habitat, the human resource requires a habitat', both of them tending, in developing countries, to be in deteriorating condition, due either to poverty or to commercial exploitation for a world economy.

All the resource areas we have mentioned hold opportunity for creative enlargement of their limits of supply. Since, in energy, the profile has at last come to the force, bringing out the multi-sectoral nature of such development, we may profitably illustrate from this sector. Historically, developing countries have been at the receiving end of technology, inevitably high cost and not necessarily appropriate. Here at least, in energy, seems to be a case which offers immediate scope for developing countries' initiatives, if not leadership; and from being 'participants in the products of technology', to becoming 'partners in the process of technology'. That there is need for further research in many of the areas has not been in doubt. Past history left these sources of this energy untouched since they were costly. When now the costs of energy have changed rapidly, it should not be taken as a matter of surprise that the technology on renewable energy resources has lagged behind. The present situation therefore is not only a natural one, but with every promise of future breakthrough, in costs and in technology, in the use of these resources. A conversion of the major agro-industries (agri-crops) in an ecosystem area such as South and Southeast Asia, to use of their own residues under a 'coupled process' for energy, could account for an impressive contribution to total energy supply in any overall strategy of the future, harmonising both economic need and environmental concern. Contrary to a 'normal law of economic growth, of a direct co-efficient relationship between increased production and increased call on energy sources', the above carries a directly 'opposite law, wherein every act of increased produc-

tion simultaneously creates an increased source of energy supply'.

Also, while on this, when the area of land under forest is computed for fuel purposes, is it only this? Or shall we not include in this, firstly, the potential to plant trees within rural areas (village or social forestry) and, secondly, shall we not increase the computation to include the potential to convert wastes into fuel? For instance, the entire palm oil industry of Malaysia is fired on its own wastes. Or, there was the threshold example from the Philippines of a factory processing 2,200 coconuts per hour into oil and related produce, generating enough waste to produce 1,500 kilowatts of energy.

Integration

There seem to be five convenient classifications in managing outer limits for growth particularly in any integrative approach. These may be set out as follows:

(a) One is the management of materials, i.e. of natural resources, renewable and non-renewable, as a 'stock' and as a flow of resources.

(b) The other is 'infrastructures' management, namely, that of human settlements and human habitat in all its forms, urban and rural.

(c) A third is management of the social-cultural 'habitat' which, as societies have demonstrated, forms an essential ingredient in social cohesion whether in resource management or in economic management. A sound socio-cultural environment, apart from being the rationale for all growth management, would help to face and overcome outer limits problems such as must arise, in which determination, foresight and decisions as a national group are required.

(d) Fourthly, there is the management of 'the international commons' and the formulation of regimen which indeed

are of overwhelming importance. We do not propose to take time on them here. We would, however, need to hope for sensible evolution of world consensus and take note of an evolving global conscience in ideas such as shared national resources, law of the sea, climate management, and others.

(e) Finally, the need for a sensible 'development planning' system, by which investment resources are allocated between capital investment, maintenance and development of natural resources, human resource development, and development of institutions. For instance, basing oneself on an exercise undertaken sometime ago, such a planning approach to relating outer limits management for growth, would involve at least the following three action points:

- A much more universal and creative system of 'land use Planning', existing now only in a few countries of the Asian region;

- A much more widespread preparation of 'blueprints' on 'land use Practices' in each country, essential both to optimal use of the land for production and for maintaining the land resources on a sustained basis into the future; and

- The development of 'Resource Balance Sheets', or 'accounts', for major physical resources, as a basis for perspective and macro planning; a system 'essential to the integration of environment in economic planning' (the approximation of 'effective' and 'physical' supplies we referred to before)[5]. In a crude from, its essentials have been seen in one or two countries so far. Such balance sheets provide the basis for key planning and programming decisions to sustain resources into the fu-

---

5. The subject of Chapter 4.

ture; to identify the proper mix of various uses of resources; and to increase, by emphasis on renewable resources, the supply of resources in several areas and instances within these areas.

Each of the five categories listed above, contributing to the management of outer limits as far as developing countries' growth is concerned, could be treated at much length. Obviously, we cannot hope to do them this justice here. One could, however, list certain key programme components, whether for research, education, or practice, as part of the development perspectives for the future in the light of the preceding prescriptions.

(1) For developing countries, before we come to real outer limits, there is an 'inner parameter of outer limits', created by the vast natural resources degradations and exhaustion from poverty. The first step, therefore, is providing the minimum economic needs, thus arresting, as we said earlier, this particular phenomenon of resource limits for these countries.

(2) The second is an undiluted programme of creating by conventional and new means, and using, several times the volume of resources now being utilised by the poor countries.

(3) Given the second, a concurrent programme component would be needed to handle the conventional pollution management problems out of increased resource use.

(4) It seems of paramount concern to develop the strongest policies to strengthen the natural resources habitat in the countries - the mountains and watersheds, pastures and croplands, coastal areas and mangroves, and the seas - and through them, the means by which the essential fauna and flora and, what the 'Bariloche authors' called,[6] 'the

---

6. Named after the Latin American World Model done in the seventies by a group of Latin American authors, and known as the Bariloche Mode.

physical environment upon which all forms of life depend', may be continued.

A component in this management of natural habitat is genetic resource conservation, misconstrued sometimes as a luxury since it was not understood popularly. As we know of course, the natural habitat is the only means by which the basis for renewable genetic vitality in the very limited crops on which humanity depends can be ensured. Instances have already occurred of crop extermination from the earth, saved not by humanly organised seed banks, but by recourse to 'the wild plant relations' of the affected crop in the natural habitats that happened to provide the basis for these genetic resource pools. In the long haul and in the wisdom of human preservation, one must think that perhaps this programme component is at all times a top concern.

(5) We talked about resource management in terms of restoration, maintenance and enhancement. All these involve technical knowledge and processes which have still to be further developed and applied. Thus a major constituent of future management must be a universal programme in the development and application of Technology to renewable and re-usable resources and residues. Perhaps, it may be sobering to recall that if the Third World were to apply energy to its food alone at the same level as the U.S. the entire oil supplies of the world would exhaust in 12 years. But at the other end, of relying on cattle power, one estimate for India implied doubling the then stock of 50 million cattle and a fodder equivalent of land that could feed 200 million people, if food production were to double. In agriculture, in industry and in commerce, economies are indulging in an enormous underutilisation of natural and human resources, by lack of a multiple and full use of resources in the production process and by a total absence of a positive approach to residues utilisation.

(6) The human habitat requires, as topmost priority, advanced management preparations to handle one of the most neglected areas, namely, the neuro-psychological so-

cial stresses, that have accompanied growth. They otherwise, would not only affect the end purpose of growth, but future growth capacities overall. In Asia, the question acquires special relevance in view of the known projected increases in urbanisation by the year 2000 and beyond.

This leads to two or three particular components in this constituent of management, namely, the need for instituting basic new policies in :

(a) City planning, involving size, suburbia, hinterland relationships, and so on. What is the future city? What is the concept of a whole city? How many 'cities' in a city should there be? How should the inside of a city look like? How should one arrange to move around and to live within a city?

(b) Rural modernization as an end in itself and as the national means of managing in-migration to larger urban conglomerations. Two essential ideas need to be accepted. First, that sooner or later, in a finally developed society, the rural population must diminish drastically. Secondly, that the rural population must have, sooner or later, 'all the modernised amenities', that are in fact feasible, through localized rural industrial centres.[7]

(c) A bold programme of communication and related infrastructure policies, beginning with fundamental 'questioning of the motor vehicle[7] as the basic form of transport'. The only way we are tackling transport now is in the Parkinsonian way; expanding into more roads for more cars, which are followed by more roads. That apart, these tell on lifestyles and on the essential philosophy of the city outside 'as an extension of the home' and of meaningful cultural living.

(7) It is essential to establish within market economies integrated development planning and integrated develop-

---

7. These ideas had been spelt out by this writer from as early as the seventies. See also Annex 1.

ment. This means holistic planning. In its application, as distinct from academic study, one has to move away from separate disciplines of economic planning, social planning, population planning, environmental planning and others, compulsively establishing an integrated planning framework and, in time, methodology.

(8) Without being autarchic, indeed neither possible nor necessary, it is imperative to establish a policy of self-reliant development, in which the maximum initiatives can come into play in evolving indigenous resources, many of which, as we have said, have not been touched in the commercialism of international market demand and supply.

(9) While the frontiers of natural and human resources potentials are being widened, it is imperative that the society's management limits are similarly widened. One component obviously is the broad policy base in governments, reflected in Legislative[8] and Administrative structures, all of which must be able to provide the means to translate ideas of resource and development relationships into actions. It has to be at central and local levels, industrial and rural, and in all sectors.

A separate component in management limits is machinery that must exist, and the priority given to it in the national bureaucracy, for fullest scale applied research and development of technology use in all sectors. While time horizons for some may be several years, that for starting research must be 'now'. Also, it is clearly important to give precedence to a national institute for applied research in this field than, say, to an institution for 'fundamental research' on the origin of the universe or such like. These are not abstract examples; and if the right priorities are not pursued, management may yet limit growth.

---

8. In some Laws, the 'criminal' may not be the poor lawbreaker, but the State itself.

Deeply intertwined with management is the role and capacity of Popular Bodies, the media and other groups in the body politic. While a 'leadership' role has often to be played by the elite, indeed has been in many cases, in the 'transformation from thinking to action', sustenance comes only where the spread has extended to 'the people'. Thus the non-political non-bureaucratic levels - the so-called non-governmental organisations - are an essential constituent in a sound body politic. Without adding to any glossary of political philosophy, one may simply say that they are a very special arm of what we know as the Fourth Estate; within countries, perhaps uniquely, combining the opportunities 'for reaching out to the people on the one hand, and interceding with governments on the other'. In the media itself, do we, for instance, highlight occurrences in a village of multi-bunding, irrigation control, or use of biogas? If we recall our fathers' or grandfathers'days, this is the sort of thing that was the topic of village conversation and exchange. Perhaps in the days when we were so blessed - not correlating it to the absence of newpapers in those days! - we got a true identification of information and social relationships, which may still serve us well.

(10) Future constraints to resources supply, if unattended, will, as through energy now, create enormous inflationary pressures and foreign debt dependencies. Such a contingency is not inevitable, but clearly re-emphasises the previous programme components that we have attempted to list.

* * * * *

Let us now set out, as mentioned at the beginning, a concise presentation of the needed 'Policy Design' for that environmental management in development we have been discussing.

Since what follows is meant to be self-contained, even for use in that form, some preceding ideas or wordings would be found repeated.

Designs and Policies[9]

A Policy Design for Environmental Management in Development

I - Background

1. The Environment Concept embraces all Sectors, not any one sector or sectors. It is a dimension in all sectors.
2. In its Definition, it is not only to do with 'pollution' and 'conservation' (in the sense of 'preservation'), but with all resource endowments.
3. Poverty, and lack of development are causes of some of the worst environmental degradations and problems.

"(The foregoing may be expressed, as Propositions, in the following three elements:

- "The Environment, is simply the totality of all our resources, literally under the sun;
- Environment management, is the use of resources,[10] not their non-use; and

---

9. Based on a Framework first done in the mid-Seventies.

10. There is no such thing in Nature, in Society, in Economics, or in proper Environment management, as not using resources. The concept of 'destruction' in 'conservation' - let alone natural cataclysm - should be accepted as 'inherent' in Management, turning our attention then to the 'nature of the resource use cycle' itself, away from negativism. Perhaps we should recall that the greater Indian metaphysical tradition does not overwhelm itself with a negative view of 'Destruction', declaring that 'Creation' itself contains 'Preservation' and 'Destruction', each part of the other (symbolised in Brahma, Vishnu and Shiva). The profound Buddhist tradition of 'Impermanence' and 'Change' underlies the same Truth. So, perhaps, St. John in the Gospel, when he says that the 'seed' must first fall to the ground and 'destroy' itself, before it may 'create' life. The Sufi tradition in Islam underscores this same Unity in change. And so does the, even more ancient, Tao metaphysic of the Far East.

- Environment management for development, is the use of all resources, alongside sustained maintenance of future resource levels.)"

4. Development and Environment are, thus, joint environmental goals as they are joint development goals - not separate and competing.

   "(The solutions to the problems of the environment must be found within the process of development, and not outside of it" (China);
   "Development is in fact the means by which many, if not all, of the problems of the environment are solved)". (UK)

5. Environmental Conservation is, therefore, not merely the 'Conservation of resources', but also the 'Conservation of development'.

   (Conversely, "development is the creation of a livable environment'. Certainly, not the 'consumerist', 'mercantilist' or 'commercial' type of development emerging in the name of development. If an Environment is 'unlivable', then there has been an under-use, or over-use, of resources.)

6. The Methodology of environmental management is not a series of 'restrictions', but the full spectrum of three inherent functions, of Restoration (of degraded resources), Maintenance (of resources while being used) and Enhancement (of resources through a vast range of 're-use'/ replacement strategies and technologies).

7. The resulting environmental Plan is a Design for 'maximum' development with assured Eco-System balance, and Policies for their sustenance.

8. The Framework of such a Plan rests on four Eco-System principles, namely:

- the 'Eco-sphere principle', in which all the elements in the Eco-system are related one to another;
- the 'Re-cycling principle', in which all the constituents in the system are continuously 'cycling' and re-cycling among themselves;
- the 'Carrying Capacity principle', in which a given eco-system of land, water or air, has a natural limit to its capacity to sustain itself; and
- the principle of 'Human inter-action', in which human beings, more than any other in the system, can alter the environmental configuration, for better or for worse.

II - Guidelines for Plan Formulation

In a search for guidelines, the following broad indications are set out :

1. In a first Group are problems which may be loosely termed 'Micro' (meaning specific, 'Unit' type, similar to the 'Firm' in Micro economics) and are essentially Qualitative in nature. These share the 'classic' view of Environment as 'pollution' and 'conservation'.

   Typically, these are about 'fragile eco-systems', such as -

   (a) watersheds,

   (b) rangelands,

   (c) forests,

   (d) grasslands,

   (e) croplands,

   (f) genetic resources,

   (g) endangered species,

(h) habitat (the basis for (f) and (g), both natural and human),

(i) mangroves,

(j) coastal areas; and island eco-systems; and the 'classic' pollution sources (solid, liquid, gaseous),

such as -

(a) soils (fertilizers/pesticides, etc.),
(b) water (run-offs, eutrophication, etc.),
(c) wastes (agro,industrial, fisheries, transport, human settlements),
(d) 'disasters' (siltation, epidemic, starvation, 'Bhopals', 'Chernobyls'),
(e) 'apocalypses' (Ozone, Global Warming, Sea level rise, and others).

2. The second Group, by and large at the 'Macro' Level, is 'Quantitative in nature, not hitherto reckoned in the Environmental 'catalogue'. This is the sheer need for enormously more resources than are being used now, or are 'available' for development. No sensible Environment Plan can escape this responsibility. In this category are -

(a) forestry sources ('expansion' through social forestry, wastes conservation; and not merely anti-felling laws),
(b) soils (fullest use of potentials),
(c) waters ('additionals'/alternatives),
(d) food grains (strains and yields),
(e) raw materials (types/volumes),
(f) energy (expansions/alternatives),
(g) renewable and re-usable resources and wastes conversions (all sectors),
(h) minerals (utilization 'scales', 'added values'),

(i) transport ('alternative' systems),

(j) urban/rural human settlements (expansions, 'linkages').

3. Both these, the so-called 'Micro' and 'Macro' issues and needs must be met by positive environment-development relationships; not negative, anti-developmental, or 'one-track' solutions.

Plans and actions must be 'productionist' not 'protectionist'. Laws need to change from being merely 'punitive' (especially on poor polluters) and emphasize conversion of 'wastes' as economic products (not as residue to be 'disposed' of 'on pain of offence').

The 'apocalypse' type issues should be of great concern, but should not mislead; their solutions lie essentially with their creators, namely, the rich countries.

III - Outline of Action for Plan Formation

1. Identify and catalogue a first List of major Areas of both environmental stress or needs, and environmental 'opportunities'.

2. Prepare short operational Notes on each of them, with outlines of designs and policies, based on positive management approaches, in particular the expected resource needs of development.

3. For major resources, prepare "Resource Balance Sheets" (separately for Renewable and Non-renewable resources) that set out availabilities, carrying capacities, potentials, and needs of restoration, maintenance and expansion - distingushing between 'physical' supply, and 'effective' supply.

4. On a selective basis, schedule certain natural resources as capital stock providing for sensible rates of use, depreciation, re-equipment and

even later 'substitution' (given new discoveries, techonologies, etc.).

5. Also for select resources, establish 'Resource discounting' systems, with future values at higher level (contrary to normal accounting of financial/economic assets).

6. Allow all E.I.As (environment 'impact' assessments) for projects only where "resource balance sheets" have been first prepared.

   ('One could have perfectly sensible E.I.As on a project basis, which are equally nonsensical on a national basis').

7. Progressively, replace E.I.As with an Integrated Environment/Economic cost benefit system, making for joint decisions in resource management and economic development.

8. Flowing from these, draft Designs and Policy Frameworks would result, enabling the formulation therefrom of systematic Area and National Plans and Programmes.

IV - Other dimensions

The foregoing are all 'ex-ante' actions; and precede any formulation of designs and policies, or plans and programmes. However, having got there, sound management must foresee a follow-through with an 'ex-post' set of actions that will, (a) ensure the essential monitoring of and intelligence on, performance, and (b) yield outstanding feedbacks to the benefit of the successive pre-planning phases of environment-economic management and development which, after all, is a continuing process.

Two major instruments belong to this Group. One is the development of an expanded, integrated, environment-economic system of National Accounts, reflecting 'true' GNP values, as well as losses and gains of resources stocks and uses.

The other, at the micro level, is what is known as Environmental ('Green') Audit of all production activities, yielding better management, a better environment, and even better profits.

* * * * *

The purpose of the next and the succeeding four chapters is to provide this comprehensive 'package' of a complete management framework; and the 'Methodology' of use of its components.

III. The Management Package:

The Tools of Environment - Development Management

This chapter is on Methodology per se. It is perhaps the one single body of knowledge most central to successful environment development management but which has received, surprisingly, the least thinking and attention[1] from the world. As we saw, there is now some fair convergence on the 'Concepts' of both environment and development, and on environment-development relationships. There is also a fair convergence on and understanding of what we may call 'Principles', which on another occasion, we had described under two captions, as 'Foundational Principles', and 'Operational Principles'.[2] There were also certain Principles which Academia had increasingly to absorb and apply in its studies, research, writings and teaching. But the area of Methodology itself has been wanting; and without this, of course, neither application to real life situations, nor teaching, can meaningfully take place.

We could, as of now, hardly use the word, 'methodology' with any justification. We should rather have to settle for a word such as 'artillery'. One reason why the progress towards a wider methodological system has been stymied is perhaps that, up to now, the beginning and the end of any 'methodology' - at least the main pillar of a so-called methodological system of thinking so far - has been what had been universally established as Environmental Impact Assessment (EIA).

Complementing this were 'ecological concepts' centering around the 'rape of nature' and, internationally, debts for nature swaps, and so on.

---

1. Some work had also been done, such as through UNEP expert groups, or external writings (including the International Banks) which, however, still rest mostly at the stage of outlining principles'.

2. In the Autumn '91 LSE Special Lectures on 'Environmental Planning for Development' (publ. '92) and in later Papers.

A third complement of the present methodological reprtoire was, of course, the 'pollution concept', from development. Under a fourth aspect of the current state of thinking were some key 'ancillary concepts' foremost among which was perhaps population. This, we have dealt with earlier.

Essentially all of them led, in methodological terms, to a set of so-called policies, exemplified, particularly in the U.S., under controls and charges. They related to activities, in the name of environmental management, called 'netting', 'off-sets', 'bubbles', and 'banking', involving, for instance, a permission to pollute within the framework of policy, so long as one could trade off with a neighbourhood; permission to pollute 'today' with a promise not to pollute 'tomorrow'; and so on. There are, of course, other policy instruments elsewhere; for example, the command and control, and regulatory type of the European system; and our own, somewhat colonial, fines and penalties approaches.

But environment management is more than these; and given now the development commitment involved in the sustainable development slogan, has to be far more than fiscal or regulatory policies, or purely 'inward looking' impact assessment type methodologies. A meaningful environment-management package has to comprehend what we referred to in the previous chapter, as the 'Quantitative' demands of resources management, as much as the 'Qualitative' dimensions of management. It is possible neither to understand environment management, or move towards sustainable development without this comprehension. As we have emphasised therefore, such an environment-development management package goes far beyond the only known 'tool' so far. It does so in two senses. Firstly, it displaces EIA itself at its own level, progressively with an Integrated Environment-Economic c/b presentation. Secondly, and importantly, EIA becomes just one element of a

total management package, the whole of which is composed of four composites, as follows:

(1) The design of comprehensive Resources Balance Sheets, for all major resources of the environment (and therefore of development).

(An 'ex-ante' macro level exercise, it then gives sense even to the fashionable EIA, preventing, as we said earlier, having a perfectly sensible EIA at micro level, which could be perfectly nonsensical at macro level.)

(2) An integrated Environment-Economic c/b presentation, in place of the currently used Environment Impact Assessments (EIA)[3].

(Both, of course, being micro level exercises; and like (1) above 'ex-ante').

(3) The eventual use, in addition to the well established SNA (the UN System of National Accounts) used by all countries, of 'SEEA' .(an expanded System of Economic Environment National Accounts now under preparation within the United Nations).

(Like SNA, an ex-post exercise and, like the Resources Balance Sheets, at macro level).

(4) The use of Environmental ('Green') Audits as a complement to the Conventional System of Financial Audits.

---

3. c. f. Lawrence Summers, "Environmentalists who point to the damage done by dams, power plants and roads evaluated according to standard economic criteria have a point. The answer does not lie in blanket sustainability criteria, or in applying special discount rates, but in properly incorporating environmental costs into the appraisal of projects. The grim fact is that no careful analysis was done of many of the projects which environmentalists condemn. The world's problem is not too much cost-benefit analysis, but too little that is done well. Plenty of environmental improvements can pass rigorous cost-benefit tests. There is no need to cook the books." (The Economist, May 30, '92; quoted in the Journal of Economic Perspectives, Fall '92).

While Financial Audit views conventional assets and liabilities, and financial profits and losses; 'Green' Audit seeks to 'cost' losses/potential gains, of hidden (or overlooked) natural assets and liabilities, from input stage through to final sales, in any production process.

(An ex-post exercise, it is, however, like EIA, and the proposed Integrated c/b model, a micro level activity).

In their totality they make up the package, and the 'tools', of Environment-Development Management. While they are the subject of the next four chapters of this book, a summary presentation of them is given at the next page.

The Package itself derives from the backgrounds of the two previous Chapters, on the Environment-Development relations and on the Designs and Policies relevant thereto. Briefly this derivation may be described as contained,

- under Ecology, in the four Eco-System principles described earlier;

- under Development, in the 'translation' of the "biospheric knowledge" as we called it, "into resource use patterns and planning actions"; and

- under Integration, in a framework, again outlined already, of 'Restoration, Maintenance and Enlargement' of these "Resources" of environment and development.

ENVIRONMENT AND DEVELOPMENT MANAGEMENT

'The Management Tools'

The Components of the Management Package

A. Resources Balance Sheets
(Macro - Ex-Ante)

B. Integrated Envt. - Econ. c/b Presentation
(Micro - Ex-Ante)

C. S.E.E.A. (Econ. cum Envtl. National Accounts) -
(The U.N. "Satellite System" Programme)
(Macro (National) - Ex-Post)

D. Environmental Audit ('Green' Audits)
(Micro - Ex-Post)

IV. Resource Balance Sheets

In the previous chapter, we did explain briefly the nature of Resources Balance Sheets, as well as its role in a comprehensive environment management framework. Here we must set out in an introductory technical presentation, the content of the resource balance sheet framework as an instrument of management, and the manner in which it would operate.

A phase which is overall and macro, it establishes certain vital premises, namely of linking resources, supply and demand; opting between alternative ways of producing for an end-use (and therefore of resources substitution, for a project and between projects); and making correct choice of a project itself, before that may be assessed. An area that is new, newer than environment assessment, it has however, for some time been the subject of separate thinking.[1]

One UNEP/ESCAP Seminar, for instance, advocated the idea of establishing resource balance sheets in national accounts and in national planning - a type of quantification of effective supply which it felt would greatly assist economic planners to introduce environment management into development planning. Pertaining to the perspective and medium-term planning stages, this concept would yield concrete benefits in terms of: national decisions on rate of use of critical resources; long term policies for their maintenance, substitution and expansion; and policies for science and technology assessment and application in relation to them.

---

1. e.g. The Environmental Dimensions in Development Planning (UNEP/UNAPDI Publication, May 1979); UNEP/ESCAP Report of the Regional Seminar on Alternative Patterns of Development and Lifestyles in Asia and the Pacific (August 1979); and the East-West Centre/University of Hawaii Guest Lecture 'The Economics of Environmental Planning' (C. Suriyakumaran, October 1979).

Such a macro context is essential to any valid project level exercise, since there could be: (i) an alternative project to achieve the same goal; (ii) an alternative source of resource supply for the same product; (iii) an input of a re-usable resource; (iv) concomitant 'restoration' projects; (v) protective activities to stabilise the resources tapped; and (vi) additional projects based on residues created, producing end products, or inputs to other industries.[2] All of these could be possibly more development supportive than the original project design, not to mention the added costs once a choice is made without this prior step.

There are three bases which are essential to such a Methodology, in any case. One is the 'macro', as opposed to a mere micro basis. Second, it has to be a 'product-loaded' basis, not simply a 'cost-loaded' basis. And thirdly, it has to refer not simply to 'control' of resources, but, in poor countries, to vastly 'increased use' of resources. These three are 'informing factors' which must figure in any sensible and useful methodological approach.

The 'benchmarks' in such a Methodology flow from what we have been talking of. They are just three things, although they are 'encyclopaedic'. The first is what we are dealing with, namely the Resources Balance Sheets. We have set out below a brief display on it.[3] Resources balance sheets refer to the evocation of macro Supply Schedules. We shall try to demonstrate shortly how this works. The second is a programming approach where, as we said earlier, one looks at environment not as a 'sector', but as a 'dimension'. The third is the development of 'integrated economic/environment cost-benefit' systems (and not exclusive EIAs).

Let us look at this Resource Balance Sheet idea that we have cited as the 'first' component. If we look at the display

---

2. The phrase "balance sheets of resources" has been used along with "resource accounting" and "patrimonial accounting" by the French for several years now; and Peter Bartelmus (of the UNSO) has introduced the phrase in connection with the work on SNA towards an expanded system, or 'SEEA' (See Chapter VI).

3. See Chart at end of this Chapter.

referred to, we will get some idea of what is explained below. This particular display or framework, captures both aspects, that is the macro resource balance sheet presentation, as well as the 'programming' phase of planning and integrated cost-benefit estimation.

At this stage, for our purposes, we deal particularly with the first one, that is the Macro level. What is given here is indeed a summary presentation of really a whole area of discipline, thinking, and work. We shall have to understand this also in the context of what has been explained in the previous pages - for instance about the 'social basis' of the supply schedule themselves. We can omit the word planning if we like, but if we start at the perspective, or medium term phase, the key words to remember in this are the difference between what will be called a 'Physical Supply' estimation, and an 'Effective Supply' estimation of a resource. These captions, gestated in the late Seventies, beginning with a Lecture at the East-West Centre, were further expanded at the International Conference of Development Associations in 1983, in a Paper which, one would think, came out with high acceptance in the discussions and conclusions.[4]

'Physical supply', briefly, is the normal estimated supply schedules of aggregate needs, not simply, of course, of financial or fiscal resources, but of physical resources. This is a normal development economist's or planner's estimate of physical supply of a resource in any given category, or sector, for the entire economy. So we have the first assumed supply, as a given physical supply.

In our Presentation, we start, as will be seen, with A(i), that is, a 'posited' physical supply of goods and resources, as above. In other words, for an economy, or for an area, there is an economic estimation of total physical supply of resources, as physical natural resources. This is the economist's 'desired' estimate, in economic terms, expressible here as both quantities and values.

---

4. c.f. the Summary Record of the Official Conclusions of ICCDA, (Annex 2).

The first step that has to be taken is to identify an 'initial Effective supply' i.e. A(ii), to meet the total national demand under economic planning, for which the economist's physical supply schedules have been produced. Note that these goods and services include expressed needs for social, cultural and spiritual needs as well. Thus, we attempt the first, or initial, 'effective' supply schedules. This is - must be - typically, the Environmentalist's exercise. We may remember our discussion about the sum total of "biospheric knowledge" that is gathered in an environmental view of resources. This is the basis on which the 'first initial effective supply' is provided. Now when we do so, we are effectively 'matching' it, in an initial step, with a posited physical supply.

For instance, there is so much forest, or petroleum reserve or gas in the country, or so much of coal, and so on. This is what the economists set out. The environmentalists will have their own estimation of sustainable 'effective supply'. This is the first step, and approximation. It is just possible that a 'physical' and 'effective' supply estimate may be equal; but, more likely, that it will be unequal, in the sense, usually, that the estimation of effective supply will be less than the physical supply.

Now comes the second, an important, part of the resource balance sheet exercise. It is a tremendously fascinating and challenging exercise for Environmentalists, in the true sense of the word. It is an attempt, to the best extent to 'approximate' with the physical supply. We use the word 'approximate' because, at first, it is not succeeding, in matching with the posited physical supply, or not succeeding, but the exercise itself, honestly pursued, that is important.

Now, how do we do this? Let us take resources classified as 'non-renewable' resources and 'renewable' resources. Under renewable, we also have 're-usable resources, and wastes'. For 'non-renewable' resources, the methodological procedure by which we would do an approximation exercise, if one were an environmentalist, or a resource manager, is shown briefly in the display. This applies whether such

resources are minerals, or 'renewables' under serious stress say water, mangroves, forests, or others.

Strategies naturally vary according to each case. For example, say for tin in a developing country, there would be an estimate of the resource for the whole country, of rate of use (and abuse), of how much is export, how much is added value and so on. These are the types of information categories involved. All this requires a longer presentation, best illustrated by case study. These go into the resource 'balance sheet presentation', which then will bring out the best rate of use of the resource. One may end up exhausting the resource within twenty years, or we may have a situation where we arrange to use this for two hundred years. That is a policy, again, which has to be decided upon.

In this particular case, there could be a consensus that it were better perhaps not to mine as much as was being done now, until the country developed the capability to 'fabricate' the 'finished goods' from the tin, or at least do so on a proportionate basis. These further give a picture of when, or whether, a resource is going to be exhausted; what in the meantime will be developed within; what, in any field, can be achieved through a "Technology" programme for environmentally friendly "alternatives"; and so on.

We used the word 'basket' earlier - a fundamental concept for both environment and development. If it is petroleum and we know there is going to be an alternative resource which is economic, then we may let petroleum be exhausted. Different resources, need different policies; and, for both environmental and economic decision makings.

Under 'renewable resources' earlier, we spoke of 'restoration, maintenance and expansion' of resources. Forestry is an excellent example of such policies which are applicable, as also farming. In forestry, for instance, we have a challenge of assessing not only soil or water effects but what our re-use policies are and, in the course of it, indeed simultaneously, ask what our alternatives are, say, to fuel wood. There is a

rate of exhaustion of forest, due to firewood. There is also the question of processing timber, rather than exporting say, to Japan. The question of re-use is a question of waste. For instance, in rubber, every year one has to fell a given number of rubber trees in an area, whether one likes it or not. That is the only way to maintain rubber as productive and sustainable. As a resource, the felled tree is a free good. These are all aspects of restoration, maintenance and expansion policies; as much as, say, mine tailings, biological methods, or wastes 'conversions'.

Finally, we come to the crux the most important thing, we think, and the most fundamental. We may recall repeating it in the preceding chapters. That is the vital role of 'Technology' as means to overcome environmental problems. Now here, the great bane, in a dynamic sense, is the failure of environmental policy to see this role of technology, with resultant conflict between environment and development. A major reason for that is clearly the static 'R & D' and Science and Technology policies in developing countries, as opposed to the developed countries, their backwardness, and the environmental, 'protectionist', as opposed to 'productionist',thinking that we spoke of before.

Because of the relative static situation of R & D and Science and Technology within the developing countries, there has been a necessity for house keeping in a diminishing sense, that is for use of resources in relatively diminishing quantities, rather than the 'conversion' of these resources, as we said, into a myriad products, as alternatives and new potentials, that are also environmentally friendly. These are again relatively simplified description of a whole range of potentials out of a Science and Technology policy, which then, in effect 'enlarges' the Resource Supply. This is the real meaning of "restoration, maintenance and enlargement" of resources, something for which the IMF/World Bank policies too, along with most national policies, simply fail to provide.

As a result of these steps, for renewable, and non-renewable resources, we get whole new Supply Schedules of

the resource availabilities in the economy - some immediately, some in the medium term, and even more in the longer term, which is also environmentally fully sustainable, alongside development. If we follow the display we have with us, S & T is directed to very specific goals, according to whether a resource is renewable or non-renewable, and these become a dominant pre-occupation for environmentalists and economists, together.

Now when we do this - and it should be clear even within this brief presentation of what is involved - what we produce, as Environmentalists, is as at number A (iv); that is, we establish a 'final effective supply'. It represents the point at which we have that 'final approximation', of the 'initial physical supply' of the resource-supply schedules of the Economist, and the 'initial' effective supply with the 'final' effective supply schedules of the Environmentalist.

Yet, to repeat, this is typically something on which both environmentalists and economists must co-operate, if the results are to be achieved; and one in which all relevant specialists will address issues. This time, they will be doing so in a harmonisation of skills and purpose; instead of in conflict of interests and results.

RESOURCE BALANCE SHEETS - THE PLANNING MODULE[1]

A Framework of Sequential and Schematic Linkages

A. Perspective/Medium Term Planning Phase:

(i) Development demand - The posited Economic Resource Needs Targets (for all goods and services) - "The Physical Supply" ⟶

(ii) The initial, environmentally feasible, "Effective Supply" to meet posited total national Demand as under economic planning. (N. - this includes goods and services needed to serve expressed social /cultural/spiritual needs) ⟶

(iii) Approximation with "physical supply"[2], thus ⟶

- For Non-Renewable Resources ⟶ (a) Initial Resources Stocks (current, forecast) ⟶
  (b) Rate of use ⟶ (c) Restorations[3] ⟶ (d) Maintenance policies[4] ⟶
  (e) Re-use policies ⟶ (f) Alternatives ⟶ (g) R&D and SC&T application to (c), (d), (e) and (f) ('resource expansion') ⟶
- For Renewable Resources ⟶ (a) Resource Stocks/'Cycles' ⟶
  (b) Rates of Use/Natural replenishments/Carrying Capacities ⟶ (c) Restoration ⟶
  (d) Maintenance ⟶ (e) Residues/Wastes 'Conversions' ⟶ (f) Alternatives ⟶
  (g) R&D & SC & T to (c), (d), (e) and (f) ⟶

(iv) Establishment of final "Effective Supply"

B. Sectoral Programme Phase :

(i) Operational Balance Sheets ⟶

(ii) Operational Programmes, separately.
for (c), (d), (e) and (f) (non-renewable resources) ⟶
for (c), (d), (e) and (f) (renewable resources) ⟶

(iii) Integrated environment-economic assessments on 'cost effectiveness' for select categories.

---

1. Originally presented at an international Lecture at the East-West Centre, 1979.
2. There could, conceivably, be some situations where "effective supply" is more than adequate to meet "physical supply" (eg. where intensity of resource use is incipient, or minimal for other reasons).
3. In "non-renewables", a resource used is resource lost; so the reference here is to 'restoration' of resource base for other uses. (e.g. mine tailings, and similar potentials).
4. For 'non-renewables' mainly as extended use policies. (e.g. resource mixes; user savings, as for energy; and so on).

Appendix[5]

A key concept in this integration exercise has been the idea of the use of resources balance sheets for key natural resources. There has been before this, a concept of materials balances which, while representing a stage beyond the earlier marginal and incremental analysis at micro level, is still self-limiting. From the point of view of integrated macro level development planning, some observations may be made on the materials balances concept in relation to the resources balance idea.

The increasing clarity about the relevance of the wider view of environment for developing as well as developed countries leads to a reappraisal of received economic concepts in the context of environmental management. The materials balance approach is a concept based on the consistency method of national accounting and emphasizes residuals generation as affecting environmental quality. As an approach, it bears only superficial resemblance in nomenclature to the resource balance approach, which has more fundamental connections with factor supply-extraction, production, distribution - and environmental management, especially in relation to development planning.

Beginning with a common property problem of resource misallocation and resulting externalities, the materials balance approach maintains that the class of externalities arising from residues (wasted disposal due to consumption and production activities) must be viewed differently. Three reasons are advanced in support of such a viewpoint: residuals do not disappear but are matter in a different form; the waste assimilative capacity of the environment is scarce; and it is a common property resource even though operative decision units are decentralised. In order to assess the external costs associated with residuals discharge or even their technologi-

---

5. With acknowledgments of close collaboration with and contribution by Prof. Bharadwaj, Profesor of Econometrics, University of Bombay.

cal transformation into different forms, an economy wide materials balance is suggested. Further the interactions increase when environmental pollution of one medium, say, water has effects on other media. Sometimes different weightage has to be given to waste disposal by incineration affecting air quality or by dilution affecting water quality. In effect, waste disposal is not an isolated problem nor a final outcome of any activity; it is an intermediary activity in the materials flow. Whatever the methods of residuals disposal, the disservices flow back to the consumers and producers who initiated the process; thus control of pollution must have a materials balance perspective for the entire economy. The focus is on the 'consumption' angle where materials exist and render services but do not get used up or destroyed. According to the advocates, the better the energy conversion and material utilisation, the lesser will be the requirement of new materials for a given quantum of production and consumption. Nonetheless, it is maintained that technological external diseconomies increase with population and production levels disproportionately.

The residual material balance is thus a definition and a concept. In order to render this physical process operationally meaningful from the economic point of view, it must be viewed in conjunction with a general equilibrium framework, to examine the inter-relationships and welfare considerations. Here the concept gets bogged down with the assumptions that necessarily go along with the models used and carries the reservations that are expressed about a neo-classical framework. Certain other drawbacks follow as a fixed coefficient assumption is made to arrive at the balance model. The model concludes that material flows from the environment minus the recycled products would be equal to the sum of residuals from the intermediate production and final consumption sectors. However, the recycle time frames have varying ranges and may not coincide with the production period in the dynamic case. The recycled augmentation of raw materials would not be balanced in a given time period. On the contrary, if recycling is assumed away then there would be no basis to assess the changing waste-assimilative

capacity of the environment. Also the aggregate nature of residuals flow does not discriminate between lethal and harmless residuals or yet changing materials balances due to changes in waste assimilative capacity. Even when, to comprehend the above factors, the relationships are expressed in terms of inequalities, they do not have empirical meaning unless the equalities hold. Thus, the more important aspects of recycling in materials balance in fact get left out of consideration.

In terms of the earlier discussion, the resource balance is an approach, and not just a concept, to formulating and assessing the physical and effective supplies of environmental factors. We call it a methodological tool as it differentiates resources by category - renewable and non-renewable - and by process. This approach, as earlier mentioned, is a system of sequential and schematic linkages forming the core frame for environmental planning in the various phases and stages. It aims at approximating the effective supply of non-renewable resources to the physical supply by activating the parameters of rate of use, and existing re-use alternatives, also allowing for changes due to R & D application. In the case of renewable resources, the approach emphasises restoration, maintenance and expansion processes along with their improvement through R & D possibilities. This forms a basis for national resource accounting, with a perspective of sustainability in resource supplies. The resource balances, therefore, naturally subsume the residual materials balances, more meaningfully, in that, use of raw materials, by products and recycling are also considered. The resource balance sheets constructed after such a total environmental assessment, would help development planning, especially for developing countries. The actual use of all the resources depends on a cost/benefit estimation extended to include the relevant environmental characteristics in each case.

The two views have a point of tangency, implying a whole line of departure. Both the views take special cognizance of the recycling and residual assimilative capacity of the environment. Whereas the materials balance concept begins and

ends there itself, the resource balance approach is a stream of thought beginning earlier and continuing further. First, conceptually, the resource balance approach is a general equilibrium macro framework which aids development planning . The materials balance concept is a tool which has partial relevance only to the inter-relationship of residuals and has static implications. Secondly, the former approach helps disaggregation as it deals with special focus on renewable and non-renewable resources. The latter is a hold-all concept for all forms of residuals. Thirdly, resources as factors of production are differentiated from the concept where residual and renewable resources as a process of consumption are emphasised. Empirically, the approach is fitted to assess changing supply positions and arriving at operational balances for each category of resource and process. The materials balance concept on the other hand is constrained by the very mechanism of balance and fixed technological coefficients. The premise and methodology of the resource balance approach seem to be the only reasonable manner in which environmental management could be integrated with development planning; while being able to subsume the materials balance objectives.

V. Integrated Environment - Economic c/b Assessments A Model

In this chapter we look at a crucial instrument of environment-development management, namely an integrated environment economic c/b system as an alternative to the touted instrument of Environment 'Impact' Assessment (EIA), still the single instrument of environment management and related economic decision makings.

Its importance stems from two different causes. The first as we just observed, is that EIA has been virtually the sole instrument of management so far. The second is that, as a project level ex-ante activity, looking at optimalities ahead of investments and not thereafter, it is, along with the macro level resources balance sheets (the subject of the preceding chapter) of singular importance.

Rather than a descriptive account of the manner of constructing an Environment Economic Assessment (EEA) model in place of the EIA, we have adopted the approach of presenting a hypothetical model, which while not naturally reflecting real figures, sets out the full spectrum of such an Assessment Format, which then could be used increasingly in practice, and with use, enriched to mutual benefit of both environment and development.[1]

Before we do so, in view of the singular use of EIA so far that we mentioned, a few words may be appropriate on the place and role of EIA as it has been used so far. It is, of course, at the sectoral stage and much more intensively at the project stage that environment 'impact' assessment begins. As we said before, since it must not function, in order to be valid,

---

1. Annex 3 herein abstracts select Theses presentations for Ph.Ds, using this Model in a University in India.

without having a macro setting, it is clear that we have been peddling the tool of environmental assessment without realising its relevant status.

Firstly, it takes its place in a total planning module. It has an essential role but it has been forced to make do in the past for things that it just could not do. Secondly, environment assessment is now on a markedly changed premise and methodology. It is seen as an assessment of the use of resources and not contradictory to, but an integral part of cost/benefit assessment and supportive of the whole process of development. Because of its origins, environment impact assessment had considered impact assessment de facto as of negative impact as if no development can have positive environment impact. It failed mostly to assess the development contribution to projects; or to related programmes, of environment management. It thus committed itself to a view of environment as cost without corresponding output. It let slip the universal fact that to produce anything, say shoes, requires a cost. We have sat back accepting the imposition of the cost equation on any environmental action. It premised itself more on inability to quantify, or on conflict situations as bases for decision-making. It left little room for the view that environment assessment like economic assessments could be contributing to optimising production decisions at project and national levels.

This is the background to an alternative environment assessment approach that will fit into a macro scheme, be production supportive, and environmentally friendly.

No accuracy is claimed for the figures of the hypothetical model; reasoned bases have been used in each case. The reader is free to improve upon these, the main point being to retain the essential elements of the framework and its objectives, namely 'data setting, assessment and decision-making'. While on the hypothetical model, perhaps it is appropriate to draw attention to the fact that the figures on resource restoration, etc., (vide Section V of the Model), are all shown as benefits, without any losses. This should not be understood to mean that there cannot be net project losses,

although it is possible that the chances of gains are greater, since in most cases we are dealing with resources or resource bases that were by and large productive earlier. This is not to say that GDP losses by degradation from the project (Section III) may not exceed the enhancements under Section V - grave degradation can leave net losses still in certain cases. At the same time, new residues and renewable resources utilisation (suggested in Section V) could still leave a net higher GDP, as a result of infusing environment management planning decisions into the economic action plan.

Countries have had a problem of how to undertake assesments, how to make use of assessments undertaken, and how to relate assessments to their development priorities.[2] What the approach offers is an unimpeachable addition to Economic cost/benefit, namely the completion of the latter's own attempt to provide the fullest basis, in terms of costs and benefits, for decision making by decision makers.[3] The framework of such an intergrated model received recognition, in a culmination of activities at a (UN/APDC), Regional Meeting in early 1982.[4]

The integrated assessment format is set out below.

---

2. The recent environment-development battle in Sri Lanka, on the Coal fired project at Trincomalee is an exemplary case.

3. c. f. reference to Lawrence Summers in Footnote 3 of Chapter III.

4. The document includes a review chapter by Amartya K. Sen on the integrated assessment model.

Environment - Economic c/b Assessment Model (EEA)

The Assessment Format

I. The Project

- Baseline data - Background Information.

II. Resources Directly Used/Indirectly Affected/Products and Residues Created

- Directly used/consumed - Indirectly affected - Products and Residues created (directly, indirectly)

III. Resources Exhausted, Depleted, Deteriorated

- Directly - Indirectly.

IV. Resources Enhanced

- By Project - Others.

V. Required Additional Project Components

- Restoration - Maintenance - Expansion.

VI. Summary: Decision-Making

- Summary - Cost/benefit presentation.

Appendix :

I. Computations -Technical Notes

II. Categories : Resources of the Environment

Annex :

Environment Assessment - A Note on Definition and Content of Relevant Terms.

Environment Economic Assessment Statement (EEA) Format
(Data Setting - Assessment - Decision-Making)

Country : Hypothetical (Tropical ecosystems) Area: Hypothetical

I. The Project (Hypothetical)

Nature:[1] Industrial/Agro-Industrial

Title: Private-cum-public sector complex, involving: 11 small-scale tanneries: 1 chemicals plant.

Time-span:[2] 20 - 30 years

Physical boundary: A valley area, the full terrain covering approximately 2,400 sq. miles. The projects under review are alongside a river.

Population : 350,000

Cost: Overall cost covering 11 tanneries and 1 chemicals plant, in million US dollars equivalent, over a period of 25 years (assumed life of plants).

	11 Tanneries	1 Chemicals Plant
Initial Capital Cost		
Land and buildings	3.3	1
Machinery	2.2	4
Maintenance[3] - 25 years (spare parts replacements, other maintenance)	8.75	15

I. The Project (contd)

Working capital - 25 years :	II Tanneries	I Chemicals Plant
Hides, chemicals	16.5	10
Chemicals for tanning	1.65	-
Labour	8.25	6.25
Total for 25 years	40.65	36.25

Products and values :[4]

Output of tanned, finished skins - 25 years	US$ 67.75 million
Output of chemicals - 25 years	US$ 60,45 million

Remarks:

Ten per cent of the forestry produce from the area; 60 per cent of animal husbandry outputs; and 40 per cent of employment (direct and indirect) are related to the above group of economic activities.

An outline sketch of the area in which the project lies is attached. The terrain is composed of rangeland, highland, cropland, wasteland, mudflats, beachheads, river and sea.

The economic resource bases consist of forest (approximately 40%), pasture (40%) and farms, beach resort, settlements (20%) (mainly of rock and rubble). Raw materials e. g. hides, are also drawn from outside the project area and help achieve economies of scale.

The project complex under assessment is the industry constellation, a recent addition to the ecological/economic scene of the area, (added as part of the ongoing development activities and sited in this area due to advantageous factor endowments and availability of labour for tanning), with mutual relationships with the surroundings, both positive and negative. The assessment is in order to arrive at a full cost-benefit indication of this industrial addition.

I. The Project (contd)

The total area itself has many other activities besides the industries, whose facets, e.g. unplanned forest logging, indiscriminate mangrove usage, pesticide and fertiliser systems in use in the farmlands, and wastes management in the human settlements including the beach resort - each have environmental dimensions which must affect a consideration of their own costs and benefits. These are not the subject of assessment per se in the present exercise.[5] All these activities are considered as old ones, having existed for a long time, with the new industrialization as the variable factor under assessment now.

---

1. Agricultural, Forestry, Fishery, Agro-Industrial, Industrial, Infrastructure, Habitat/Settlement, Cultural.

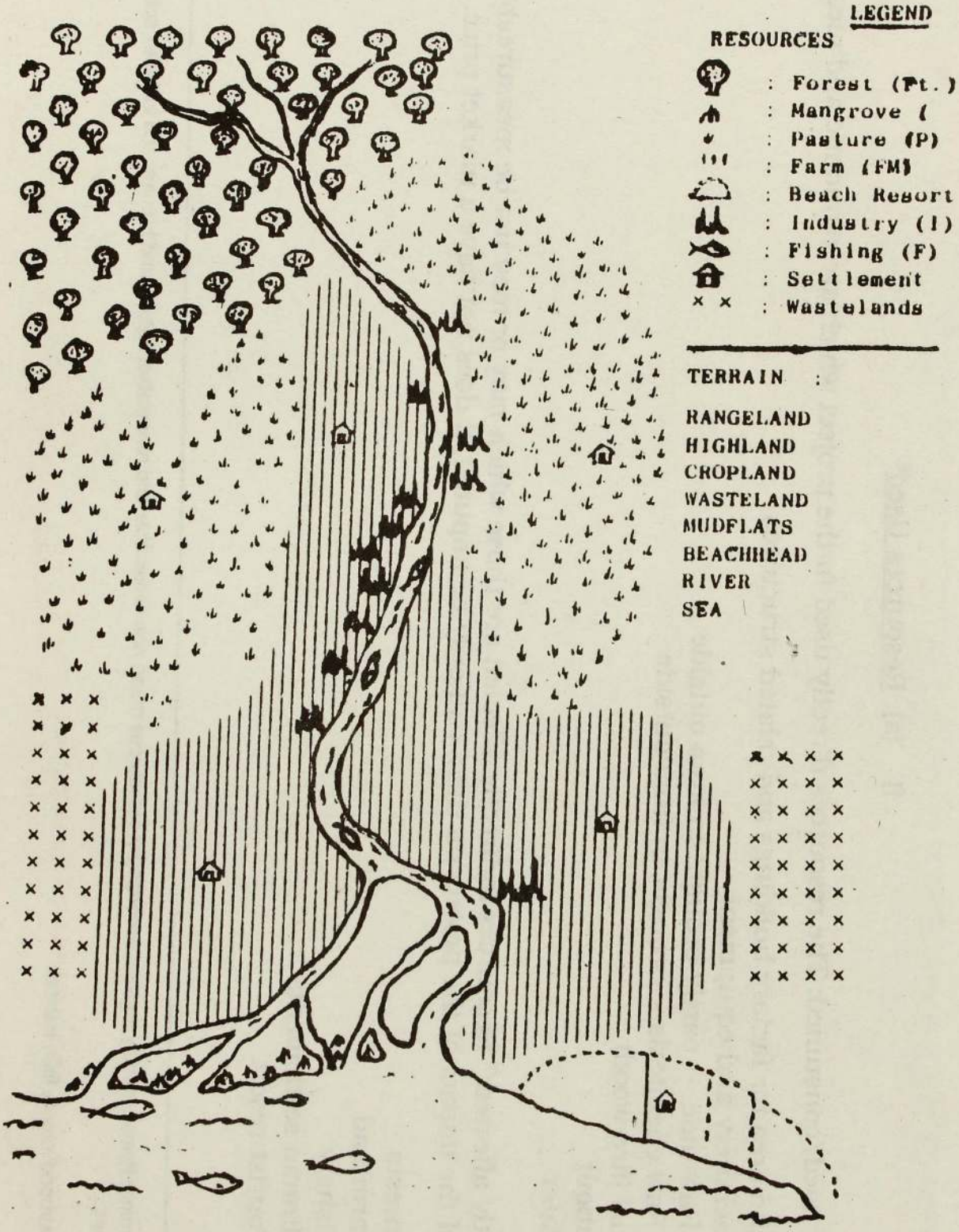
2. Expected productive life.

3. See Computations at Appendix.

4. At current prices. For discussion on non-use of price discounting, see Introduction above, and Environmental Assessment Statements : A Test Model Presentation; page (x) and pages 5-6.

5. For an introductory discussion of these, see 'Environmental Assessment Statements Test Model', page 7 on "project complexes" assessment; and the preceding comments (pages 6-7) on "continual" assessment system, for other activities that follow the initial investment.

Sheet 1 (b)



II. (a) Resources Used[6]

(i) Directly used/consumed: The resources directly used in the project which are economic and measurable

(a) Land area for factory buildings and related structures
(b) Machinery and equipment
(c) - Raw hide - partly brought in from outside
- Raw chemicals - brought in from outside
(d) Fuel (fire-wood)
(e) Labour
(f) Water

(ii) Indirectly affected:[7] Resources indirectly affected are those which may or may not be measureable; the value of the impact of the project on them can only be imputed, it does not have a market price.

(a) Forests
(b) Farmland
(c) Fishery
(d) Human settlements
(e) Tourist resort

---

6. Exclude minor items ; identify imports accordingly. Resources mean non-renewable and renewable, natural and human; and includes spatial and temporal dimensions.

7. 'Neighbourhood' crops, fish; habitat.

II. (b) Products and Residues Created[8]
These are goods and services which confer a benefit or involve a cost.

(i) Directly from development process :

(a) Water - effluents
(b) Chemicals (to be recovered from effluents)
(c) Unused by - products - ash from furnaces
(d) Hair - from tanneries

(ii) Indirectly, in affected areas:

(a) Wood tops, branches, roots, etc. left after fuel wood extraction.

8. Solid, liquid, gaseous (atmospheric); covers by-products, residues, wastes.

III. Resources[9] Exhausted/Depleted/Deteriorated
(By project as now implemented)

	Item[9]	How	Losses	
			Quantum[10]	Value[10]
(a)	Forests	Extraction of fuelwood without replacement	2,000,000 cu.ft. p.a.	$ 100,000 p.a.
(b)	Farmland	Made uncultivable due to discharge of untreated effluents	Total around 200 ha.	$ 300,000 p.a.
(c)	Fishery	Due to discharge of untreated effluents into river	90% of river harvest; 150,000 lbs.	$ 100,000 p.a.
(d)	Water	Used up for industrial process	Not estimated	$ 100,000 p.a.
(e)	Human settlements	By deteriorated quality of river water	15 per cent of supply	$ 30,000 p.a.[11]
(f)	Tourist resort	Air, water and landscape pollution	25% drop in tourist intake	$ 500,000 p.a.

9. Derived from II.
10. 'Value' considered as 'GDP' decrease or increase, as relevant.
Best approximation where so needed. Also where called for, set out qualitative notes.
11. See Computations at Appendix

IV. Resources[9] Enhanced
(By project as now implemented)

Item	How	Costs[12]	Gains	
			Quantum[10]	Value[10]
(a) Farmland: Pasture Cattle (b) Labour: Agricultural Industrial Forestry (c) Human Settlements	All enhancement under these resource categories are products of the economic activities, whose net gains are therefore already inherent in the economic cost-benefit computation; to be fully reckoned but not double counted in the environmental cost-benefit computation presented here: Main enhancements are: new employment created, and accretion in welfare and conditions of living as a result of income.			
(d) Domestic fuelwood	Becomes available as tops, roots, branches, after fuelwood for factories is extracted	Non-market labour	$ 500,000 cu.ft.	$ 20,000 p.a.
(e) Water	Part recycled in plant	$ 50,000 p.a.	50% of total	$ 50,000 p.a.[13]

IV. Resources[9] Enhanced (cont'd)

Item	How	Costs[12]	Gains	
			Quantum[10]	Value[10]
(f) Hair	As by-product	$ 5,000 p.a.	Not estimated	$ 15,000 p.a.

12. Estimated 'present' costs.
(Fixed-Maintenance-Working Capital, presumed average for project time-span).

13. Hypothetical. Assumption that benefit, at a minimum, matches the cost has been used as basis for inputing in some cases in the 'Environment Assessment Statements Test Model'. However, this is not for use as a 'first resort', or substitute for computation of value otherwise feasible.

V. Required Additional Project Components - for Resource Restoration, Maintenance, Expansion (Potential Activities)

Suggested Activity Item and Description	How	Costs[12]	Benefits	
			Quantum[10]	Value[10]
(a) Re-afforestation	Forestry replacement programme with selected fast growing species	$ 50,000 p.a.	1/10 of past depleted area; plus full replacement	$ 200,000 p.a. (+)
(b) Effluent treatment	Preventing deterioration of river water and farm land	$ 200,000 p.a.	Total effluent	$ 500,000 p.a. (+)
(c) Fish Culture	Re-introduction of species into river, Desiltation, replanting mangroves, etc.	$ 15,000 p.a. $ 50,000 p.a.	150,000 lbs.	$ 100,000 p.a. (+) $100,000 p.a. (+)
(d) Human settlements, environmental sanitation.	Through effluent treatment	$ 15,000 p.a.	Total area of human settlements	$ 100,000 p.a. (+)
(e) Tourist resort	Result of effluent management - mainly under (d)	$ 10,000 p.a.	Recovery of lost tourist intake	$ 10,000 p.a. (+)
(f) Recovery of chemicals from effluents	Conversion into commercial products	$ 5,000 p.a.	90% of effluent	$ 5,000 p.a. (+)*

Suggested Activity Item and Description	How	Costs[12]	Benefits	
			Quantum[10]	Value[10]
(g) Conversion of miscellaneous tops branches and roots into wood chips	Bricketing for fuel	$ 15,000 p.a.	50,000 cu.ft. equivalent[14]	$ 50,000 p.a. (+)
(h) Biomass	Pyrolysis of non-briket - table residues	$ 100,000 p.a.		$ 100,000 p.a. (+)
(i) Windmills	For water pumping	$ 100,000 p.a.		$ 200,000 p.a. (+)
(j) Restoration of cultural heritage	By repairing and cleaning up surroundings of monuments of cultural importance	$ 100,000 p.a.		$ 100,000 p.a. (+)

14. Hypothetical.

@ See 'Environmental Assessment Statements Test Model'. The Table at page xi, Item (h'), 'Input released'.

VI. Summary

I. The Project	Mainly industrial with agro-industrial linkage in the tanneries, Total cost - over 25 years :	$ 76.9 m.
	Products which are hides and skins and chemicals, accumulated total over 25 years:	$ 128.2 m.
	Among other relations, 60 per cent of the animal husbandry output and 40 per cent employment are related to the above project complex	
II. Resources Used/ Affected/Created	Apart from land, machinery and labour, the main inputs are raw hides and skins, chemical raw materials, and firewood for fuel.	
	The main resources indirectly affected are farmland; fisheries; water, tourist and cultural attractions.	
	The main residues created are water (some of which is recycled and used in the plants), chemical residues, and wood tops, branches and roots, after fuelwood is extracted.	
III. Resources Exhausted/Depleted/Deteriorated	The resources exhausted, depleted or deteriorated are considerable. The total losses in terms of output equivalent for 25 years: @ $ 1,400,000 p.a.	$ 35.0 m.

VI. Summary (contd.)

IV. Resources enhanced	The resources enhanced (outside of that inherent in the economic activities) amount to an equivalent for 25 years: @ $ 85,000 p.a.	$ 2.125 m.
	Their costs total, for 25 years @ $ 55,000 p.a.	$ 1.375 m.
V. Required Additional Project Components-for Resource Restoration, etc.	Several potentialities exist within the project activities for restoring and maintaining resources to economic advantage and for enlarging the supply of these resources by reconversion of the residues and indirectly affected resource areas.	
	These, in terms of output equivalent total, for 25 years @ $ 1,465,000 p.a.	$ 36.625 m.
	Their costs total, for 25 years @ $ 660,000 p.a.	$ 16.50 m.
VI. Decision-Making	The environment cost-benefit would be as follows:	

Environment Cost/Benefit

A.1.	The economic cost/benefit ratio, on the investments as initially planned, is 76.9 : 128.2 equals	1 : 1.67
2.	The attached GDP losses as a direct result of the economic activity, totals $ 35 million reducing the project's net output from $ 128.2 million to $ 93.2 million	
	Thus a real economic cost/benefit ratio would be 76.9 : 93.2 equals	1 : 1.21

VI. Summary (contd)

B.1. The costs of resources already enhanced plus those to be enhanced total $ 1.375 million plus $ 16.5 million = $ 17.875 million

2. The GDP equivalents of these two total $ 2.125 million plus $ 36.625 million = $ 38.75 million

C.1. The total project cost, i.e. the original economic investment cost plus the foregoing cost of resources enhanced = $ 94.775 million

2. The total project activities output of the original economic investment plus the results of resources enhanced = $ 166.95 million

D.1. The environment cost/benefit is 17.85 : 38.75 equals 1 : 2.2

2. An enlarged cost/benefit ratio incorporating the economic and environmental investments and outputs would be 94.775 : 166.95 equals 1 : 1.76

Note :

One component, namely the fuel input released into the economic investment as a result of alternative energy development which is an environmentally induced cost reduction in the economic cost/benefit table, has not been credited in the above. It has been presumed hypothetically that the additional alternative energy is providing a base for other increased economic development activity as well. Else, the net cost of the new energy will be less the'released' firewood fuel cost.

The cost/benefit assessment on the previous page may also be presented in tabular form, as follows :

Cost/Benefit Presentation

	Costs			Benefits	
Economic cost /benefit	(a) Original 'given' cost	76.9 m.	Crude c/b 1 : 1.67	Original 'given' benefit	128.2 m.
	(b)		Net c/b 1 : 1.21	Less output de-graded	35.0 m. 3
	(c)			Net benefit	93.2 m.
Environmental cost / benefit	(d) Enhanced resources	1.375 m.	Envtl. c/b 1 : 2.2		2.13 m.
	(e) Restored resources etc.	16.50 m.			36.25 m.
Enlarged cost / benefit	(f) 'Total' costs	94.775 m.	Total c/b 1 : 1.76	'Total' benefit	166.95 m.

Appendix I — Computations and Technical Notes

1. In this project, the extensive scientific, economic, cultural and social analysis of the various facets in, and relating to, the project complex are not detailed. These in fact constitute the customary presentations of Environmental Impact Statements (EIS), even though the latter may treat them from a more qualitative point of view.

   These background information and data, for the project complex herein, would cover a wide spectrum of specializations: Forestry, Agronomy, (Animal Husbandry, Farming) : Hydrology and Marine Biology (Fisheries) ; Environmental Sanitation and Engineering (Public Health, etc.) ; Tourism Planning and Human Settlements Development (Physical Planning, etc.); Chemical Engineering (Industry) : and Sociology and Economics (Assessment). All these technical notes, in well-digested presentations, would form essential components of this Appendix as well as of the total environmental assessment statement as a whole. The various conclusions eventually arrived at and converted into quanta or values - at Sections III, IV and V of the Environmental Assessment Statement (EAS) - would of necessity be derived from the foregoing technical background information. (See Appendix II).

   The role that environmental specialists have seen for themselves in EIS so far will necessarily continue but with more of the needed integrative approach between the natural and social sciences.

2. For the purpose of the illustrative project herein, only the following two computations are entered:
   (a) Page i. - Cost : Envisaged maintenance capital for 25 years as follows :

		$ Million
0 - 5 years	=	1.75
5 - 10 years	=	2.0
10 - 15 years	=	4.0
15 - 20 years	=	7.0
20 - 25 years	=	9.0
Total		23.75

(b) Page vi (d) - Human Settlements: Value has been derived as follows :

- Computation of incidence of related environmental illnesses derived from comparative experience, along with age group classification;

- Estimate of prophylactic treatments as applicable (vaccinations, innoculations)

- Estimate of hospital building and similar expenditures;

- Estimate of medical costs in terms of average unit, such as per bed;

- Estimate of fall in productivity of employed work force.

While the last item is a GDP effect, the others are an additional cost effect in a cost/benefit presentation and could be added to the industrial project cost. For the purpose of the presented illustrative project, they have instead been cumulated as deductions from the project GDP, assuming that the latter is less to the extent of 'health' costs.

Ironically, health provisions could also be read as responsible for GDP increase, by the employment and services generated, thus giving a matching benefit for cost. An epidemic prevented, will not be in the GDP, except marginally due to environmental sanitation; but an epidemic treated will, by the services and treatment extended, become an increase in GDP, to the chagrin of the environmentalist! (Of course, in final reckoning, an epidemic also first depresses the GDP by loss in productivity and the subsequent net GDP result may vary). The approach adopted in the above exercise, while not necessarily recommended for universal application, could somewhat help overcome such a depressing conclusion.

CATEGORIES : RESOURCES OF THE ENVIRONMENT

1. Air (atmosphere)
2. Water (all fresh water : rivers, lakes, underground)
3. Soil
4. Minerals
5. Montane ecosystems / rangelands
6. Forests
7. Grasslands
8. Croplands
9. Coastal areas (including corals, mangroves, deltas, island ecosystems)
10. Seas/oceans
11. Habitat : genetic resources; wildlife
12. Habitat : human settlements
    - urban
    - rural
    - infrastructures
13. Social endowments
    - cultural/heritage
    - aesthetic
    - recreational
14. Others

Environmental Assessment

A Note on Definition and Content of Relevant Terms[1]

1. The Environment is the total surroundings, of our natural, human and man-made resources.

2. Environmental Impact (of a development including past or already existing development) is:

   - the adverse impact on the environment of the development (the familiar syndrome)
   - The beneficial impact on the environment of the development (e.g. rice fields, inherently following construction of a dam)
   - The adverse impact on the development of the environment (e.g. saline, marsh or arid ground)
   - the beneficial impact on the development of the environment (confluence of e.g. soil, rain, raw material, transport, labour, etc.)

3. Environmental Quality is a given state in the quantum or composition of resources involved in the development, created by any or all of the processes of:

   - exhaustion; depletion; deterioration (the last, per se; or transformed as residue or waste)
   - enhancement (i.e. inherent in the development)
   - restoration; maintenance; expansion (all three, by planned action)

   While quality is a static measure of a state at a given time, quality itself is the result of a dynamic process of change over a period of time.

4. Environment Management is the obtenance, by judicious handling of the impact and quality changes above, of the optimum sustained benefits from the development. Benefits mean accretion of positive gains as well as minimizing of adverse effects to the extent possible.

5. Environmental Assessment/Environmental Impact Assessment is the evaluation of the various impacts and the resultant natural and induced changes, as simply and precisely as possible for optimizing the total benefit to the development and to the environment, the latter conceived as the basis for 'sustained development'.[2]

6. Environment Assessment Statement is the presentation of the foregoing in a manner conducive to making the required investment and development decisions.

---

1. The above Note was the definitional basis used in 'Environmental Assessment Statements : A Test Model Presentation'. (UNEP Reg. Off. - UN Asian and Pacific Development Institute, Bangkok, March 1980).

2. It is noteworthy that this phrase was used when this Model was first developed, as early as 1980!

VI. The Expanded System of Environmental-Economic Accounting (S.E.E.A.)[1]

PART 'A' - STATUS

Introduction

1. The General Assembly of the United Nations, in December 1989, decided that the coming U.N. Conference on Environment and Development (UNCED) should aim at recommending measures to be taken at the national and international levels to protect and enhance the environment, taking into account the specific needs of developing countries, through the development and implementation of policies for sustainable and environmentally sound development with special emphasis on incorporating environmental concerns in the economic and social development process and of various sectoral policies and through, inter alia, preventive action at the source of environmental degradation, clearly identifying the sources of such degradation and appropriate remedial measures, in all countries.

2. A report was therefore prepared by the United Nations Statistical Office (UNSO), which was at the time currently developing methodologies for integrated environmental-economic accounting in co-operation with the World Bank and other organizations. Relevant information was also obtained from UNCTC, the World Resource Institute, ECLAC, OECD, UNU, ECE, and other sources.

Setting

3. The overall goal of economic development is the fulfil

---

1. Since this Chapter is concerned to reflect the lead work of the United Nations in this field, the text below is based mainly on the contributions of the United Nations Statistical Office, and of Peter Bartelmus of that Office. Some of the discussions or conclusions on economic or environmental accounting, even though open to further discussion, are recorded as given.

ment of human needs and aspirations, and to the extent possible the accumulation of wealth for the needs of future generations. The development process is made possible by the use in production systems of key inputs such as natural resources, man-made capital, technology, labour and managerial capacity. In view of the increasing stress observed on some ecosystems of the planet and the depletion of some of its natural resources, the concept of sustainable development has been introduced to ensure the continuation of economic development without compromising further development in the future. Sustainable development therefore recommends that policy decision-makers in aiming to fulfil the needs of present generations should also aim at maintaining the income generation capacity of economies (and enterprises).

4. Sustainable development policies should engender changes in production and consumption patterns as well as significant shifts in technology use and macro and micro-economic management. Moreover, it should shift environmental policies from an approach of dealing with environmental problems after their occurrence to an anticipatory approach of addressing the sources of environmental depletion and degradation. One first step towards the integration of sustainability concerns in macro-economic management would be the establishment of better measurement of how the environment plays a crucial role as a source of natural capital and as a sink for by-products generated during the production of man-made capital.

Towards an SNA Satellite of Integrated Environmental and Economic Accounting

5. Systems of National Accounts (SNA) have provided the most widely used indicators for the assessment of economic performance, trends of economic growth and of the economic counterpart of social welfare. However, three major drawbacks of national accounting have

raised doubts about the usefulness of national accounts data for the measurement of long-term sustainable economic growth and socio-economic development. These drawbacks include :

(a) the neglect of scarcities of natural resources which threaten the sustained productivity of the economy;

(b) the failure to account for the degradation of environmental quality and its effects on human health and welfare; and

(c) accounting for environmental production expenditures ('defensive' expenditures) which tend to increase national product but which may instead be considered as social costs for the maintenance of environmental quality.

6. In view of the fact that no international consensus has yet been reached on how to incorporate environmental costs and benefits as such in national accounts, it seems premature to expect radical changes in the SNA, a well-established system of economic accounts that serves many different, in particular short and mid-term, socio-economic analyses. Further reasons for not replacing the conventional accounts are the experimental nature of environmental accounting and possible inconsistencies in the valuation of non-marketed goods and bads (pollutants) and the values of market transactions. The elaboration of the standards of environmental and natural resource accounting in an SNA satellite system of environmental accounts has therefore been proposed for consideration in several fora. This approach permits close linkage to the SNA without disrupting the core system. The ultimate objective is twofold:

(i) to provide policy decision-makers with more accurate information bases to support sustainable development policies;

(ii) to allow users of economic data to choose among different information systems according to their particular area of interest.

7. The proposed satellite System of Integrated Environmental and Economic Accounting (SEEA) follows as far as possible the principles and rules established in the SNA. It is based on SNA's production boundary, follows its analysis of costs and outputs and incorporates the same accounting identities between supply and use of products and between value added and final demand. However, traditional systems of national accounts, focusing on market transactions, do not record changes in the quality of the natural environment and the depletion of natural resources. These effects are particularly relevant for the measurement of an adjusted concept of value added in production, which is compatible with long-term environmentally sound and sustained economic growth, and of an adjusted concept of net income, which takes into account the welfare aspects of environmental depletion and degradation.

8. The main objectives of the SEEA can be summarized as:

(a) Segregation and elaboration of all environment-related flows and stocks of traditional accounts.

Satellite accounts, in the narrow sense of detailed accounting for expenditures and revenues in major areas of social concern, have been pioneered by France. There is now an increased interest in identifying separately all flows and stocks of assets in national accounts related to environmental issues and in estimating the total expenditure for the protection or enhancement of the different fields of environment. One objective of this segregation is the assessment of the increasing part of the Gross Domestic Product (GDP) which reflects so-called "defensive expenditures". These are in effect current efforts to defend people against the effects of pollution and saturation of the sink capacity of ecosystems. It has been argued that such expenditures distort

the final results of economic activity, which should be calculated net of the cost of environmental restoration.

(b) Linkage of physical resource accounting with monetary environmental accounting and balance sheets.

Physical resource accounts aim at covering comprehensively the total stock of reserves of natural resources and changes therein, even if these resources are not (yet) affected by the economic system. The proposed accounting for these resources in SEEA is considered as the "hinge" by which comprehensive physical resource accounts could be linked to the monetary balance sheets and flows of the SNA. Non-monetary data in physical accounts are thus an integral part of a more comprehensive elaboration of the SEEA.

(c) Assessment of environmental costs and benefits.

In contrast to the above-mentioned limited approach, a broader framework for satellite accounting, covering additionally external environmental costs and benefits, is proposed in the SEEA. Taking the current state of knowledge and data availability into account, the SEEA focuses on expanding and complementing the SNA with regard to two major issues, namely:

- the use (depletion) of natural resources in production and final demand; and

- The changes in environmental quality, resulting from pollution and other impacts of production and consumption, on the one hand, and environmental protection and enhancement, on the other.

Possibilities of extending SEEA for the analysis of environmental welfare effects, i.e. the "damage costs" of the impairment of human health, recreation and other aesthetic or ethical values, are further issues under discussion.

(d) Accounting for the maintenance of tangible wealth.

The generally advocated paradigm of sustainable development stresses the need to account for the use of both man-made and natural assets in order to be alert to possible non-sustainable growth and development patterns. SEEA therefore extends the concept of man-made capital (stocks of commodities and fixed capital) to include natural assets. As a consequence, SEEA accounts for the additional costs of the depletion and degradation of these assets, which extends the concept of capital formation into one of capital accumulation. A further extension could also reflect the transfer or "discovery" of natural capital for economic use.

(e) Elaboration and measurement of indicators of environmentally adjusted product and income.

The consideration of the depletion of natural resources and changes in environmental quality permits the calculation of modified macro-economic aggregates, notably an Environmentally adjusted Domestic Product (EDP). Possibilities of introducing an Environmentally adjusted National Income concept (ENI), which would account for further health and welfare effects of environmental impacts, are also currently being reviewed.

9. Accounting framework and procedures.

The difference between the SEEA framework and conventional accounting lies in the introduction of environmental costs of "quantitative" depletion of natural resources and "qualitative" environmental degradation (largely from pollution), mirrored in the expansion of capital asset boundaries to include natural assets.

10. Accounting for Sustainable use of natural resources

Natural resources are considered to be part of the tangible wealth of a nation. The SEEA thus includes, in

addition to produced assets of man-made capital goods and stocks of commodities,

(a) produced, but "naturally" grown, assets of agriculture, forestry and fishing; and

(b) non-produced natural assets of

- scarce renewable resources "in the public domain", i.e. the natural environment, such as marine resources or tropical forests whose growth is considered to be outside the active manageral control of agriculture, forestry and fishing,
- non-renewable resources of land, soil and sub-soil assets (mineral deposits), and
- cyclical resources of air and water:
- the capacity of the natural environment to absorb and dissipate pollutants and wastes without unacceptable levels of damage and risk.

The depletion of natural resource capital by different economic activities is recorded as an environmental cost of these activities. Together with the costs of intermediate consumption, environmental depletion costs can be deducted from gross output for the calculation of "sustainable gross value added". In order to maintain the accounting identities of the SNA, the same deduction has also to be made from final demand.

11. The above-mentioned physical resource accounting methodologies provide relatively straightforward tools of measuring depletion rates of natural resource stocks or reserves. However, placing monetary values on these stocks or changes therein is more controversial. Where natural resources are substitutable by other - marketed - materials, or human or produced capital, the estimation of the replacement costs, i.e. the market value of

procuring the substitute, is probably the best valuation procedure. Where such substitution possibilities do not exist, i.e. in the case of "complementary" resources, valuation is more difficult, since the eventual exhaustion or irreversible degradation of these resources foreclose any options for future generations to produce the same output with the same production technology. Various valuation procedures have been advanced and these include depreciation of the total economic value of natural resources or alternatively the calculation of a user-cost allowance.

12. Accounting for environmentally sound production in consumption:

Environmentally sound production and consumption patterns allow for the maintenance or improvement of environmental quality. The costs of neglecting such maintenance, i.e. of allowing continuous environmental degradation by economic activities are actually economic costs for using natural resource services. These costs are allocated to the different industries and private households responsible for waste discharge and pollution or other impairments of the quality of air, water and land. Further impacts result from the involuntary "importation" of residuals, e.g foreign waste dumping on national territories, and from the residuals of scrapped capital goods. Total environmental degradation is mirrored by a decrease in the value of non-produced natural assets and an "export" of residuals.

13. The deduction of environmental costs from conventional macro-indicators does not mean that these costs are actually internalized at the micro-economic level by individual economic agents. These costs are imputations which do not affect supply and demand patterns and corresponding price formation during the accounting period. The deduction of such imputed values generates aggregates whose valuation has not gone through the mill of price formation in the market and which are

therefore not strictly comparable to the value of market transactions presented in national accounts. The function of indicators, modified by such imputations, might thus be more to alert to structural distortions of the economy and unsustainable trends in its growth than to provide an accurate picture of past economic activity.

Establishing SEEAs In Member States

Basis for Action

To do proper accounting and to measure more accurately what is true income is in itself important. But perhaps even more important is the contribution that this improved information will make to better policy-making at the national level. Some countries have already expressed their interest in establishing better accounting practices to include natural resources in order to help decision-makers in making policies that better contribute to sustainable economic development. Substantial knowledge has been gained through research and case studies on natural resource accounting at the national level. In many countries relevant and sufficient information has been gathered although not necessarily organized in a way to be readily used in the preparation of SEEA. The preparation of national reports for UNCED may contribute to the organization of information for SEEAs, in a future phase.

Introduction

An important outcome of the 1972 U.N. Conference on the Human Environment in Stockholm was to affirm that environmental problems are caused by highly accelerated economic growth as well as by activities induced by an actual lack of development. A broader view of environmental damage was also advanced, which included, besides the discharge of toxic substances, the degradation and depletion of natural resources. An integrated and co-ordinated approach to development planning, which included safeguarding the natural resources of the earth for the benefit of present and future generations, was proclaimed in the "principles" of the conference report (United Nations 1973).

Eight years later the IUCN World Conservation Strategy advocated the "achievement of sustainable development through the conservation of living resources" as its basic aim. The International Development Strategy for the Third U.N. Development Decade for the Eighties also referred to the "need to ensure an economic development process which is environmentally sustainable over the long run" among its goals and objectives. During its 38th session the U.N. General Assembly called upon the World Commission on Environment and Development to propose long-term environmental strategies for achieving sustainable development by the year 2000. Sustainable development was the all-pervading theme of the Commission's Report, issued in 1987.

Although there is general agreement on the desirability of sustainable economic growth and development, it is less clear how "sustainability" can be defined operationally so that indicators can be developed that signal significant deviations from the sustainable path of development. It appears that politicians in most countries continue to base their decisions on the assumption that overall economic and

social welfare rises and falls with the popular macro indicators of gross domestic or national product, GDP or GNP. In fact, these indicators are usually taken to move parallel with aggregate income, which is obtained by making an allowance for the wear and tear of capital assets used to produce output and corresponding income. As far as the produced capital is concerned, an element of sustainability is thus introduced in the definition of national income. This approach reflects the Hicksian view of income as a practical guide for prudent conduct toward consumption, which should not exceed a certain limit beyond which a person or a population would be impoverished.

The concept of capital maintenance has not been extended to natural and human capital assets in national accounting. As a result, in the case of natural assets, the degradation and depletion of the natural environment and its resources contribute to illusionary income flows that cannot be maintained in the long run. Moreover, expenditures by government or households for "regrettable" measures to counteract deteriorating environmental conditions actually increase national product and income. Measures of economic welfare were therefore advanced that purported to correct the misclassification of regrettable expenditures as final and that made allowances for important nonmarket activities, environmental degradation, and the depletion of natural resources. Best known are perhaps the pioneering efforts by Nordhaus and Tobin made popular by Samuelson's textbook as "net economic welfare" or `NEW'.

At the request of the U.N. Committee for Development Planning, the U.N. Statistical Office (UNSO) critically reviewed the concepts, methodologies, and empirical applications of these measures. The review concluded that considerable conceptual and measurement problems make estimates of the value of environmental damage "essentially exercises for multidisciplinary research and experiments, not for routine collection of statistics," and that difficulties of agreeing on the scope, concept, and measurement of welfare would render such approaches "inappropriate for official and

especially international use". The environment statistics program of the UNSO focused, therefore, on developing physical statistics and related indicators. A significant limitation of such data is that they lack a common numeraire, which would permit aggregation across broad sectors of the environment. Despite its limitations, GDP thus continues to be the main indicator of economic success or failure.

Joint UNEP/World Bank workshops set out, therefore, to reexamine the feasibility of physical and monetary accounting and concentrated on the field of environment and natural resources. This field appeared to be better researched and easier to assess than the whole gamut of welfare effects originally addressed by economic welfare measures. A consensus emerged in the workshops that enough progress had been achieved to link environmental accounting to the standard System of National Accounts (SNA) (United Nations 1968) and to include certain aspects of environmental accounting in the ongoing revision on the SNA. This Part examines the treatment of environmental issues in the SNA and reviews the main approaches to resource and environmental accounting for possible linkage or integration with the SNA.

Environment Statistics and Physical Accounting

The close interactions among environment, population, natural resources, and development require an integrated approach to planning and policy formulation, which in turn need to be supported by comparable social, economic, and environmental data. On the one hand, environment statistics systems attempt to compile raw data from a multitude of sources and to present them in a coordinated manner in statistical compendia such as yearbooks and bulletins. Further aggregation and more rigid presentation of the stocks and flows of natural resources in physical terms are, on the other hand, the objective of natural resource accounts and balances.

Environment Statistics

At the international level, the Conference for European Statisticians (CES 1973) of the Economic Commission for Europe took the initiative to develop a system of environment statistics that would complement the already existing systems of economic statistics (the SNA) and social and demographic statistics (the System of Social and Demographic Statistics, (SSDS) (United Nations 1975). It soon became apparent, however, that the current state of knowledge about the environment and its statistical measurement, as well as widely differing environmental concerns and priorities, did not permit an internationally applicable statistical system to be established. Therefore, under the guidance of the U.N. Statistical Commission, the UNSO developed a flexible Framework for the Development of Environment Statistics (FDES) (United Nations 1984). Since the FDES itself does not recommend statistical definitions and classifications, no direct linkage through common concepts and classifications was established with the SNA or other statistical systems.

The FDES was then expanded into a series of technical reports on "Concepts and Methods of Environment Statistics," which will propose definitions and classifications for statistical variables and indicators of high priority. Because these statistics include indicators of resource depletion and environmental degradation, their use for establishing resource and environmental accounts in physical terms will be addressed specifically in a report on "Statistics of the Natural Environment." These methodologies will be applied at the regional and national levels in a Global Program of Environment Statistics.

Materials/Energy Balances

Close linkage to the SNA has been attempted in more selective approaches to accounting for flows of materials and natural resources. The UNSO developed draft guidelines for statistics on materials/energy balances (MEB), which were seen as a module of a larger system of environment statistics

(United Nations 1976). The primary purpose of the MEB is to trace the extraction and transformation of materials and energy from natural resources, through various successive stages of processing, to final use, and thence back to the environment as waste or, alternatively, to secondary use. Compatibility with the SNA is achieved by using its standard categories, such as domestic output and consumption, imports, and exports, and its classification of economic activity. Contrary to the concepts of market transactions and monetary valuation used in national accounting, physical stocks and flows and materials/energy transformation processes are presented in such balances.

The U.N. Statistical Commission considered the MEB to be an interesting long-term approach, but too ambitious for short-term implementation because countries still lack the necessary statistical capabilities. As a consequence, only the energy part of this approach was further developed in balances that show energy flows from the production of primary energy, through conversion processes, to the stage of final consumption (United Nations 1988).

A work program to standardize definitions and terminology for mineral resources was initiated by the U.N. Committee on Natural Resources and later transferred to the Statistical Commission. The Commission requested the UNSO to further develop mineral consumption statistics and raw material balances (including the secondary recovery of metals), provided the necessary resources could be made available. Such resources could not be found, however, and work on this program had been suspended.

Environmental Aspects of Input-Output Systems

In focusing on processes of resource flows through the economic system, the MEB can also be considered as a physical extension of the input-output tables of national accounting. These models can incorporate resource requirements and waste residual outputs, which reflects the fact that the materials/energy inputs and outputs for the economy

must always balance. However, detailed classifications of production processes that provide for a further breakdown of the relatively heterogeneous classification by industries would be needed to obtain more stable technical coefficients of resource use, production and residuals.

Although the SNA provides for the full integration of input-output tables, country tables were often compiled separately from national accounts because they focused on specific analytical uses. A future handbook on input-output statistics and the current review of the SNA as a whole will address problems of better integration of input-output practices into the SNA framework. For the time being, however, there are no plans to deal specifically with natural resource and energy flows or pollution processes in the input-output system.

Resource Accounting

A few countries with well-developed monitoring and data collection capabilities have turned to a somewhat simplified physical accounting approach. The basic objective of resource accounting systems is to provide a coherent picture of resource use and depletion or increase, which can be linked to, or integrated with, the national accounts. Norway's resource accounts concentrate on selected natural resources and extend the SNA balance sheets to cover the total stock (including nonmarketed stocks) of the respective natural resources in physical units. The French "patrimony" approach is more ambitious in its attempt to include ecological processes that are not directly affected by human intervention, that is, interactions among the physical components of the environment and its biota.

Environment and Natural Resources in the SNA

Common to all the above approaches is the use of physical units, which permits aggregation only in very limited areas as, for example, in the energy sector by means of conversion factors. Physical accounts and the indicators

presented in their framework assess resource availability, use, and overuse, and they are thus important tools for managing natural resources. However, they are only an intermediate step in the overall assessment of the national resource base, which is required to formulate and evaluate resource policies that are compatible with general development policies. To calculate overall measures of economic performance, a common numeraire, such as the monetary unit of national accounting, is needed. Therefore, aspects of the environment that are already covered by the SNA are examined below before any further methodologies of monetary environmental accounting are described.

Flow Accounts

The basic objective of the SNA is to provide "a comprehensive and detailed framework for the systematic and integrated recording of the flows and stocks of an economy" (United Nations 1968). No explicit reference to the environment or natural resources is made in any of the core flow accounts described in the "blue book" of the SNA. Various activities listed in the international standard industrial classification (ISIC) refer, however, to the use of natural resources such as agriculture, hunting, forestry, logging, fishing, mining, water supply, and transportation as well as to the environmentally related services of housing and sanitation. Similar services are also reflected in the classification of government expenditures by purpose. Since the cost of land improvement is included in gross capital formation, this concept also covers transactions dealing with selected natural resources. In none of these concepts and classifications, however, are environmental transactions clearly identified. They are typically lumped together with other nonenvironmental transactions. Moreover, certain environmental expenditures are treated as final where they actually represent a cost to society. (see "Environmental Costs and Expenditures," below).

Balance Sheets and Reconciliation Accounts

To date, national efforts have largely focused on the accounting of flows or transactions to the neglect of the

stocks presented in balance sheets. This occurs despite the fact that balance sheets form an integral part of the SNA, linked to its flow accounts through capital transaction and reconciliation accounts. There has been growing interest, however, in measuring national wealth and, in particular, its tangible aspects, a significant part of which is made up of assets of the man-made and natural environment.

Following a recommendation of the "blue book", the UNSO issued detailed guidelines on balance sheet and reconciliation accounts within the framework of the SNA (United Nations 1977). The guidelines distinguish between reproducible tangible assets, including the fixed assets and stocks of enterprises, financial institutions, government, and private nonprofit institutions, and the nonreproducible tangible assets of natural resources and historical monuments. The classification of stocks and fixed assets presents important aspects of the man-made environment and lists buildings and infrastructural works as part of fixed assets. The measurement of the availability and use of natural resources and the assessment of related environmental problems are considered to be some of the main uses of the classification of nonreproducible tangible assets. Land, timber tracts and forests,subsoil assets and extraction sites, and fisheries are the principal categories of this classification.

In line with the basic principle of the SNA to limit its scope mainly to market activities (except for imputations for directly competitive nonmarket activities), natural resources in the public domain are excluded. This category includes rivers, lakes, parklands, unused wilderness, and the atmosphere, which are not subject to ownership rights and are thus generally not sold or purchased. Outlays on the permanent improvement and extension of these items are covered in capital formation and thus increase the reproducible tangible assets (as "other construction works" or "land improvement") of the balance sheets. But no capital consumption is charged against these outlays. However, the total initial expenditure for naturally growing but commercially traded assets, such as the stock of animals, timber tracts, plantations, and

fisheries, is counted as capital formation. Further growth and depletion are not recorded as capital formation but are included in "reconciliation accounts" (see below).

Balance sheet accounts are linked to the SNA flow accounts by capital finance accounts, which portray a significant part of the changes between opening and closing assets and liabilities. There are, however, several other changes in assets and liabilities, such as revaluations, unforeseen events, and, in particular, increases or decreases in nonreproducible assets, which are not included in the flow accounts of the SNA. To cover all differences between the balance sheet accounts at opening and closing dates, these changes are formally introduced in so-called reconciliation accounts.

The following items of the reconciliation accounts are particularly relevant for environmental analysis: natural growth less depletion of timber tracts, forests, and fisheries; new finds less depletion of subsoil assets; and losses in land and timber tracts in catastrophes and natural events. Changes in land quality due to erosion, waterlogging, desertification, or upgrading and increased availability of mineral resources due to technological advances are not shown separately. They are recorded as changes in the market value of land and subsoil assets as part of the revaluation item of the reconciliation accounts. All these items are excluded from the capital transaction accounts and thus do not affect the level of national income or product.

Monetary Environmental Accounting

As already discussed, physical indicators and accounts cannot be aggregated into overall measures of resource depletion and environmental degradation. Consequently, they cannot be compared directly with the standard measures of economic performance to assess the sustainability of economic growth or development. For this reason, physical measures have not become standards in national planning and policymaking, but have been largely restricted to use in environmental and resource management. Because of the

prominent role of national accounting and its main aggregates in formulating and evaluating national plans and policies, various environmental accounting approaches attempted to tackle the issue of sustainability and environmental degradation within, or as close as possible to, the established systems of national accounting.

Most of these approaches favour the direct adjustment of SNA concepts, classifications, and tabulations. It is hoped that this would cause politicians and administrators to base their plans and decisions on a concept of sustainable income, which accounts for the total cost of destructive and wasteful uses of the environment and natural resources. During the recent revision of the SNA, however, it was generally agreed that no significant conceptual changes should be introduced in the central framework of the SNA. Rather, the emphasis should be on clarifying, simplifying, and updating the SNA for both producers and users of the system and on improving its consistency with other international standards of statistics. A possible compromise (suggested below in "Future Work") is to elaborate the different methods of environmental accounting in satellite accounts and tabulations of the SNA.

The following review of the main approaches discussed in the UNEP/World Bank workshops illustrates the possible contents of satellite accounts. These basic categories of environmental accounts are distinguished according to the main environmental concerns addressed in the workshops, namely accounts of environmental costs and expenditures, natural resource capital, and environmental services.

Environmental Costs and Expenditures

The measurement of environmental outlays and, as far as possible, of resources or "incomings" of the principal agents of the national accounting system has been pioneered by France in "environmental satellite accounts". Operating (running) costs or current outlays are distinguished from investment and other capital formation expenditures. One of the main problems in this approach is to identify the environ-

mental activities for which outlays have been incurred. This problem exists because the standard classifications of the SNA were not designed to generate statistics on environmental expenditure.

For government expenditures, the classification of the functions of government (COFOG) does not yet contain a category relating to the protection of the environment, but it indicates that such a grouping may be feasible in the future (United Nations 1980). A list of functional classes that include information on research and other aspects of environmental protection is advanced for "further examination". A draft classification of outlays of industries by purpose (COIP) was developed by the UNSO in 1975 but was not further discussed or promoted. It lists nine categories, one of which specifies outlays on pollution abatement and control. For this category, outlays for "end-of-line" measures are said to be relatively easily allocated. However, the incremental costs of measures that are incorporated in the production process can be only estimated. For private nonprofit bodies serving households, the SNA contains a classification of purposes consisting of eight categories that do not specify environmental purposes. For households, the SNA's classification of household goods and services might eventually be linked to a general and more detailed central product classification (CPC), which has been prepared by the UNSO. One division of this classification reflects environmental functions in categories such as "sewage and refuse disposal" and "sanitation and similar services".

The development of functional classifications in the SNA that cut across sectoral boundaries and identify expenditures for environmental purposes would permit these expenditures to be aggregated for the whole field of the environment and broken down by environmental protection category. The aggregate of the total (final and intermediate) environmental expenditure describes how much a nation has been willing to spend on environmental protection during the accounting period. This aggregate also facilitates international comparisons, since it is not affected by different institutional arrangements for environmental policymaking and budgeting.

Functional classifications of environmental expenditures can also be used to measure so-called defensive expenditures incurred by the government, households, or industry to counteract environmental degradation. When such expenditures are counted as final consumption or investment, they increase directly national product or income. Government expenditures typically include outlays for environmental protection and remedy, while households might bear the cost of medical treatment for pollution-related diseases or the avoidance of environmental disamenities, for example, by resettlement. If environmental expenditures are incurred by industry, however, their current cost component is counted as intermediate consumption, which potentially decreases (in the case of full employment of the factors of production) industrial value added, that is, industry's contribution to national product. Capital expenditure for environmental protection by industry is treated, however, as final expenditure and is thus fully counted as an increase of GNP.

All these expenditures serve only to maintain a certain level of environmental quality or, in other words, to "defend" society against the unwanted side effects of production and consumption. They could, therefore, be considered as a cost to society, to be deducted from gross production and final consumption (see "Indicators of Sustainable Product and Expenditure," below). Apart from expenditures for environmental protection and compensation for environmental damage, defensive expenditures may also include other social costs of urbanization and industrialization, such as commuting costs and provisions for environmental hazards in industries and the working environment. As already mentioned, it may be difficult to identify separately defensive costs in the case of combined measures that restore environmental conditions and raise productivity or utility at the same time.

The social restoration cost of meeting or maintaining environmental standards for safeguarding sustainable economic development has been advanced as an indicator that might usefully supplement national product. The indicator describes how far a nation has drifted from its desired level

of environmental quality and can thus be compared with the extent the nation has progressed in raising its level of production. Standards for sustainable development could be set by decision makers or by science, and appropriate measures to meet these standards could then be formulated and costed. For irreversible losses of renewable resource (extinction) or for nonrenewable resources, the cost of developing alternative resources or facilities could be estimated. The method of using standards has been proposed because of the difficulties of devising shadow prices for environmental functions (and their losses) that are directly comparable with market prices of produced goods and services.

Natural Resource Capital

Most changes in the resource assets of a country have been excluded from the standard flow accounts of the SNA because of the lack of reliable data and uncertainties in estimation and valuation procedures, particularly for assets whose returns are typically spread over many accounting periods. As described above, some of the more commercial changes are recorded separately in reconciliation accounts, but these accounts have rarely been prepared and thus are largely neglected in policymaking. Now, however, awareness of the unsustainability of income resulting from the consumption of finite natural assets has created new interest in accounting for selected resources in physical accounts and has also revitalized attempts to assign monetary values to the stocks and flows of these accounts.

In principle, such accounts can be developed in harmony with national accounting concepts by extending the SNA's balance sheets to cover fully natural resources such as water, forest, or wildlife, even if they have not been the object of commercial transactions. Contrary to the practice of reconciliation accounts, the separate listing of additions (discoveries, net revisions, extensions, growth, or reproductions), reductions (extraction, deforestation, or degradation), and revaluations in "national income accounts for natural resources" has been proposed to record changes in the values

of the stocks of natural resources during the accounting period. Net changes in the value of the resource position can be estimated from these accounts for the calculation of sustainable income or product indicators. Other procedures to estimate the depletion factor in the calculation of sustainable income include applying depreciation principles to the stock of natural resources or calculating user cost allowances for their intermediate consumption (see "Indicators of Sustainable Product and Expenditure," below).

Environmental Services

The amount of environmental expenditures or costs described above does not reflect the correct value of actual environmental damage. On the one hand, the value of damage may be higher or lower than the cost of repairing it. On the other hand, accounting for environmental expenditures neglects the fact that pollution is connected with both the benefits of using nature's disposal and absorption services and the "disbenefits" resulting from losses of these and other services that benefit consumers directly. Contrary to defensive expenditures, these services are not priced by the market system and are thus excluded from standard national accounts.

The introduction of a natural production account into the national accounting system was therefore suggested. Such an account would record environmental services (for example, waste disposal, cooling, and provision of oxygen and nutrients) as output from, and environmental damage (in particular pollution effects) as input into, the environment, with the balance representing a net environmental loss or benefit. Industry, government, and household production accounts receive nature's output as "free" services (counted as a subsidy or negative input) and deliver environmental "bads" (as negative outputs) to nature's production account.

The model claims to be fully consistent with the principles of neoclassical economics in measuring the environmental aspects of social welfare. There are, however, considerable

problems in measuring and valuing nonmarket contributions from and to nature and in double counting the external economies and diseconomies of these contributions that are already reflected as productivity changes in the production accounts.

Indicators of Sustainable Product and Expenditures

The environmental accounts described above produce aggregates that can be used to modify the value added or the value of gross production created, and the amount of expenditures allocated for consumption and investment by those transactors of the economy that use or protect natural resources and environmental services. Accordingly, the following new concepts of gross and net domestic product, income and expenditure have been proposed to supplement traditional GDP or NDP calculations.

Sustainable Net Product and Expenditure

Correcting national income for changes in the net resource position, which is obtained from accounting for depletion and the increase in the stock of natural resources, has been proposed for calculating indicators of sustainable income or product (see "Natural Resource Capital," above). It has been argued, however, that geological discoveries of natural resources can be neglected, since they do not reverse the process of depletion but extend only the period over which depletion can continue. Consequently, if the depreciation concept were extended to the consumption of natural capital by resource exploiting industries, it would account sufficiently for sustainability in a measure of sustainable product.

The valuation of natural resource stocks could be based on the principle of replacement costs or willingness to pay. However, changes in the value of environmental assets can result from both physical depreciation and capital loss or gain, as, for example, with increasingly heavy use of a natural resource, such as the use of a water body for fishing and recreation. In theory, valuable of capital loss or gain should be based therefore on the marginal benefits of uses.

The extension of the depreciation principle to the consumption of natural capital affects the net value added of industries that exploit natural resources and thus the NDP. In addition, defensive expenditures have been considered as intermediate rather than final consumption, and the further deduction of such expenditures from net national product has been proposed. This procedure would yield a new indicator, which has been termed "sustainable social net national product".

Such sweeping treatment, however, loses track of the accounting identity between national income (the sum of value added, created in production) and national product (the value of final demand) because defensive expenditures contain elements of both intermediate and final consumption and capital formation. A new, more systematic approach to dealing with (deducting) defensive expenditures has therefore been proposed in a draft SNA Framework for Environmental Satellite Accounting (Bartelmus and van Tongeren 1988). The idea is to reduce the production boundary of the SNA by covering only nonenvironmental activities and thus excluding all production of environmental goods (filters, chemicals, or waste disposal plants) and services (protecting or restoring the quality of the environment) that are used in intermediate and final demand. In this manner, value added and final demand are adjusted to obtain identical total values. Further allowance for the depreciation of natural resource assets then obtains a measure that could be termed "sustainable net national expenditure" (SNNE).

As an alternative, the joint UNEP/World Bank Expert Group Meeting in Paris (November 1988) suggested applying a wider concept of depreciation to calculate "environmentally adjusted net domestic product." This concept would include both the depletion of the environmental "stock" assets of natural resources and the degradation in the quality of "permanent" environmental assets. The depreciation of environmental quality could be estimated as the difference between actual defensive expenditure and the cost of restoring

environmental quality to the level at the beginning of the accounting period (in other words, "potential" defensive expenditures). However, such a procedure neither accounts for the "inflation" of NDP by defensive expenditures nor reflects actual environmental degradation or damage. Clearly, more research is needed to clarify the relations between damage costs (expenditures) and actual damage as well as their implications for environmental accounting.

Sustainable Gross Product and Expenditure

Unfortunately, net product is infrequently calculated and rarely used in quantitative economic analysis because of the well-known difficulties of estimating depreciation. Therefore, GDP has usually received more attention in economic planning and policy, under the assumption that the gross and net indicators move similarly over time. The adjustment of gross rather than net product or income has therefore been suggested to obtain a measure of "sustainable gross domestic product" (SGDP) or "sustainable gross domestic expenditure" (SGDE).

The draft SNA Framework for Environmental Satellite Accounting proposes to calculate SGDP by accounting for the exploitation of natural resources as intermediate consumption of different production activities and deducting a corresponding amount from final demand as a change in "environmental assests." For estimating the amount of intermediate consumption to be deducted from the gross output of resource-exploiting industries, the calculation of a so-called user cost allowance has been advocated. User costs calculations avoid the difficulties of estimating physical or value depreciation by allocating a certain amount of the receipts from extractive industries to an actual or hypothetical fund, which, if invested, would "create a perpetual stream of income that would provide the same level of true income, both during the life of the resource as well as after the resource has been exhausted." Discoveries are simply dealt with by changing the parameters of the life expectancy of the resource, that is, the resource-extraction ratio, and SGDE is

derived from SGDP by deducting additionally defensice expenditures of environmental protection. An approach for deducting defensive expenditures without violating accounting identities was described above (see "Sustainable Set Product and Expenditure".)

Modified Gross or Net Product

The accounting for environmental services and damage (or their difference, that is, the net environmental loss or benefit) has been described as the result of introducing a natural production account that modifies gross output in the production accounts. This procedure would yield a "modified gross national product". Deducting environmental and other economic depreciation from this aggregate produces a "modified net domestic product," which would account for environmental degradation as well as resource depletion. Considerable problems of measuring and valuing environmental services and damages will probably make the estimation of these indicators the object of research studies rather than of routine compilation in environmental accounts.

Future Work

As indicated at the beginning of this chapter, worldwide concern with the sustainability of current patterns of production and consumption has raised doubts about the suitability of standard accounting and its main aggregates for integrated socio-economic and environmentally sound planning and policies. In this context, the World Commission on Environment and Development drew attention to the need to shift emphasis from the standard environmental policy of dealing with environmental effects after they occurred to "an approach concentrating on the policies that are the sources of those effects." Such policies should be assessed by indicators that present socio-economic progress net of all environmental costs. Up to now these costs have generally been neglected or wrongly accounted for in the standard macro economic aggregates.

The obvious place to develop and standardize concepts and procedures of environmental accounting is the existing standard System of National Accounts, the SNA. The ongoing revision of the SNA provides a unique opportunity to examine how the concepts, definitions, classifications, and tabulations recently developed in the fields of environmental and resource accounting can be related to, or integrated in, the SNA. At the current stage of development it might be premature, however, to change radically a well-established system of data collection and accounting that serves many different short, medium, and long-term socio-economic analyses. Therefore, standards for environmental and resource accounting should be further elaborated in a satellite system of environmental accounts of the SNA. Efficient linkage will require some amendments to the existing classifications as well as explanations of, or cross-references to, alternative concepts and tabulations in the core recommendations of the SNA.

A first draft of the SNA Framework for Environmental Satellite Accounting was discussed by the joint UNEP/World Bank Expert Group Meeting on Environmental Accounting and the SNA, and several recommendations were made:

* The revised SNA should provide a place for environmental accounts within the overall system and should discuss the fact that conventional income and product measures do not reflect environmental degradation and depletion of natural resources.

* Environmental accounting should be presented as satellite accounts and not in the SNA itself.

* Functional classifications should be developed that identify separately environmental goods and services, in particular in COFOG, CPC, COIP, and ISIC.

* Environmental resources that cannot be valued as stocks should be listed in the form of an inventory that may include indicators of physical quantity and quality.

* A first step toward measuring sustainable income and product should be to deduct the depletion and degradation of environmental assets; further research on deducting defensive expenditures is required.

The meeting also suggested that further work be undertaken toward a draft manual through pilot-type case studies and the evaluation of existing resource accounting systems in industrial countries. The UNSO has included the preparation of a handbook[2] environmental satellite accounting in its work program and will collaborate closely with the World Bank, UNEP, and other organizations in this effort.

---

2. The publication, entitled "UN system of Expanded Environment and Economic Accounting (SEEA)", is expected to be out in late 1993.

VII. Environmental ('Green') Audit[1]

1. *Introduction and Premises*

By all accounts, the concept of Environmental Audit is still new anywhere in the world, and indeed non-existent as yet in most countries. In this area too, it seems that we are indeed living in a world of slogans and lip service. But we are in good company for it is not only environment but development as well. The economists do tend to sit complacently professing an accomplished field of knowledge, which is furthest from the truth. The 'holy grail' of what was called 'steady state' growth, that is where an advanced level of living, or a satisfactory, adequate standard of living can be attained - without having to depend perennially on growth rates based on gargantuan consumption levels of national and world resources every year - has been an illusion. In terms of modern economics, there have been some conceptualizations but there has been no answer. Thus we are living in a very uncertain situation, both in terms of resources use and growth, as economist, and as environmentalists.

We must mention, though, that there is absolutely no doubt as to the future of environmental audit. We have seen earlier its place in the spectrum of environmental management. Within this frame, there is no doubt as to the future of environmental audit as a profession. If we may use this magic target 'Year 2000', there is every possibility that there would be by then, what may come to be called an environmental audit profession. It is thus also better that we start right now, thinking about it in association with those concerned, while accepting that it is a new field in which much follow-up work is required.

---

1. The Chapter is largely based on a Lecture delivered at a Meeting on the Subject in Sri Lanka, in April 1991.

Environmental Audit, as we shall see, is a close relation of Financial Audit. The practice of environmental audit in due course, alongside financial audit, will enhance jointly the standing, performance, profits and profitability of Firms, apart from enhancing national capabilities and national performance.

Let us first get an introductory idea on the premises on which environmental audit stands, Without doubt it is one of the central or key instruments, for enhanced environment development management. As we know, 'environment and development' is now a key 'label' after the Earth Summit, with 'sustainable development' at centre stage. So there is no escape from that, and for good reasons. In that framework, as much as financial audit looks at assets and liabilities, environmental audit, looks at 'stocks and flows', in the perception that the environment is the source of all resources (of development) as the sink of all wastes. Like financial audit, it looks at certain commonalities; but it also uniquely views resources as the source of all development. Such a dimension is not conventional in normal economic analysis, or in financial accounting.

Financial Audit views conventional assets and liabilities, resulting in financial profits or losses. Environmental Audit 'costs', losses, and potential gains, of 'hidden' or 'overlooked' natural assets and liabilities, which in the course of their non-use, do not enter into computational systems or national accounts. As is quite evident, for instance, success or failure in financial operations will appear as profit or loss. Management results in environmental resources operations do not appear anywhere as profit or loss. But it is a loss or profit, or gain in a different sense.

Now environmental audit, because of the history of 'impact assessments', can be simply considered as something negative. Impact assessment become something which was looked at as if it slowed down economic growth. This is, as we saw, due to its failure to expand into an integrated environmental cost-benefit system. Yet, 'good management equals

good profits' as the dictum goes. Now, 'good environment management equals good management', and therefore 'good environment management equals good profits', As we shall see, more specifically later, it is important to have in mind that Envirommental Audit is not a negative concept or system. What we are looking at is something that in the end will help the entire management process, make for management efficiency; therefore make in fact for more profits.

What 'green audit' does functionally is to elicit needed, otherwise omitted, missed or overlooked data and information for management, whether of a firm, public enterprise, agency or even certain governmental departments and bodies. Thus, it enables the management system to open its eyes as it were and to serve, in the areas it has identified, as strong management aids. This is its background, and this its rationale.

The purpose of this Chapter is to discuss this concept in its full range; and to set out a Methodology. We shall come to the methodology, which is the heart of our presentation, after certain essential introductions, advancing, one hopes, its adoption as an integral part of environmental development management and sustainable development.

If we may consider all of us as entrepreneurs because that is the essence today of open market policy based development worldwide, environmental ('green') audit is a 'tool of management'. It is vital that it be not considered an instrument of control. It is very important in the implementation of such a programme that governments avoid any system which smacks of controls. We say this, because already in some countries,[2] apparent environmental audit systems have been introduced, which seem less 'audit', and more controls, mainly as questions. If so, one does not motivate entrepreneurs or managers to share, to come forward as it were, which is the whole purpose of the exercise. The modus operandi of environmental audit, as a tool of management, is to stimulate the creative forces of management itself, not to suppress by governmental controls.

---

2. For example, the system introduced by administrative fiat in India from 1992.

Its recent origins naturally make it a still evolving system. Everything has its origin, as we know. Financial audit itself had its origins, in the Middle Ages among the City States of the Mediterranian when the merchants did not know whether they were spending their capital on their wives and children as family expenses, or whether they were spending from their incomes. So the critical distinction between capital, which must not be eroded, and income, which alone may be expended, was developed. Environmental Audit too had a motive force, its stimulus. It arose in what we may call the 'eco-system awareness' of the community regarding capital stocks and flows which are not accounted for. It was soon realised that a lot of 'natural' capital was being used which was not accounted for, and that is why the environmental audit idea arose. Much more recent than financial audit, certainly it requires a helping hand - one should think from financial accountants and auditors, but distinctively assisted by economists, environmentalists, and other specialists.

Environmental audit as we know it today, started in the 1970s, in the United States, as checks on legislative compliance, although it was perhaps not the right start. Firms had to report on emissions of pollution of various types and the figures were translated into management decisions, against goals set by government or authority as the policy makers, which the firms had to meet. Not a control system entirely, it was a carrot and sticks approach as well. It started primarily in the health and the safety areas.

Quite quickly, this idea spread to Europe alongside the American multinationals that went in during that period. However, the European background or culture apparently took it on a different course. It came to be looked on as a system which would demonstrate what was termed 'greener performance' a - 'boast', if you wish, of better performance. Perhaps that had something to do with the political equivalent of the 'Green Parties'. Anyway people started looking at wider issues, of the 'source' of the resource that was going into production. A number of examples come immediately to

mind such as minerals or forestry or fisheries, crops, and others. Looking at these things meant, in any event, coming closer to the real meaning of environmental audit.

Soon it came up also in a progressive healthy development, as 'issues audits', that is, looking at or evaluating the role of a rain forest or wetland not simply for production, but as ecological systems for water conservation, in soil erosion, conservation and a whole host of related matters like biodiversity and others. Thus it was a whole 'universe' of knowledge in which ecologies became central in a manner which was quite new.

The 'issues audit' now developed in additional ways, and started to look at what one may call 'life cycles' of products. Looking at product life cycles meant that one did not just throw something away as a disposable dump, but looked at its life cycle, right from its inception, through its conversions, or its re-use. The distinction soon also arose easily between 'man-made' and 'natural' capital, the necessity to allow for depreciation of natural capital separately and the necessity to allow for 'reverse discounting'; quite contrary of course to economic and financial discounting concepts. On the last, in financial conceptualisations obviously, future values are at discount in relation to present values. But in the environmental imperatives, at least for select resources, one might well have to resort to 'reverse discounting' where future values, of constrained resources may have to be discounted in a reverse way, that is by imputing higher future values. These we have seen also earlier under environmental designs and policies, and their relevance for management overall.

We are also on the threshold now of re-categorising business assets. It has probably not really emerged yet; certain countries like Norway, Netherlands, are looking at it. Yet, the whole idea of re-categorising business assets, which are normally as financial audit presentations is probably on now.

When all this has been said, there is one more point, an important background which we must mention. This is that,

for developing countries, neither the US nor the European experience is enough; because there is one factor which has been an 'ellipsis' for the developed world, and a convenient one. As in many respects, the former are very often at the 'receiving end' of ideas. Because the ideas come with money, you also somewhat bury your own ideas and take the money; The ellipsis, as we mentioned earlier, is the distinction between the 'Quantitative' management of the environment, and the 'Qualitative' management of the environment. Basically, what it does mean is that the industrialized countries, which are already eating up resources, are collaborating in a World environment management programme which is Qulitative management, essentially to manage pollution, emission levels for ozone layer containment, and that cluster of concerns.

We must grant indeed that technologically, there is tremendous advance in the North's application of technology for resources re-use and so on. Yet, it is basically the Qualitative management of the environment that is of prime interest. But if what we need in the developing countries is any type of multiple resource use, we cannot foresee an environment management system, which envisages a limited use of resources, or the 'non use' of resources. Thus, there is an additional challenge in all that we are looking for, in this area of environment management. That means also that we cannot easily go on literature from the West alone, which need not really be the relevant basis for growth. We need urgently to develop systems which are 'development sensitive' and 'development supportive', a key phrase that we must emphasize.

II - Instruments

The essense of building the 'greening' element into accounting as environmental accounting, is easily stated. It is, quite briefly, that we have to set prices for all materials, and for all end products. That much is easily said. That is what is central in building greening into accounting. But, of course, one matter that comes up immediately is that, in the

'market', values are set because products have a 'value-in-exchange'. They have a market price in the usual economic definition that we are so familiar with. But what we have in environmental value is 'value-in-use', like for air or anything in the environment. It does not come into the stock exchange, anywhere. It is not bought, converted into a 'product' and sold, except say, air as oxygen or gas, and so on.

We need, therefore, to introduce systems of valuation, and criteria of evaluation, which will recognise the two parameters, of economic necessities on the one hand, and environmental limits, and opportunities, on the other. We cannot escape this any more now, or in future. We cannot bury our heads and just be only an accountant, or an economist, or a biologist. That is one of the reasons why it must also develop at university and academic levels, among others.

Yet, again, we need to be cautious. These are in the Western literature, certain insights which give guidelines that serve well for the advanced economies, but may not serve others equally when they are in the process of developing. For instance, there are steps like end-of-process controls in the West, which others are imitating. There is even technical advice being given to countries, with government support, for example to introduce legislation which is just copy book of legislation of other developed, high resource use, or 'resource profligate', economies. Developing countries need to be 'partners in expertise' themselves.

Next we have the 'polluter pays' principle; well known indeed. In a developing country it does not really apply all the time; and we shall give an example of that later.

'Willingness to pay' is another principle. In an American neighbourhood, it is possible to say you are going to put up a play ground and what price would you put on it. And the person replies, "Well, I am prepared to forsake so much value of this for the sake of open space"; which then gets noted as the value of the alternative that is sacrificed for it. Yet, that

is the indulgence of a high mass consumption, high income level, high standard of living type of society. In a poor society one cannot blindly adopt this; also a society where, as we stated, we have a development need for which far more resources are necessary. It is not play grounds, of course, but the 'yard stick' that we refer to here.

So also with Environmental Laws. They have close relation to Fiscal decisions. Environmental laws and Fiscal policies work together, and are tied, because fiscal policies are translated for enforcement by enacted laws. There was the case in Brazil, to give one instance, where the rain forest was being ravished by a process in which the tax and legal structures make it all even more possible. Land tenure was encouraged by a legal requirement to demonstrate activity on the land, obviously reasonable on the face of it, because if a person had no activity he should not be entitled to land. The activity on the land was cutting down the trees. When that was done there were also certain tax concessions earned by the activity. The result of all this, of course, was an ironic economic phenomenon through legal and fiscal policies - something certainly for national and international fiscal associations to pick up.

A positive example was what came under the term 'judicial activism'. The Indian case is interesting here. Justice Bagwathi of India, now retired, became during his term a 'high priest' of judicial activism. In one important instance which arose out of what was called the Menaka Gandhi case, during her tenure as India's Minister of Environment, the following situation came up. The Indian Constitution at Chapter 3, Article 21, simply laid down, according to Dicey's 'rule of law', that a person's entitlement to safety, or the right of safety was only subject to procedure established by law. Now this was interpreted in the Indian Courts therefrom, up to the time of Bagwathi, as a means by which summary action can be taken so long as the laws said that the person coming under its meaning can be apprehended for violating what the law stated was inviolable. It happened that when the Convention on human rights was established in the United Nations,

there was no environmental awarness, as a Principle, at the time. What the judicial system in India did under Bagwathi's leadership was to bring in the right to a clean and healthy environment as one of the basic human rights. Further it did not rest at simply leaving it in a phraseology like 'procedure established by law'. By judgments and case law, it established the need for a 'due process of law', before an individual's environmental right may be ridden over. In other words therefore, the accused or plaintiff, was given a chance to present his side of the case, and as a result of this, there emerged a significant crop of judgments which established the 'right to a cleaner and healthier environment' as a 'component part' of the 'right to life' of a citizen. The Courts thereupon decided in these terms in favour of a number of citizens, where the environmental system had been degraded. Generally, in these cases, the Courts did not take a negative, in the sense of punitive view of the industrialists, telling them to close down, etc. They, instead, goaded them into looking at their resources, as we said, in a 'life cycle sense' and to bringing in the desired, enlightened policies.

A classic case of law is what came to be illustrated in Sri Lanka and some like countries, in an FAO study of some years ago. Fish silage, fish waste, in certain places was being thrown by the fishermen on the way side. Now this is 'waste', in which environmental law whips itself into action. It was a case of purveying copied law, of transplanting without adapting before absorbing. The Law says that anybody who pollutes or throws refuse has to be prosecuted. So a poor fisherman is warned; perhaps warned for the second time; and then fined on the third occasion; or otherwise even sent to jail who knows. The only 'benefit' is that his wife and children afterwards have no means of sustenance. 'A waste is not a residue to be discarded, but a resource to be converted into useful product'. In this case the silage or waste, especially to a developing country which had foreign exchange shortages, is an excellent source of fertilizer. Going on this, it was for the government to initiate policies to convert it into fertilizer. The question then was, in this case, when the law prosecuted the poor fisherman, who was the 'criminal', the fisherman, or the State?

A further case came up in Geneva in the course of the 'Third Prep Com' Meeting, held prior to the `Earth Summit'. We mentioned before that Malaysia faced developed country pressures to stop the cutting of forest. Malaysia's implicit reposte was that the North was not doing enough in assisting their economic development; until then, they must also rely on their own sources. The point here is that the forest, like in Brazil or the whole South East Asian zone, is a great natural reserve, and another 'carbon sink' of the world. Carbon emitted by economic activity is absorbed by trees, with oxygen returned into the atmosphere. Given that the North is the largest polluter, its pollution is globally transferred and purified in the tropical forest eco-systems. Thus, if the polluters were using a forest as a carbon sink, should they not pay 'rent' for use of the forests, for a major economic and environmental function? In that type of question, the issue becoms international, not only national.

III - Costing Experiences

Before we come to setting out the 'Green audit' system itself, let us look briefly at some real problems in the process of costing. That the problems are there, is not surprising. In the financial field, the Accounting Profession itself indeed took years to reach its present standards and quality. In environment, even more perhaps, actual costs and benefits are blurred or tend to get blurred. One reason is the difference between value-in-use and value-in-exchange concepts. The other is man-made, or through governmental 'interventions', by hidden subsidies and exemptions and the like.

In illustration of the first, let us consider certain cases. One of the best is a set of studies that were done abroad for certain countries, namely Costa Rica, Indonesia, Mexico, Papua New Guinea and Thailand. They know what their GDP is, for what it is worth, as social policy making or planning tools. The country studies conducted what were called 'Adjusted Accounts' of National Income, which discounted for resource losses or such like, by degradation, depletion, exhaustion of natural resources, which cannot be the basis

afterwards for wealth creation. In this context, a concept was introduced called the 'wealth creating capacity' (WCC) of the countries concerned. Now, when the wealth creating capacity of these countries was ascertained through the 'system of adjusted accounts', it transpired that 'WCC' grew more slowly than the GDP of these countries. Thus, there was something wrong in the way that natural capital stock, as 'capacity' stock, was being used.[3]

For instance, when forest trees are cut and sold, they enter GDP, and yield an income. But, when a forest stands, it does not enter into any computation, because it is simply a value-in-use. In other words, in order to be computed as increasing our welfare, a forest has to be cut down and 'destroyed'. If it is not cut down, it is not computed as a 'produce'. Whereas, in reality, we know that forests serve tremendous functions, that are not only esoteric, but also directly and indirectly economic. So for animals at large vs animals slaughtered; grasslands in nature vs grasses up-rooted by grazing; or bio-diversity itself vs plants depleted by sale. Then we have the effects of changes such as erosion, floods, life styles, habitat, human settlements, recreation; or wider phenomena with desert formations, climate, water, and others.

At the same time, there has been a tendency in Aid from the North to use these, again, as decisive reasons for the developing countries not to use natural resources. In that form of course, it is unfortunate, for two reasons. One is that, at the micro level there are tremendous potentials for what we called 'expansion' of resources. The second is that there is, in the economic scene, what we also mentioned earlier as the

---

3. Note that "WCC" is not affected by environmental policy alone, or even primarily so. It could be even more fundamentally affected by wrong Investment priorities, particularly by lack of equipment, tools and machinery industries and skills formations of various types. Such capacity, by more financial resources and technologies, also makes environmental management far easier and more feasible. Indeed, it is these that have, historically, more than off-set the clear falls in WCC that the already developed countries experienced during their wanton wholesale destruction of forests, wildlife, soils - and even indigenous populations - in their earlier years.

'basket' concept of resources. As we pointed out, this has happened right through history, from when man moved from the stone age to the next, the iron, the copper and so on. Similarly, in today's natural resources configurations. Somewhere into the 21st Century, we may never need petroleum. So, as a matter of historical truth, as also a matter of logic, resources are there also to be utilized. It is not a question of non-utilization. The question we must have before us is rather one of carrying a proper 'focus' in our management systems, for optimization of our resource uses, along with sustenance modes of resource configurations in a given area, or for the economy. There is absolutely no doubt about the very basis of humanity's growth on this reality of 'resources expansions' in the past.

In a slightly varying illustration, from the Middle Ages, we talk about kings living in 'Camelots', or Maharajas in opulance. If we compared the welfare levels that they and their 'elites' had, and the welfare levels that typical middle class, lower middle class, or even certain working class populations, have in typical developed countries today, in terms of health, education, housing, amenities, services, the foods, there is a tremendous accretion of welfare to these populations, that has been made by 'economic' growth - not by any other means. For developing countries, therefore, transfers of these concepts must need be appropriate and relevant.

There are also illustrations at micro level. For example, we stated earlier that for an epidemic treated, the costs become an 'increase' in GDP. But if by wise systems or habits, we prevent an epidemic, then it did not enter into GDP. This type of conceptualization and modality has to enter into the accounting systems. So too for several man-made ecological disasters affecting soil, water, forest, irrigation, crops, fertilizers. In normal accounting these ironically can show micro-profits and macro GDP increase. They clearly call for segregating 'enviromental stocks' and flows; correcting for

'redressive' or 'defensive' expenditures; and attempts to seek out the 'net costs', and receipts of operations.

Interestingly on this particular question, under normal accounting, when natural capital, say a mine is depleted, that is not felt by the 'Firm', because the latter merely buys the mineral in the market. It is largely nobody's business, except some governments which happen to care. But where the same Firm owns its own property, typically land, then the Firm values any erosion whatever of that property as erosion of capital. What the Firm does not do therefore, is to value the unseen erosion of the source from which it gets its own raw material. As we shall see, it is not the responsibility of the Firm alone. It is this 'extension' that we have to look at in environmental audit, with a development supportive, positive role by the State.

It is here that the nature of the approach the government takes, as 'controls and penalties', or as a 'co-partnership' in better management systems, and in introduction of technology, as 'conversion of resources' into useful products, all come into play. A whole package of what government's role is in this is therefore involved. But if we view it as government 'intervening' with the private sector or with managers or entrepreneurs or accountants, instead of as a partnership in the process, then it will not work. It has to be a creative and incentive led, not a command and control structure.

A special aspect of cost (market) distortions, we said earlier, is Government led subsidies, exemptions and the like. We saw something of this in the Brazil forest logging case. There are others, for example the minerals, prominent among the offenders being the developed countries like the United states, Japan, France, Germany. In these cases, which can also include agriculture, industry and infrastructures, the real costs are not seen. The issues too are not merely local or national, but also international. Their 'interventions' skew markets, inhibit re-use or recycling, and push for more indiscriminate mining, of all minerals (metals, industrial materials, construction materials and energy

materials). A policy line based on Environmental Audits can be (i) taxing, not subsidising, extraction, (ii) stimulating re-use of world stocks, (iii) subsidising benign alternatives, and (iv) launching indegenous research.

Again, these are not policies for blind application to poor countries, where their priority is creation of development bases, that is creating vital oil, mineral, other industries, in a first stage to development. Even capability for environmental management can depend on this policy.

IV - The Model

Let us now, leave the matter of costing and related issues and lessons. Let us go now to the heart of the system, namely the Model, or management framework of the Environmental Audit ('EA') System. It has certain foundational ideas:

(1) In terms of area, it covers the whole spectrum of the production stages, from the source, through the production process, on to final product stage.

(2) In terms of effects, as we saw already, it comprehends all of the direct, indirect, and 'neighbourhood' effects.

(3) Conceived as an 'instrument' of management, it looks at 'restoration' of resources, 'maintenance' systems for resources, and 'expansion' of resources, a term as we saw, not normally known, but refers especially to the application of technology for re-use of resources, to discovery of resources, and of new uses which never existed. These instruments as a strategy, aim to assist - along with other exercises, in particular the ex-ante 'Resources Balance Sheet' exercises - in attaining multiple level supply of the resources needed for development.

(4) On this, we often hear only about 'over-use' of resources both as advocacy from the North, and in

a garbled way, with the 'impact assessments' in poor countries. Yet, there are three phenomena namely, 'over-use' of resources, 'under-use' of resources, and 'wrong-use' of resources. If there is environmental degradation, if a Development is not immediately sound, that can be due, not simply only to over-use of resources, but due to under-use as well, or to wrong use - in all Sectors and all areas of the economy of a country.

(5) A final, informing principle in a methodological framework is what we called the ellipsis areas in economics and in environment. Economics has a blind spot in that it does not reckon welfare conditions of labour, in its profit and loss accounts; it just has wages as cost. Environment has its own blind spot where, as we mentioned, environment impact assessment is considered as if it were meant to track down the negative impact of development which of course is totally wrong.

These are the background, or the informing principles, the 'philosophy', the 'religion' behind the Model that is presented. The Model itself is designed for practical application, and use; and we shall now take this up. It consists of four Formats or Charts which, together, make up the framework of management. What they do is to set out the categories and contents in a typical production flow, showing net effects on stocks of resources (benefits and losses) and flows of resources (costs and receipts) and indicative profit/loss (c/b) results.

Let us take Chart A (see next page). This will be an essential opening lay-out, also in the conventional sense when evaluating or analysing economic projects. We begin with the left side of the display, where the economic profile of the project or activity will be made out as a background. The right hand side is an addition and carries the environmental dimensions. On the left side, we have the conventional layout

ENVIRONMENTAL ('GREEN') AUDIT
(A Schematic Presentation)

A - Project (Firm, Agency, Other)

Economic	Environmental
1. Nature: ..... (Agricultural/Agro-Industrial/ Industrial/Infrastructural/ 'Service').	1. Legislative/Fiscal Background — Corpus ..... ; Incentive vis-a-vis Punitive- ..... ; Other ....
2. Title	2. Consumer Conscience (The Market Context)
3. Horizon: ..... (Life-Span, etc.)	3. Technologies — Given ..... ; The Frontiers .....
4. Location/Boundaries:	4. Given Company ..... — i. Policey ..... ; ii. Awareness ..... ; iii. Management Structure (The Environmental ..... Spots) ..... ; iv. Skills on Board ..... ; v. Training ..... ; vi. Monitoring System ..... ; vii. The Working Environ ment .....
5. Scale/Costs:	
6. Products/Outputs:	
7. Others (Special Notes) :	5. Others — viii. Public Relations ....

of what a project will be like, its nature, whether it is agricultural or industrial, etc. its title, life span, locations and boundaries, scales, costs, products or outputs and other special notes.

Now, on the right side, we have the environmental description which normally will not be reflected. It will lay out the main legislative and fiscal backgrounds. In the contexts of what we have said before, these questions will be understood on what is the existing Corpus of law which is applicable to this particular activity. Is it incentive oriented or punitive oriented, that is 'productionist' or 'protectionist'? It is not a policing or control approach, but a 'participatory' one.

The second entry there is 'consumer conscience', an emerging idea. In the American and European countries, there is an increasing consumer preference for environmentally friendly products; shelves and stores and shops advertise themselves as green, or environmentally friendly; in other words, that they use resources which are not environmentally offensive. Yet, while this may be minimal in developing countries at the moment, it may not be so in some years.

Next is technologies, a vital component and very important to assess. We shall come to that again in a later Chart. Just like today where we work with chemists in chemical firms, so 'technologists' are important to look whether there are given technologies or not, and what the 'known' frontiers are. By frontiers, one does not mean some distant technology where, shall we say, we can get energy from hydrogen, which may take fifty years; but on which groups can work right now, or are working, though not in 'this firm'. This firm cannot work on it; it is just a producer of some nice commodity. But there could be frontier areas in technology development and it should be the business of whoever is preparing the Studies, to probe into it, to talk to the scientists or technologists, and to try to find out the 'frontier areas' which can then become the basis for 'policy development', in the later part of the framework, below.

The fourth item deals with a number of inner management issues. Is there 'awareness' within the Company? What is their policy? Do they have a known policy of the Board of Directors on environment? The answer may be 'nil' for now; but that is no discouragement. If they are aware, and have a policy, what is the management structure? Is it at one point in the management system, or more? Is there an environment officer? - a young man or lady to whom they will say, 'All right, you are the environmental officer and now you will help us by making yourself understood to us.' What are the skills, available, if the earlier answers are positive? Does the company have any training schemes? What is the monitoring system? And then, what is the 'working environment'? It is not evident here, on the left hand side, but it is simply not a question of paying wages, only. Finally, what are the Company's public relations arrangements?

Next we go on to the second stage from there, that is to the Second Chart. First it looks at the assets and liabilities from the economic side. That is, the left hand side under assets are, land, building, materials, equipment, inventories, cash equivalent, products, etc., the type of things that appear on a normal financial presentation.

On the right side, that is on the environmental side, we have the 'resources used'. The first six items there are similar to the 'left hand side'. There is a number seven under Environment, blank on the left side, namely labour, Labour under economic activity is simply as wages and costs. But in an environmental operation, conditions for labour will also be factored, to be considered under resources utilized or used. Similarly, we have Number nine in the Environmental side, which is very important. It is at this point that there starts a look, as we said, at wastes and discards over the whole spectrum, as one of the basic informing principles of resource management overall. For no fault of their own, management systems and enterprises do not look at this. They are just concerned with buying items at the best price in the market, doing a good job with their own management, financially and economically, and selling high. Nobody can blame them for that.

B - Assets and Liabilities : Economic/Environmental

(1) - Assets/Resources Used

Assets
(Financial)

1. Land
2. Buildings
3. Materials (Primary)
4. Materials (Intermediate)
5. Equipment (Plant, Machinery, etc.)
6. Inventories (on 3, 4 and/or 5
7. .....
8. Cash & Equivalents
   (Balnces, Stocks, Advances, etc.)
9. Product/s
   (Finished, in transit, in process, in stores)

Resources Used
(Environmental)

1. Land
2. Buildings
3. Materials (Primary)
4. Materials (Intermediate)
5. Equipment
6. Inventories
7. Labour
8. .....
9. Residues/Wastes/Discards

(2) - Liabilities/Resources Affected

Liabilities

1. Shares (Self cancelling)
2. Loans (Various)
3. Special Stocks, Issues
4. Depreciations
5. Rents, Wages, etc.
6. Taxes/Dividends
7. .....
8. .....
9. .....
10. .....

Resource effects

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. Degraded
8. Depleted
9. Exhausted
10. 'Enhanced'

Next, we come to liabilities. Again, on the 'left side', liabilities are standard, as shares, loans, stocks, depreciations, rents, wages and taxes and dividends. That would be the normal, financial accounting, or the economic side, of the presentation. If we look at the right side, that is the environment side, we see that none of these items has 'resource effects'. But we have items seven, eight, nine and ten which do not appear at all on the left side. These are the resources that are degraded, directly or indirectly or in neighbourhoods, depleted, or 'exhausted', and 'enhanced', that is as we had said, by new or known technology and practices.

These are not things that we need to run away from. For, within the womb of these problems, lie also the potentials for enhanced management, enhanced resource utilization, and, very often, enhanced profits. This is also where the partnership of the State comes in. If the State treats firms as if they are to be pursued and harassed, it is not likely to work. But where there is a partnership concept, then we could marry the so-called 'direct, indirect and neighbourhood effects' in a harmonious relationship of optimization of resources. Thereafter, there could be a sharing of benefits both at private and public levels.

We come now to the important operations stage. This is the Flow Chart 'C', of resources costs and benefits, in three Groups. On top, we have the Economic operation and next the Environmental operation. The third, on Technology, serves both. Together it is, typically, an 'environment - economic flow chart for sustainable management' at the Firm level; and sustainable development overall.

In the Economic operation, we have the resources - 'at source', 'in process' and at 'end product stage'. Resources are the basic input. Next are the intermediates, third is labour and the fourth is the final product. Now resources, at source, to repeat, are degraded, depleted, exhausted and have direct, indirect, neighbourhood effects. In process of use, that is at intermediate stage, they can be over-used, under-used or wrongly used. Further, conditions of labour and welfare

accretions can be neglected to the point of causing visible health and other problems. We may recall our earlier example of an epidemic treated as an accretion to our national growth, but an epidemic prevented as not so. At the final, last stage of the Economic operation, we have 'non-market' products, as residues and wastes.

The Environmental operation, is the heart of the environmental management system. It is not just enough, for instance, to conduct environmental impact assessments and then find fault with everybody else. That is negative. So too for us here. What is necessary is that when a resource is degraded, depleted or exhausted in whatever way, there should be systems of analysis, examination and management, which look at potentials for resources sustenance by 'restoration', 'maintenance' and 'enlargement'. There is a whole range of these, whether in industry or other sectors. For instance, under agriculture, biological methods of pest control are a well known, established instrument.

At the intermediate goods stages, within a production process, there are tremendous opportunities, as experience has shown, for rationalisation and optimization. Under labour, it is indeed very important to look at what is called 'working conditions' and enhancement of the 'working environment'. Environmentalists are quite right in this, for the longer term economic values themselves, by enhancement of the working environment.

At the final product stage we have re-use, re-cycling, and development of alternative products, systems and designs. For instance, a change from petroleum to natural gas in some systems, or re-use and re-cycling as we saw earlier and innumerable others are still untapped potentials. It is probably amazing how in actual experience, countries one after the other come out with potentials, of which people never realised their existence. This is a fascinating aspect of our task, our future hope, a justification for what we commend here.

The last heading, applying to both the above is, therefore, the Technology operation. It is absolutely basic, making the difference, especially for the developing countries, be-

C - The 'Firm' - An Environment-Economic Flow Chart for 'Sustained Development'
(Resources, Costs, Benefits)

					Costs	Receipts
(1)	The Economic Operation	Resources ('at source')	Intermediates ('in process')	Labour	Final Products (at end product phase)	Economic	Economic
		Degraded/Depleted/ Exhausted. (direct, indirect, 'neighbourhood'	Ovewr-use, Under-use, Wrong-use.	'Conditions' Welfare Accretions	Non-market Products. (residues/wastes)		
(2)	The Environmental Operation	Resource 'Sustenance' (restoration-maintenance - 'enlargement')	Rationalisation, Optimisation, etc.	Working Environment, 'Enhancement'	Re-use, Re-cycling, Alternative products Systems, Designs.	Environment - Economic (for - labour)	Economic Environment (incl. human environment
(3)	The Technology Operation	R & D - 'Alternative Resources' Development. (comprehending bio-technology, re-use technology, materials technology; including knowledge, skills, systems).				Economic - Environment -	Economic Environment

1. 'Full use of all resources alongside sustained maintenance of future resource levels.'

Note - Both these phrases were introduced in March, 1980. ("Environment Assessment Statements : A Test Model Presentation" UNEP/UNABDI, BKK) ten years before there emerged the slogan of 'Sustainable Development', since enthroned at the 'Earth Summit, '92.

tween stagnation and prosperity. We have very poor R & D and Technology programmes here, inspite of high visibility institutions. There is very little 'industry' related technology taking root. Environmental Technology itself basically covers 'bio-technology, re-use technology, and materials technology'. We know of things happening in the world around, not only in the North, but others like Korea, or India. It is the pursuit of this that holds the key to harmonizing the problems of, and realising the potentials from, development and resource management, and making sense out of a combined economic environment management 'philosophy'.

If we do these, then of course we have, under Costs, as at the end of the Chart, those that are economic, and those that are environmental. In a sense it is the central part of a resources or environmental (green') auditing system.

The last Format (Chart D) we have is essential to the Model or framework, though it is not, analytically, an integral part of it. This is because of the problems that we have with some of the perceptions of legislators and tax specialists. We used the phrase 'productionist' vs. 'protectionist' legislation and taxation systems earlier. The purpose of this Form is simply that, when an environmental audit is undertaken, it will be necessary for this information to be available to policy makers.

The steps start, first, with listing the issues serially. Next, where a particular legislation is applicable to this activity, if we agree that it is good law, then what is the record of compliance? If it is good, then everybody should comply. But where it is wrong or deficient, what are the implications and consequences of compliance? As we said, a lot of law and a lot of taxation as in the Brazil case and fish case and so on, could be wrong. So, here is an area for really true management innovation; and for Government to move away for simple bureaucratic controls. The last Column is for required new alternative legislation, if that is the case.

D - "ENVIRONMENTAL" LEGISLATION/TAXATION[1] : COMPLIANCE: ADEQUACIES: NEEDS

"Issues Index"[2]	- Legislation -		
	Where relevant - Record of Compliance -	Where 'Wrong' or 'Deficient' - Implications, Consequences of Compliance -	Required New/Alternative Legislation
List Issues serially)	(Describe)	(Describe)	(Itemise, with notations)

1. Legislation can be purely normative, i.e. requiring adoption of stipulated policies, standards, etc. A main thrust, however, has been the use of fiscal instruments as enforcing policies. The aims of the latter can be broadly classified under three groups, as 6a) Taxes with 'marketable permits' (allowing for pollution 'sharing', within determined overall limits); (b) Levies with enhancement investments (the 'receipts' visibly funding costs); and (c) Fines and Penalties (virtually pure extension of 'penal' concepts).

   While enactments are increasingly 'mixed' now, across countries, broadly (a) is very much US in nature; (b) is European; and (c) 'Colonial'.

2. By cross reference to the Environmental issues/needs emanating from Charts A, B & C.

The foregoing conclude the core of the exercise. They give, as we said, for the activity, the categories and the contents, in a typical production flow, showing the net effects on stocks of resources as benefits and losses, and on flows of resources as costs and receipts of actions; and bring out, in indicators, the cost/benefits, or profits and losses of both resource use and development.

VIII. The Future

I - Education, Training, Technical Assistance;

II. - Policies, Prescriptions, Assistance, Implementation.

Our main concern in this concluding Chapter is to try to look at some of the supporting policies and instruments that should come together, to give a fair chance to developing countries in particular, and to Organizations as well as academia, to adopt and to apply seriously, the four-fold environment development management package that has been set out in the preceding pages. We consider this extension of support capability below, in two portions, as in the sub-title above.

It is not still easy to do so, however, without noting once more, as a prologue to these instruments and policies, the setting in which we presently operate, and which has itself to become responsive to the real needs.

The major background to it is that the policies and instruments developed and applied by the North to itself, and recommended and perforce adopted by pressure of international funding by the South, are essentially for economies to keep churning out incessantly increasing outputs year after year, at very high levels of consumption of resources. Just as one instance, in an observation by Schumacher sometime ago, the United States was using 40 percent of the world's resources for 6 percent of the world's population. Efficiency, as a hallmark, would have been if 6 percent of the world's population were to use 6 percent of the world's resources, and make it succeed in producing a sustainable and acceptable standard of living. Clearly, the rest of the world cannot imitate the US model; clearly also, there must be something wrong in environmental management 'controls and charges' instruments, if they were the only tools available. Doubtless, environment management cannot be only or mainly as containing pollution for ever increasing resource use.

In this sense, sustainable development itself,even if we understand it properly, can be slightly confounding because, amazingly, it can mean two different things to the two different groups, namely the economists and the environmentalists. To the economists, unfortunately, sustainable development equals a 'steady rise' in GDP. To the environmentalists, it means 'constant' GDP. We say constant GDP, because as we know, where in a proper environmental programme, we are ultimately able to stop 'deforestation' and stop the production of offensives like aerosols and others, there are countervailing alternative environmental output which arise - which in effect have already been seen to expand the total output in a national economy. So, shall we say, not falling, but 'constant' GDP. Yet, here is a contradiction and an opposition, which we must face.

In economics, we still have not come across any other attainable equilibrium, except on a steady rise of GDP. We have, everyday at this time of our recession, leaders weeping in their speeches and TV interviews that the production of cars has not gone up - that is, hundreds of thousands of cars, every month. This is just one - there are all the others. For it is the only way in which 'sustainable development' has come to be possible in the 'economic system' as we understand it.

So, we have two conflicts with environment. The highest possible economic equilibrium level is, of course, an unquestionable desideratum, as against a 'low' equilibrium level. But the price of a never stopping annual increase in GDP is another matter. Some years ago there was that 'Holy Grail' which students of yesteryear in particular, used to read about-namely the so-called 'steady state economics'.[1] There was something like a 'natural rate of interest', and of course the money rate of interest; and an approximation of it to the former induced a more stable rate of capital formation, and investment.[2] For the time being, however, all this has gone by

---

1. As, particularly, in the writings of Harrod.

2. Keynes' expectation of zero marginal efficiency of capital was another, later, example.

the board, leaving us with the never ending rise in production as the only way we can attain equilibrium.

Secondly, this raises a big Twentieth Century conundrum, that is equally amazing. As we said, we are praying for 'cars' to be produced in increasing quantity, like farmers praying for rain, as the only way to pull out of recession, towards another equilibrium at the end of it. This belongs to development economics and, obviously, we cannot expand on it at this stage. But, the question remains that perhaps, in a Market economy we cannot do any better. The question is, is a market economy incapable of anything else, that is, of attaining equilibrium except on a never ending rise in output? Perhaps the now discredited Command Economy may have done it, if it had known its politics better. But we do not seem to have a model, theory, or analysis so far that sees a market economy achieving this. Perhaps here, more than anywhere, we have, really, the fundamental problem of 'sustainable development'.

Yet, for the South, the only relevant policies of environment and development management have to be those that increase resources use, for both development and environment management. It is in this 'management path' that there is need and opportunity for pioneering management approaches. For, in such a context, they have to be certainly not a poor imitation of the Western policies, but new and innovative integration of resources 'restoration, maintenance and enlargement' as integral part of the development process. This is the value, thrust and rationale of the preceding Chapters, spelling out a Composite Package of Environment-Management Tools, integrating resources use with maintenance, and combining environment management with economic development.

A great onus rests in this regard, with the world institutions, like the World Bank, regional development institutions like the Asian Development Bank, and equally with the leading developed Countries, in looking more humbly both at the adequacy or otherwise of their own management tools,

and at their own future policies for global co-operation in resource use and sharing of technology.

Given this understanding, and in fulfilment of the stated purpose of this Chapter, let us set out below some lead ideas for priority consideration in the two areas mentioned.

1. On Education, Training and Technical Assistance.

(i) At the centre of the whole process of reorienting the environment management system, is the reorienting of so-called 'resource persons' round the world, who are the back-bone of training and education development for current policy-making, and for the future generations.

(ii) It is basic, therefore, that Global Institutions and Developed Countries should co-operate wholeheartedly in reorienting their own thinking on Management.

(iii) In parallel, it is basic that the Developing Countries should carry through their own policies and instruments of management.

(iv) In a fusion of these two streams lies the key to future salvation.

(v) Hopefully following from such a process, key Training activities should be launched at national and international levels involving professionals and practitioners.

(vi) For this, 'collaborative' technical assistance programmes are the ideal mechanism, with the concept of 'Third Country financing' originally pioneered by the Netherlands in the late Sixties for economic development assistance, as an important instrument of developing the world's technical assistance pools.

(vii) A series of national and regional Training Institutes or Centres, ideally with existing Institutes and Centres (including the United Nations University), should be vigorously supported by the World Bank, Regional Development Banks, and Aid Agencies and Countries, in a programme of Skills Development, Case Studies, and Country Programming.

(viii) As the ultimate foundation, assisting the emerging younger generations,

(a) Schools should be encouraged with materials and publications that introduce these concepts; and

(b) Universities should develop 'Integrated Environment-Development Courses' that will provide Graduate and Post-Graduate Degree Certificates;[3]
As also specially tailored inputs to all other specialist courses in the other disciplines, for example economics, chemistry, biology, engineering, physical planning, and others.

II - Policies, Prescriptions, Assistance and Implementation

The need for reorientations in these by aid agencies and countries, has been referred to above.

Here one would wish to conclude with a look at the real prospects as there are, for a Future with policies, prescriptions, collaboration and acceptance of the needs, and the necessary wherewithal, for a sustainable global future. Viewed in these terms, it would seem the Global Community is not yet ready.[4] Yet this is one of the unique areas where we cannot

---

3. A profo-type Post Graduate Course degree already accepted in principle by some Universities is at Annex V.

4. Neither 'Brundtland', nor the 'Earth Summit' and (as a Third-World Minister observed) its 'Agenda 21', had anything on the methodologies.

wait until it is ready; for it may be too late, to sustain at that time, what would well have become an 'unsustainable ecological-economic global system'.

While brave attempts to sign Protocols and Conventions to contain pollution levels, or to limit the destruction of forests cannot be gainsaid, the abiding answers cannot come from these. They can come in one way from a still unlikely revision of the development Model historically entrenched now in the world. Under this model, any attempts by developing countries to settle for 'sub-optimal' technology, is derided; and if that does not serve, in any case attacked frontally, by the now enshrined policy of open market competition and free imports. 'Self-sufficiency' by countries at an accepted standard from themselves, is tabooed by the world's accepted economic co-operation Systems.

A parallel, more humble, but it seems, abiding policy would be for countries, organizations, institutions and others to begin to apply something like the tools of environment-development management, as in the package described in the Book, with which to make a beginning. If adopted also by the rich countries, developed further and made into an uniform, standard methodology, by which all may abide in their standards of resources exploitation, conversion, exchange, and 'disposal', it may indeed serve us all well. The fact is, there are no ground rules now, and no level playing field.

As 'next option', even if some modest but honest assistance were given to those developing countries that want to start on the lines of that integrated environment-development methodology, we might see hope.

This will require that the rich countries and the various International systems, accept the early pursuit of the use of the 'Management Tools' - Resources Balance Sheets, Integrated Environment-Economic c/b Systems (replacing the EIAs), and the Environmental ('Green') Audit. The 'SEEA', for its part, under the enlightened work of UNSO, is bound to emerge in due time, as a handmaid serving all these areas, in the way that SNA, with all its limitations, has served.

If that step were to emerge, then this Book may have served its purpose - with some prospect, in a later future, of a saved global environment, stable populations and satisfied peoples.

ANNEXES

ANNEX 1

Pedestrapolis: Future City-An Account of a Visit Made in 1990*

---

* Earlier editions of this appeared during 1978 and 1979 in national newspapers/ journals in certain Asian countries.

"1990" has indeed come and gone, and a "Year" awaits our decisions.

Pedestrapolis: Future City - An Account of a Visit Made in 1990

This could perhaps be any city. It certainly was one of the future, as seen in 1990 and written about here shortly thereafter. Pedestrapolis may not in fact be a descriptive term for what was achieved there or for what it was about; and what it has become, from a former congested, confused and traffic laden melee, aware of its ever increasing problems but hitherto circumventing rather than overcoming them. It was now a city where - people all the people - in fact moved as they willed; where the city became very much part of the home - of the children, the housewives, the work people and the old; and where traffic no more obstructed the people or the people the traffic: It was also a city of the present, in fact what many more like it could have already become.

The following is simply the result of a compulsion to record the experience and, with it, the relative simplicity of the analyses and the prescriptions that were used. Just now, it would appear surprising that it had not come to pass earlier. Perhaps what has been achieved was simple because, also, it was so fundamental; with efforts in the past all the time looking for non fundamentalist and complex - solutions.

Basically, the revolution in Pedestrapolis was one in mode and means of transportation - from the homes, to the schools, to the offices, the shops, the various other institutions and back to the homes. It was thus a city of people who moved around without motorcars of their own; these were in their own homes and as to how they were used we shall come to in a little while. There were no parked cars to overshadow and no metal curtains of traffic jams.

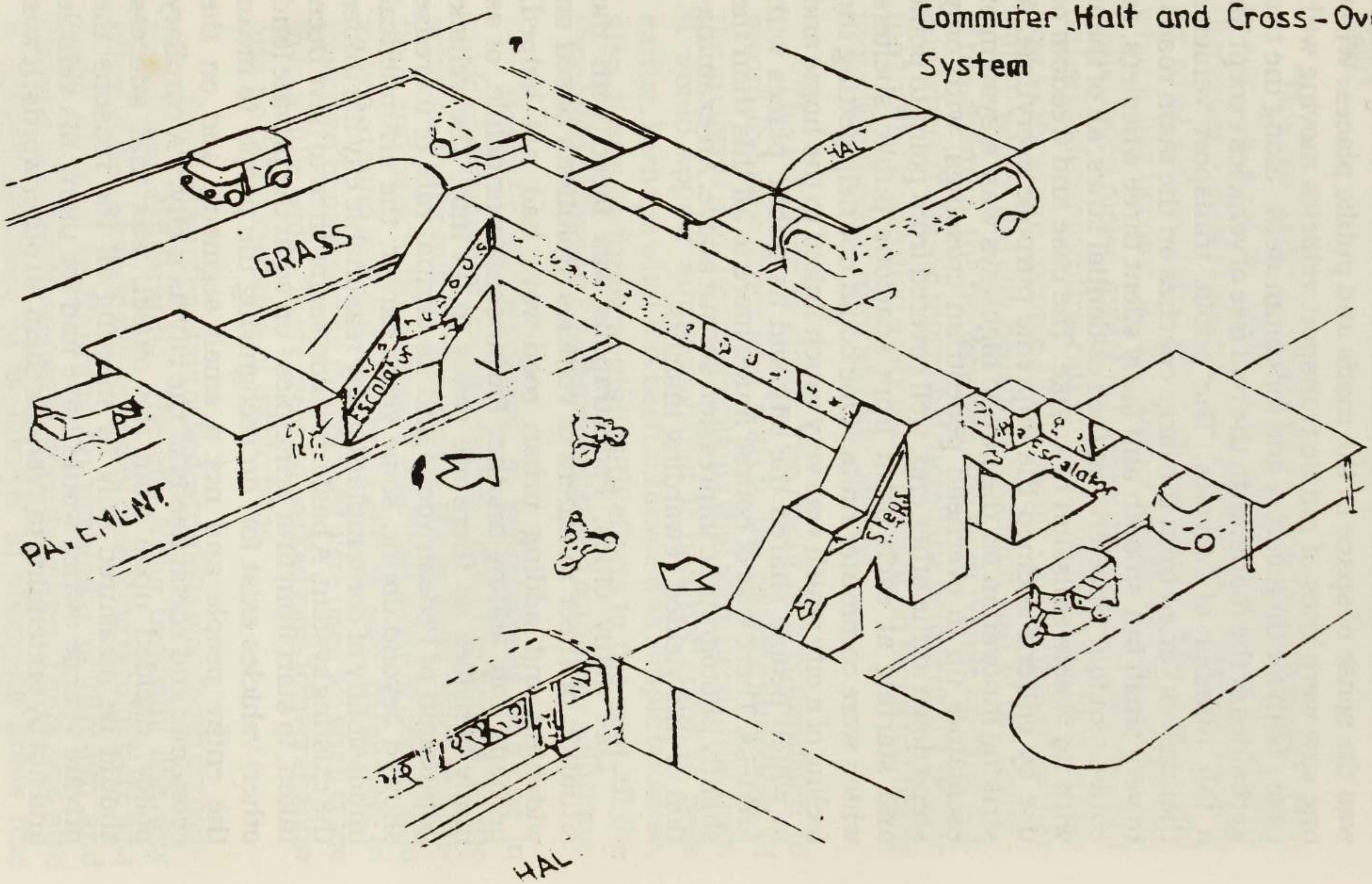
The first impressions of Pedestrapolis were both conventional and exhilarating. The city looks basically like any other, it was historically so in any case. One is told there was some physical re-planning, in particular of through and circular sub-roads among residential zones. There was also a notable presence of 'walkways' in shopping areas (the

Scandinavian pedestrade) and more routine shopping centres nestled within the residential zones. Particularly visible was the sense of space in the roads and public places. What one saw were lines of public transport vehicles moving with ease - both for themselves and for commuters - along the two kerbsides of the roads, with the rest free of vehicles except for a fair number of bicycles. The public transport vehicles themselves varied from the large coaches on the main roads, to very small but smooth and fairly silent three wheelers, or equivalent four wheelers, on the residential lanes, all of them with no visible emission of smoke. The ease and freedom of use by citizens seemed the supreme purpose everytime. A striking innovation on the public highways was a system of escalators up to overhead pedestrian crossings, with only steps down at the other end, well covered from point to point and starting at each point from spacious public shelters which were commuter halts.[1] One could not help getting the feeling of a city which was very much linked to the home and in which people shared the city and its public places with fullness. There was of course much more to all this than the slightly photographic impression set out above. An examination of this yielded rewarding insights.

Like many cities, Pedestrapolis was faced with the situation of sheer numbers of vehicles. Solutions based on widening and adding urban road-ways had not helped, perhaps only adding another Parkinsonian principle, of as many vehiciles as there are roads to fill into. The vehicle population of Pedestrapolis and its annual rate of increase showed beyond doubt, some years earlier, the arithmetical impossibility of contemplating any reasonable city life under the existing system. A basic decision seems then to have been taken, to start from first principles - on what the private (and other) vehicles exist for, on recognising the people to mean the entire people and not a small segment, and on the economic and social needs of the city as a city.[2] A corollary policy, decided upon from the outset, was that success should be measured only by meeting all the reasons the private vehicle owner would have had for using his vehicle and not by pretending to overlook them. In other words, it was

Diagram I.

Commuter Halt and Cross-Over System



elearly recognised that the private owner does not take his vehicle out to inconvenience others (even he considers it an unavoidable nuisance in many cities today) but because there were positively certain needs emanating from a home - represented by a child, a housewife and the worker - for which, in the past, public systems were just not there. Thus, the aim in the reformation was not to bring down the facilities based on real need for the group of private owners, but to maintain, by alternative means and modes, the essence of all these facilities and simultaneously to extend the same to the rest of the population. It was essentially a new city image. It was considered that a typical set of facilities enjoyed by private vehicle users, and legitimately so, included ability to step from home into vehicle without submission to delay or weather; and similarly to get to the point of 'service' (school, office or shop). These were to be ensured and if there was discontinuity in travel between the two end points, the level of convenience, in terms of time or weather or accommodation, was also to be assured.

Today, the translation of these basic principles in Pedestrapolis, notwithstanding some improvements still to be effected, has become both a success and, almost surely a solution to the future elsewhere.

The mechanics of the system - we shall also briefly refer to its economics later - is somewhat as follows. All residential sites, and these are not only the affluent areas, have been improved for attainment of a fairly interlinked lane network within each localized area, from which as a whole one or more sub-roads lead to the commuter halts on the highway. In some places, particularly in the area between the highway and the coast, with its parallel residential lanes, the task has been much easier and the results exemplary. From a central base in each of these zones, a required number of mini-vehicles operate at very frequent intervals, for boarding at will, either by hailing, or advance telephoning where homes have telephones, or by switching a blue light at the gateway to the road, for the mini-vehicle to see and stop. These vehicles could normally carry three or four persons with

normal luggage kept on the floor. If more space is required for special purposes including, for example, direct commuting to the airport, a suitable vehicle could be noticed, if necessary also by conveying the message through any passing mini-vehicle. For normal commuter needs, the mini-vehicle would proceed to the covered commuter halts mentioned earlier, beside which the public coaches arrive and also from which the escalator facilltates crossing over to the commuter halt for coaches travelling in the opposite direction. A basically similar system operates at the arrival point, with smaller feeder or distributory vehicles commuting into the shops and work places etc.: or, on the return, within the lanes in each residential zone.

Within each localized area, the mini-vehicular movement is broadly anti-clockwise, with vehicles here using the left lane. In other words, the focus of movement inside each localized area is essentially towards the covered commuter halt on the highway. All intra-area vehicular movement, is either down the sub-roads from the highway focal point or is up these roads, ultimately turning left to the focal point. A simplified illustration, notwithstanding variations, of this general pattern is given here.[3]

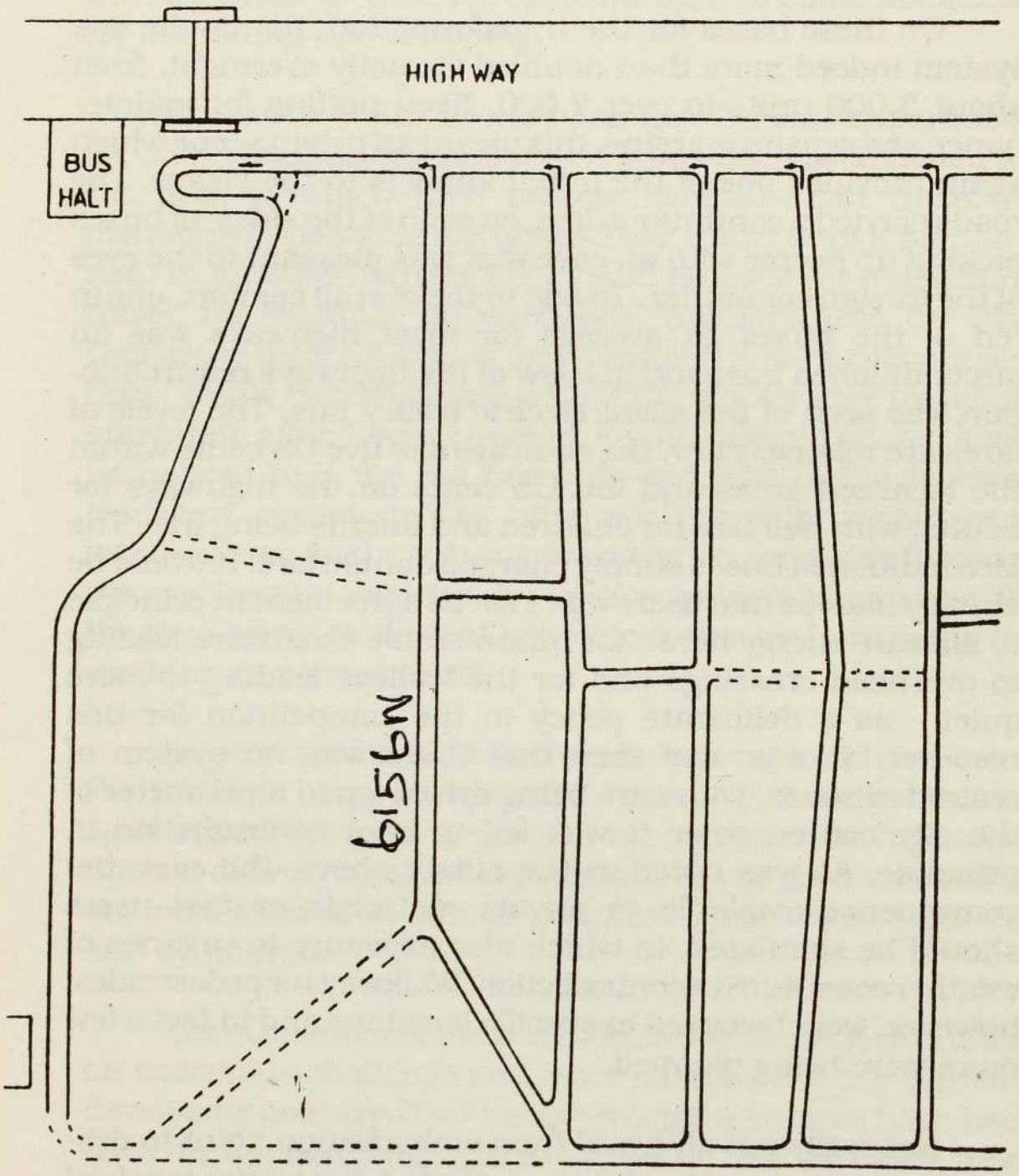
The management and economics of both the transition to the present system and its operation were highly fascinating and original. First on the management. It was found that, given the present and projected population of the city, and allowing for the existing and planned capacity of the suburban rail system, the existing stock and trend increase in public buses plus the private cars and taxis just about met the commuter demands. However, brfore proceeding further, it was firmly decided that no commuter shall for his daily purposes have to be overcrowded or to stand in a public bus. On these data bases, the initial estimates were made of total number of required buses. Very broadly, the estimated figure was raised by 20% to provide seats at all times to commuters;[4] and was raised by one twentyfifth of the total figure for private vehicles and taxis, on the basis of a two passenger average use for cars and 48 to 52 passenger capacity in the buses. The

Diagram II

Residential Zone - Feeder Traffic

To Commuter Halt

.. .. New link line



actual number of buses on the roads at any given time was of course related to the peak and non-peak hours of traffic. Trucks - and any private cars that still wished it were confined to the 'trough' period, from 8 p.m. to 7 a.m. within the city.

On these bases for the transformation, the public bus system indeed more than doubled virtually overnight, from about 3,000 units to over 7,000. Even netting for maintenance and repairs margins, this meant an urban scene which again provided one of the initial impacts to the visitor. The roads carried a continuous line, on each of the sides, of buses picking up people with an ease that was pleasant to the eyes of the foreign commuter. To add to the overall comfort, one in ten of the buses on average for most highways was an airconditioned bus; and in a few of the highways reintroduction was seen of the silent electric trolley bus. The levels of fares are relatively low, the equivalent of five US cents within the localized areas and ten US cents on the highways for adults, with half fare for children and infants being free. The airconditioned buses simply charged double fare. It would be already noticed that there was a social agreement in principle to allocate energy here - for innumerable escalators leading to overhead crossings and for the trolleys leading to more quiet - as a deliberate policy in the competition for this resource. It was also seen that there was no system of restricted zones, with cars being driven up to a perimeter of the city contre, since it was felt to be a contradiction in principle. As was noted at the outset above, the essential convenience available to private motorists or taxi users should be simulated, in which also exposure to vagaries of weather constituted a contradiction. Walkways or pedestrades, however, were favoured in specific locations and in fact a few more were being planned.

Naturally not all travel from embarkation point to destination is by a single public bus. Quite a few routes involved linkages. 'Maximum smoothness and coupling arrangements obtained in this as well. Basically, the arrangement was one of alighting on to the covered shelter and walking across to the linkage point (if the travel continued in the same direc-

tion) or taking an overhead crossing to the appropriate shelter (if the linkage travel was in the opposite direction). It is worth repeating that buses were available almost 'immediately'. Major destinations, which mean also conversely major embarkation points, had bus stations of varying size, with facilities for rest, refreshment and, in some instances, for marketing and shopping.

The stock of private cars has now become superfluous for daily communting and a policy has been established for the uses to which their owners may now put them. As mentioned, the roads are open to car traffic from 8 p.m. to 7 a.m. In addition, private cars could be used for out-station travel, for example, on weekends, holidays, and the like. Departure before 7 a.m. or arrival after 8 p.m. is encouraged. Strict traffic checks obtain within the city for cars travelling outstation after 7 a.m. or before 8 p.m. to avoid abuse. It will be noticed that the old taxis are not part of the highway transport system in the city; nor generally within each localized area on the sub-roads and lanes, for which there are the special mini-vehicles. It appears that one reason was, for the time being, to prevent private car owners from using the roads as converted taxis;

Bicycles are freely allowed on the highways and elsewhere. For the time being motorcycles have been heavily discouraged within the local areas and barred from the highways. Special delivery vans, of say perishables to groceries and so on, were allowed in limited numbers under licence (for use and by hours).

The economics of the transformation on the face of it was an enormous challenge and more so since the city was in a developing country. Two basic principles seem to have been used in approaching and overcoming this problem. They derived from the fact that a financing of additional bus capacity could be related to the motorcar capacity, in which the capital cost of all motorcars was demonstrably financed historically by local income earners; and that the foreign exchange cost, where cars were imported or raw material or

components were got down for manufacture or assembly, was similarly a demonstrated capacity. A first step therefore, on the eve of the transformation was to halt all new car purchases, without prejudice to such purchase some years afterwards or without prejudice to a particular income earner financing a car for himself, but subject to a prior commitment to the cost of a car being contributed to the central governmental fund for public transport. All existing car owners were therefore required to contribute, as repayable capital contribution to this fund, full replacement cost if their existing vehicles were 5 years or more and at a downward graded percentage for newer cars, up to a floor level, of half the cost, depending on how recently the income earner had to incur the expense of buying his car. There were, obviously, visible initial gaps in meeting the full needs, in local currency or foreign exchange, but it was held that, over a limited lead period, the resource situation both for the householders and for the economy would even out.[5] To reinforce this, the government gave added fillip to the existing motor bus, coachwork and component manufacturing plants.[6] By these means, the capital financing was realised and achieved with minimum strains. Some of the infrastructure costs, involving the new system of public commuter facilities, were carried as additions by the State as part of social cost. On the ratio of 25 cars or taxis to one bus, there should have been some resources available to spill over into the financing of infrastructure costs, through the margins of excess value of the 25 car ratio over one bus purchased.[7]

As a result of these steps, the present situation emerged, with a society, of all age levels and work types, moving freely; while previous car users still enjoyed the same 'facilities' they looked to as before, form their homes to their destinations and back.[8] Quite obviously there was still room for improvement, particularly noticed in the historically more ill-planned residential zones, with their far from symmetrical layout and their tortuous lanes. But these shortcomings were truly marginal compared to the total situation. Their problems had to do with essential physical planning rather than transport logistics. It seemed that, given time, they would be overcome.

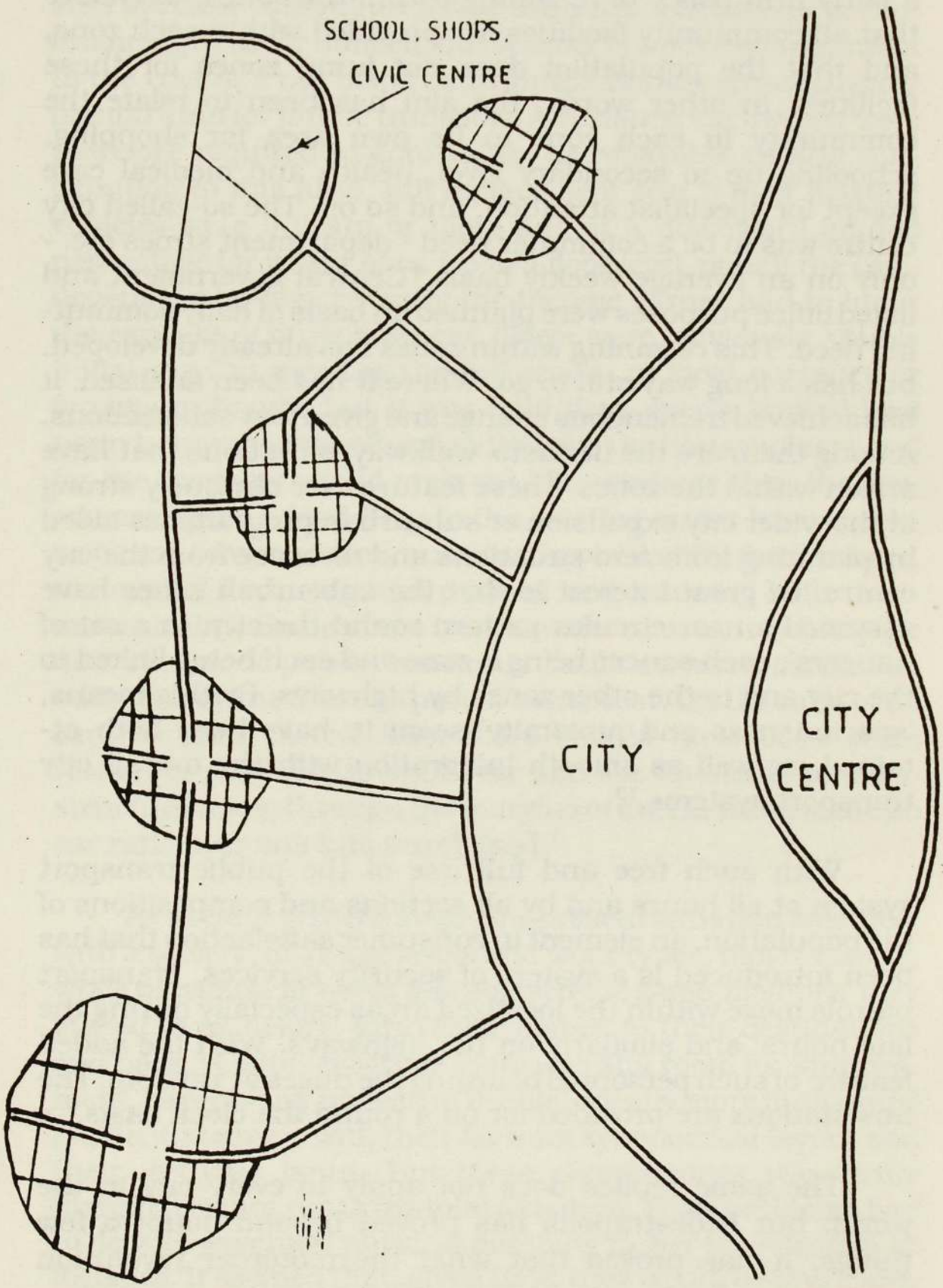
There were two methods of approach which the authorities used as overall policy. One was a forward planning to contain the future population level of the city, which was obviously not for commuter purposes alone. The second was a fairly firm policy of re-zoning within the zones, to ensure that all community facilities are provided within each zone, and that the population does not jump zones for these facilities. In other words, the aim has been to relate the community in each zone to its own area for shopping, schooling up to secondary level, health and medical care except for specialist attention, and so on. The so-called city centre was to be a commuter need - department stroes etc. - only on an average weekly basis.[9] Central government and listed office purposes were planned on basis of daily commuting need. This re-zoning within zones has already developed, but has a long way still to go. Where it has been finalised, it has achieved tremendous change and given new satisfactions. Among them are the derfacto 'walkway' situations that have arisen within the zones. These features are obviously strong in the wider city expansion or sub-urban programmes aided by planning from zero situations and distance from the city centre. Of great interest is that the sub-urban zones have assumed a near circular pattern round the city, in a set of 'saucers', each saucer being a zone and each being linked to the city and to the other zones by highways. By this means, 'spaciousness and proximity' seem to have been both attained, as well as smooth integration with the overall city transport systems.[10]

With such free and full use of the public transport system at all hours and by all sections and compositions of the population, an element in consumer satisfaction that has been introduced is a system of security services. Transport patrols move within the localized areas especially during the late hours; and similarly on the highways. With the added feature of such personnel boarding the buses at random. The bus stations are provided for on a round the clock basis.

The same replica does not apply to every city in the world: but Pedestrapolis has proved beyond doubt a few things. It has proved that what the motorcar revolution

Diagram III

SUB URBAN ZONE SYSTEM



created, viz travel to and from the 'doorstep' of each household, it can provide by public means. It has also proved that it is quieter and easier going around in the public places, and more beautiful. It has established a dimension for the city, as an extension of the home and perhaps part of the family life style. It has made standard, ideas on peripheral and self-contained zones, that were known before but not carried wholeheartedly. And it has shown that these can be realised without undue problems. It has thus established a sustainable mechanism for societies in cities, in terms of meaningful living and moving around. Even with all its still noticed shortcomings, Pedestrapolis is perhaps a prototype that will ultimately be found in all cities.

NOTES

1. See Diagram 1.

2. It is noteworthy that traffic growth, to a point of 'standstill', need not be the only motivator for a reformation. In the capital city of another country which had to clamp down on all private car imports for foreign exchange reasons, the need arose to step up public facilities sharply, leading now to the beginnings of a scheme similar to Pedestrapolis. In fact this situation could be easier to handle since private cars are in any case getting effete; it represented an opportunity not to be missed.

3. See Diagram 2.

4. Overcrowding varied by times and by routes and additional capacity was derived from an aggregate of peaks weighted for traffic load.

5. On the premise that in the traditional system of private transport, there is a continuous flow of 'future generation buyers' of private cars, a scheme obtains for income earners at that level to furnish as loans to the State a notional capital cost of what has been defined as a 'standard' car.

6. Domestic car assembly capacity was diverted in a planned way, to tractor and truck manufacture etc,: and for mini-vehicles.

7. However, this was partly offset by a liberal approach to the purchase of taxis for special service, such as to the airport, hospital etc., from the residential zones; and by taxi owners as such not being liable to the capital contribution mentioned earlier - they contributed, like any others, if they were private car owners. Taxis not purchased were allowed to operate for the present within the residential zones if they so wished, or to move to outstations in the country.

8. A pleasant feature was the voluntary practice for VIPs and DPLs also generally to use the public transport system. As a rule, this obtains, the exceptions being State functions and other protocol needs.
9. There would be daily commuters but on average a commuter or family was not expected to need the city centre except once a week or so. There was of couese no restriction by compulsion.

10. See Diagram 3.

ICCDA* Third International Conference (June 1983)

---

* International Co-ordinating Committee of Development Associations.

Panel No.1: "Management of Development and Social Change" (Keynote Address)

SUMMARY OF DISCUSSIONS (Extract)

Part of a network of efforts to understand the present situation in the universe of developing countries - and not excluding an eye on the world's present impasse and crises, - the discussion about "management of development and social change" revolved basically around concepts, ideas and policy suggestions aimed at promoting growth and an overhaul of social structures. The point of departure for the discussion, Prof. C. Suriyakumaran's paper, begins with a clarification of fundamental themes related to : (a) the holistic nature of the development process; (b) the need of management for change in agents - social, demographic, environmental, technology - whose changes are the result of overall development as much as they are the cause; (c) the core of development management as bending to the best advantage the growth conditioning factors; and (d) the inadequacy of concepts and theories employed in the last four decades for development purposes.

The paper then goes on to its main problem, namely how to obtain development by managing human and natural resources. It identifies the goals of economic growth as an enhanced welfare basis.....and sustainability of the production structure. According to the argument used by Prof. Suriyakumaran...the process of development follows a simple mechanics of combination to productive advantage by means of capital, of land and labour, whose product is the creation of wealth under fixed conditions in any economy. This constant process generates a surplus to be re-inserted in the income flow so that growth may continue. Such is the rule of capital accumulation and economic expansion - a fact well known by the student of economics.

Prof. Suriyakumaran introduces then the notion of internal "fabricating capacity" as a means for a country to acquire the needed progressive "non-dependence", with which,

besides other factors like a meaningful industrial structure, a sound agricultural system and the relevant range of wage-goods output, the basis for self-sustained growth is formed...

After World War II, the road to growth was taken confidently by the developing countries, under the belief that the rising expectations then created could be fulfilled. To a general climate of political, economic and humanitarian aspects that seemed to favour development, was added a firm promise of international economic cooperation for growth. Prof. Suriyakumaran points out all this, showing that the great population surge that occurred simultaneously made the achievement of the key components of sustainability of development almost unattinable - thus leading to frustrated expectations. To such gap between promise and performance other gaps - like the growing income gap - must be added to form the picture of dependent development. We therefore can understand how the capacity for surplus generation is suffocated.

The next step to investigate into the question of how to get rid of the unsuccessful growth path is to explore the notion of "management for development", Prof. Suriyakumaran treats it as integrated development or planning, offering here a genuine contribution to the subject. He calls attention to the need of seeking a methodology of ideas and their coalescence, what is that he attempts to do by integrating environment - considered the totality of our resources, natural and human - and economics. By speaking of "environment management for development" as the use of all "resources alongside sustained maintenance of future resource levels", Prof. Suriyakumaran suggests as policy prescriptions not a catalogue but "a framework or a planning module". Basically, what is needed in this context is to attempt an "approximation" of two categories he introduces in the discussion, namely "physical supply" and "effective supply" of a resource. The task boils down to the construction of "resource balance sheets" which may provide information concerning decisions on resource exhaustion, maintenance and expansion. Prof. Suriyakumaran optimistically considers that those calcula-

tions will establish a dialogue between environmentalists and economists and provide for the estimate of "final" effective resource supply. All the above planning is to be conducted on the macro-level. Sectoral and project planning can proceed and the final result will be "maximization" of production.

The final stage of Prof. Suriyakumaran's insight is what he calls "the infra-structure of development". By it he means "the organizational, political and cultural basis" indispensable for sustainable growth. At this juncture, the ideas presented created some controversies. Prof. Suriyakumaran, for instance, stated as a historical truth that "no country was a `democracy' at the time of its take-off to growth"... On the other hand, he was also very critical of philosophies of basic needs, employment-intensive strategies and small technology, having tried to show that such perceptions of reality do not allow developing countries to catch up with the developed world. In fact, the core of his presentation is the idea of development as the "attainment of the same level of wealth" of the rich countries "and sustenance of this level thereafter". This argument seems to suggest that some level of wealth could be simultaneously achieved by all countries. However, one should not commit the error of assuming that just because something is desirable is must also be possible.

Another point that was stressed by Prof. Suriyakumaran is the need of "a transforming cultural ethos" without which wealth creation cannot be accomplished. Such ethos, it is derived from his argument, should not take "narrow refuge in cultural pasts". Of course, it is no easy task to define the set of cultural conditions that stimulate a growth environment. Easier is to recommend, as Prof.Suriyakumaran does, to de-emphasize the total reliance that developing countries take on the developed ones for their own economic expansion. Instead, he proposes the establishment of effective co-operative mechanisms among developing countries - something that goes beyond verbiage. He goes on even to deny the relevance of efforts towards a new international economic order. An important point he juxtaposes to his considerations is that "the capacity to develop has not been the preserve of one people alone".

In the discussion that followed Prof. Suriyakumaran's presentation, there was consensus about various points he raised - the width of the subject he examined, the integrated character of development, the need for new theories, models and propositions - an area to which Prof. Suriyakumaran has certainly made a contribution here - and so on. Nevertheless, it was pointed out that we must work on the contents of such theories and models, for enormous problems emerge, both of a theoretical and ideological nature, as well as practical ones, when we try to devise new ways of handling old questions, such as development and development economics. The study done by Prof. Suriyakumaran touches on various points which were not, however, fully analysed. But he is ware of the possibilities he had in the short time of his presentation. One point that requires a deeper insight - and this is a recommendation for further research - is the internal political dependency relationships. In other words, there seems to be a necessity for a better understanding of the mechanisms that prevent a self-reliant development today in Third World countries; or of how decisions are made by governments and by capital.

Another point stressed in the comments on Prof. Suriyakumaran's paper was that the way he presented his analysis permits to arrive at a number of reflections usually proposed under binomial fashion; physical supply and effective supply; management of development after development and management to achieve development; mass change and marginal change; welfare as a short-term goal and sustenance of prodution structures on the long run; availability of productive resources and combination of resources for surplus generation; the impasse planners face concerning programme of hygiene which engender population growth and programmes of environmental protection that recommend respect for nature, thus giving rise to the conflict between utilization and non-utilization of resources; finally, the need to implement schemes of successful industrialization...and the difficulty of doing so under democracy in developing countries.

ANNEX 3

Integrated c/b Assessments-Select Post-graduate Theses

(4 Studies)

Code No 3:1:2:6

Year 1982

Degree M.E.

Title of Thesis : Environmental analysis and assessment of public conveniences

Author : N. Raghurajan

Supervisor : R. Pitchai

Keywords : Sanitation, impact, environmental assessment, cost benefit ratio, night soil management system

Abstract

The principles of environmental assessment according to the UNEP Test Model Format is illustrated here with reference to a project contemplated for improving the night soil management system of a small community in Madras, spread over an area of 1.5 sq. km. and having a population of 20,000 people, belonging to the economically weaker section. This study is significant in the context of the International Drinking Water Supply and Sanitation Decade since it pertains to the solution of a recurrent and important sanitation problem. The environmental analysis followed traced the resources use and transformation in the project and summarised the cost and benefit aspects of providing the facility.

The exercise indicated that the proposed system of night soil management by way of public community latrines coupled to digesters, and drying beds would be beneficial and cost effective, both from the economic and from the environmental view points. The environmental assessment as carried out in this thesis was found to be an appropirate methodology for assessment which could be readily followed in less developed countries.

Environmental Analysis and Assessment of Public Conveniences A Conceptual Case Study

N.Raghurajan*

Introduction

The tool of environmental assessment of projects has been used to evaluate a project contemplating the betterment of sanitation in respect of night soil management system of a small community in Madras spread over an area of 1.5 Sq.Km. and having a population of 26,000 people belonging to essentially the economically weaker sections.

The present system of sanitation prevalent in this project area is practically open air defecation even though 29 Nos. of public conveniences are already present in this area. The main deterrent preventing the effective use of these public conveniences and favouring open air defecation appears to be the absence of assured water availability at the public convenience for use as ablution water and other general flushing and cleaning water, even though each public convenience has a nearby open draw well. The lock of an adequate, assured maintenance also seems to be an equally important reason.

Proposals

Under the proposed project, the open draw wells at each of the public conveniences are proposed to be energised with a power pump to provide for a continuous system of flushing

---

* Engineer, (Presently retired), Metrowater, Madras.

the toilets by an automatic flushing system using an overhead tank. The night soil from the public conveniences is expected to be used along with animal dung generated by the cattle population in the area for running a bio-gas digester at each of the public convenience locations and thereafter to dispose of the effluent from the digester into an oxidation pond and a fish pond. The sludge is expected to be dried on sludge drying beds and disposed of and manure for fields nearby. Figures 1 to 4 present the schematic datails of the proposals.

Environmental Impact Assessment

By way of environmental impact assessment, the format furnished by the United Nations Environment Programme Regional Office in Banglok as their 'test model' has been adopted and all the inputs to the projects as well as benefits from the Project such as bio-gas, fish, enhancement of sanitation in the area, raduction of incidence of diseases in the area and public health benefits, restoring productivity otherwise lost have all been quantified using national norms. This involved the following.

1. Adequate description of the project in terms of physical details and all micro and macro inputs.

2. Identifying resources that are directly used, indirectly affected and also exhausted, depleted and deteriorated.

3. Identifying the resources enhanced.

4. Identifying the products and residues created.

5. Computing economic equivalents of the foregoing resource transformations and

6. Working out the benefit to cost ratio including economic and environmental costs and benefits. Certain amplifications of the terminologies as used in this report are presented herein.

(a) Resources directly used or consumed

The following resources have been identified as directly used in the project. They are: (1) Land area (2) Ground Water (3) Labour (4) Fuel Oil (5) Bleaching Powder (6) Machinery (7) Animal dung.

The assumption made in costing the resources used were

(i) The land cost at the location of P.C.'s and digester has been taken as Rs 10/m^2. In the case of the land needed for drying beds and fish pond etc., the cost had been taken as Rs.5/m^2 as these locations are unfit for human habitation.

(ii) Ground water that would be used for the public conveniences has been priced at Rs. 1.00/1000 lit.

(iii), (iv) & (v) Costs of labour, fuel oil and bleaching powder etc. have been included in the computation of total capitalised cost as well as operation and maintenance costs.

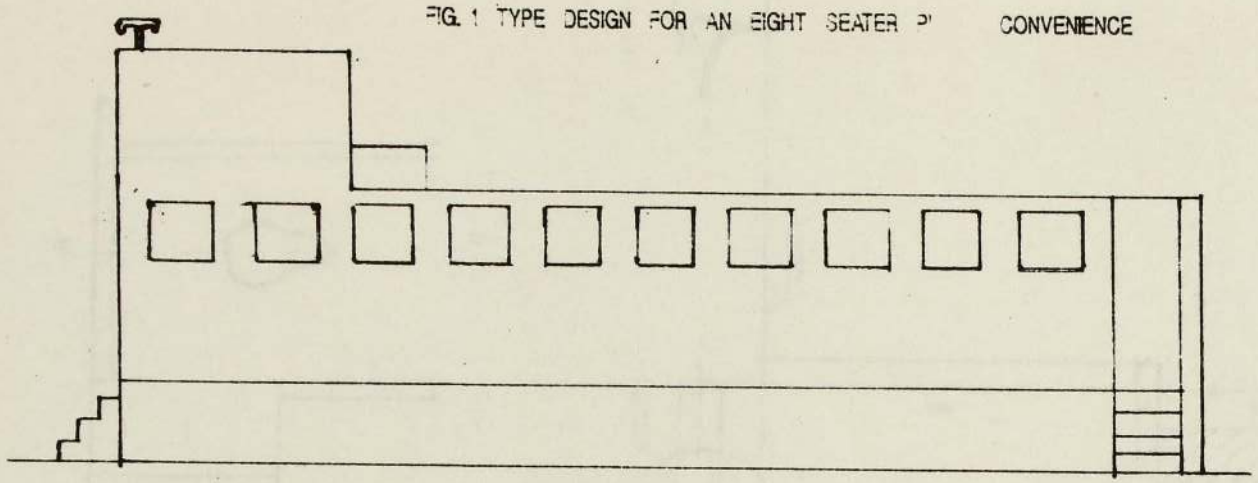
(vi) Cost of machinery has been included in the capital cost and it is assumed that it will be fully replaced after 15 years.

(vii) It is intended to use the night soil for biogas generation by mixing it with the necessary quantum of animal dung. For this purpose an animal dung availability survey in the are was conducted and it revealed that nearly 50% of the raw dung requirements for Biogas can be met with from within the area itself at a cost of Rs.5/ Ton and the balance 50% need be imported from outside the area at a cost of Rs.25/ Ton of wet dung and hence an average cost of Rs.15/Ton of wet dung is assumed.

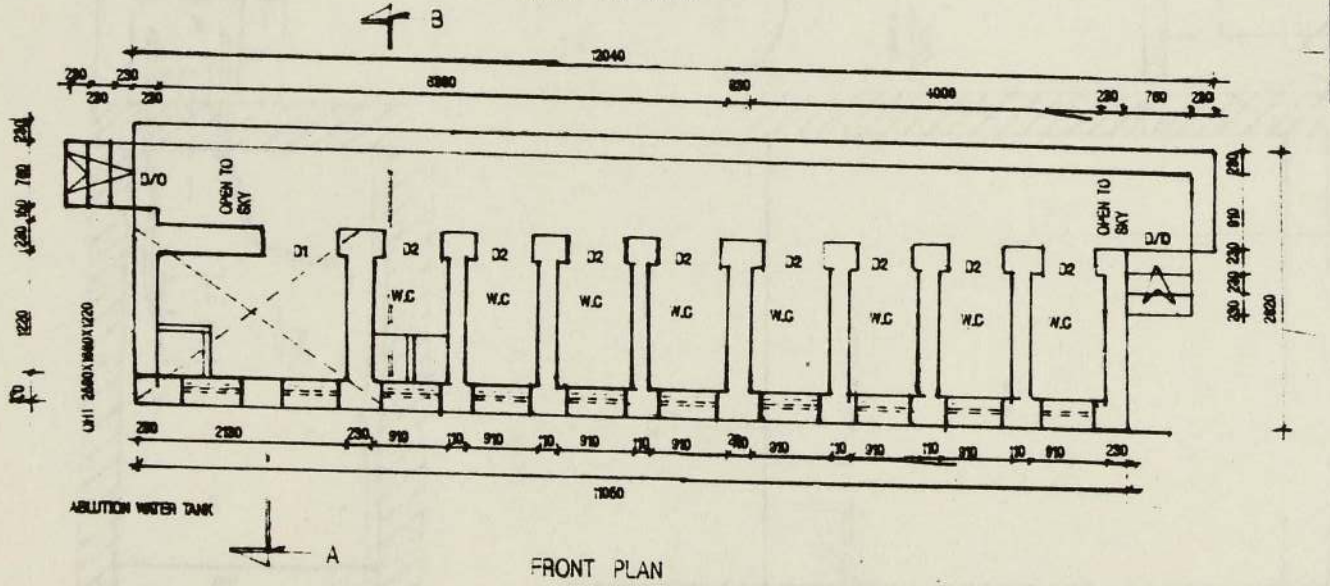
(b) Resources Indirectly affected

Resources exhausted, depleted or or deteriorated. In as much as the present project is an environmental improve-

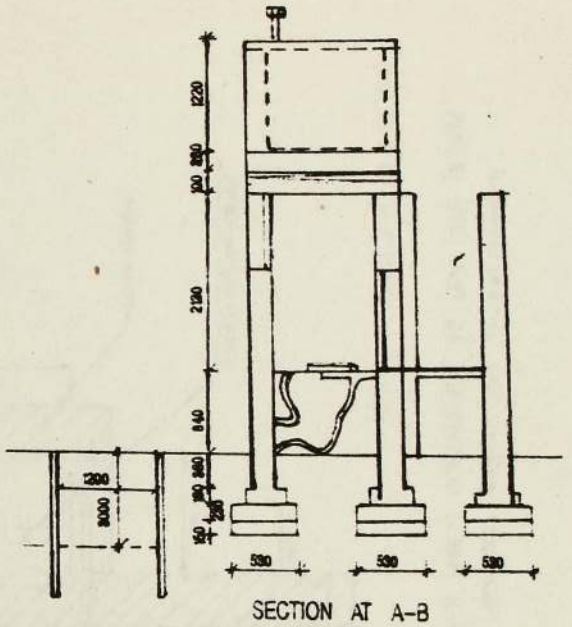
FIG. 1 TYPE DESIGN FOR AN EIGHT SEATER P' CONVENIENCE



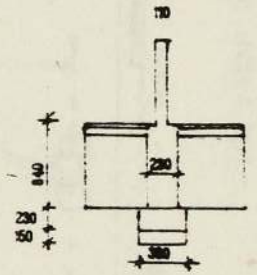
FRONT ELEVATION



FRONT PLAN



SECTION AT A-B

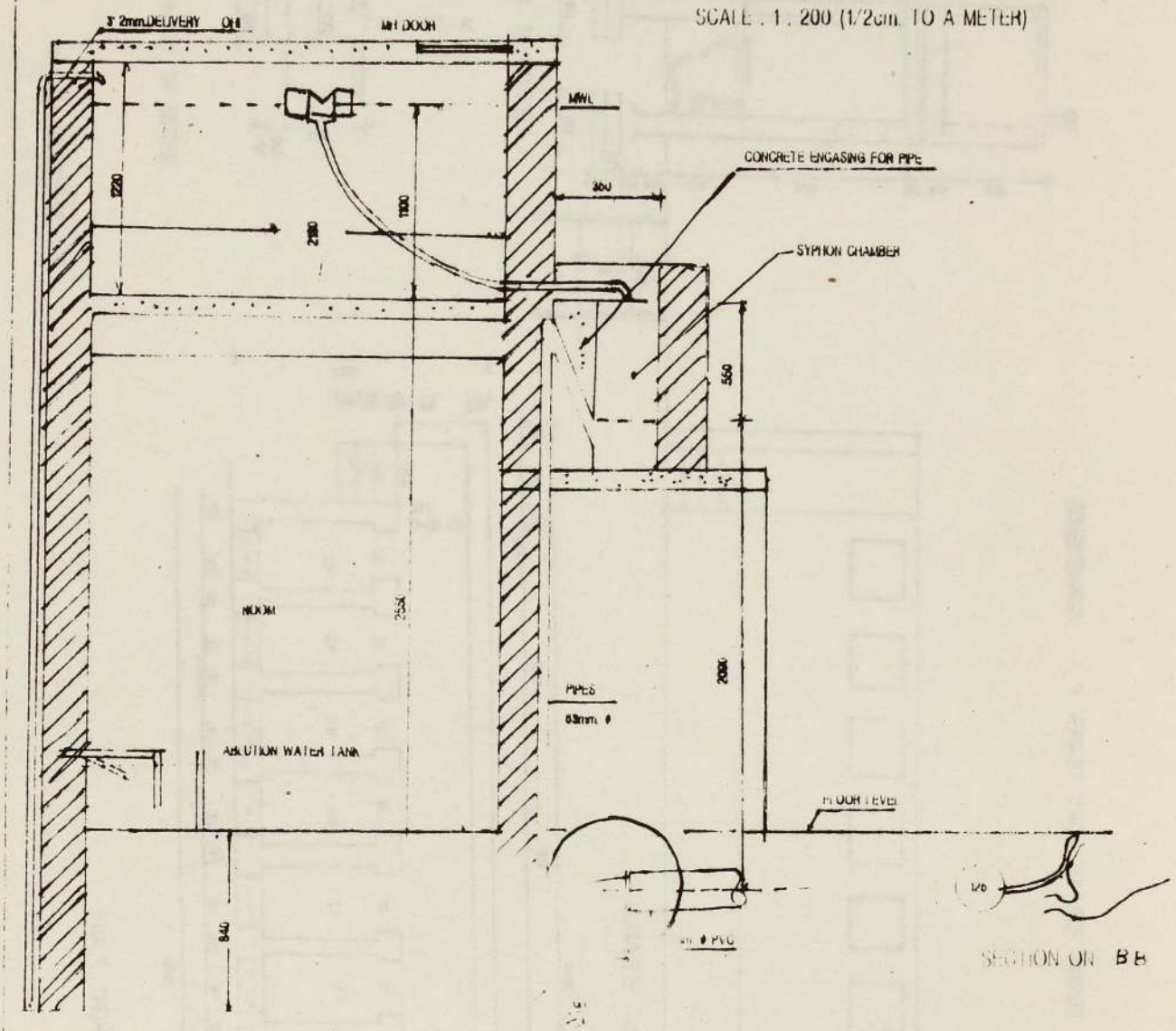


SECTIO AT 110mm WALL

ALL DIMENSIONS IN mm

FIG 2 DETAILS OF THE PROPOSED PIPINGS AND SYPHON CHAMBER FOR A EIGHT SEATER PUBLIC CONVENIENCE AS PER TYPE DESIGN

SCALE : 1 : 200 (1/2cm. TO A METER)



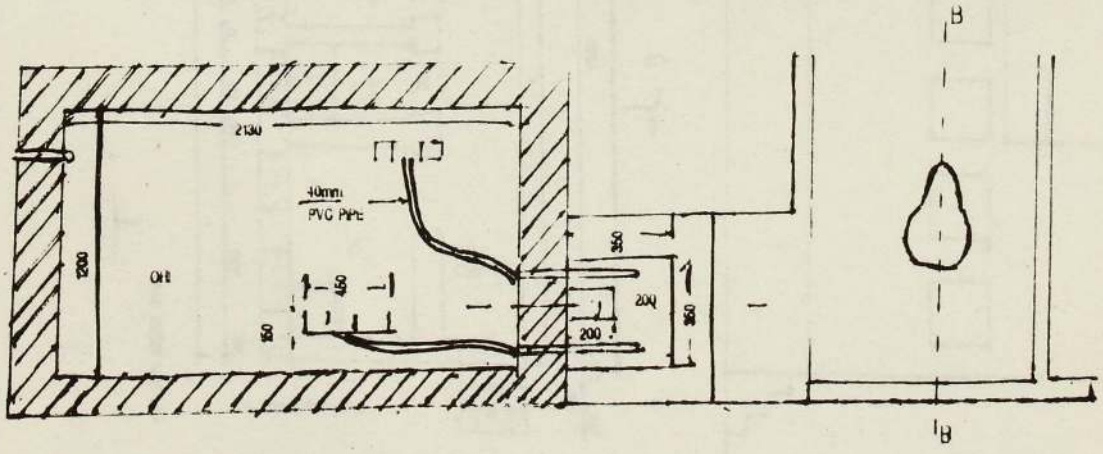
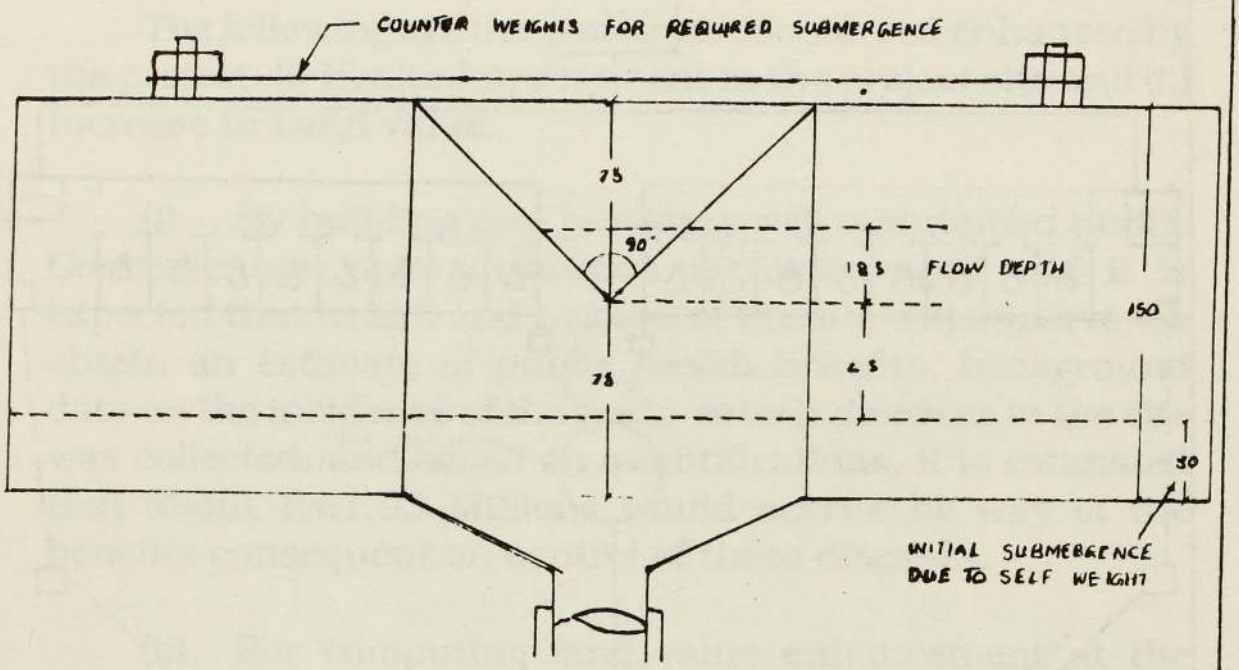
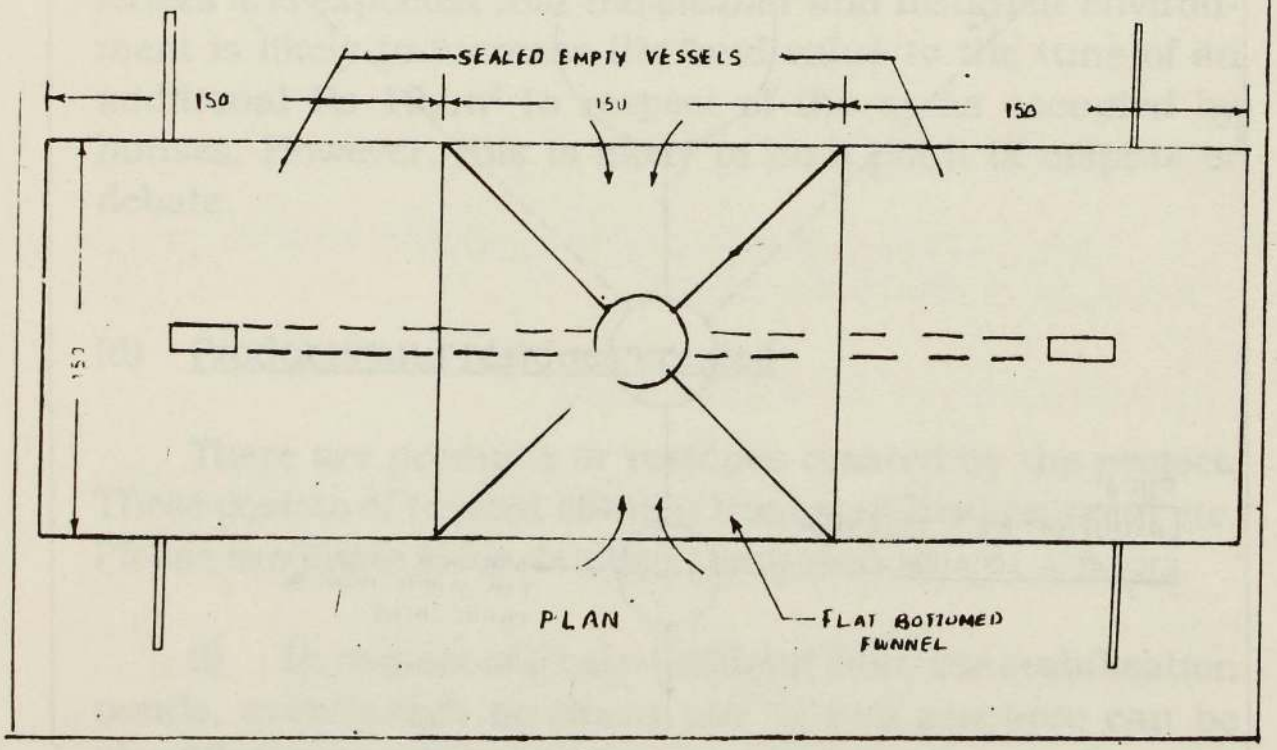


FIG 3 FLOAT MOUNTED 'V' NOTCH SCALE 1:50



ELEVATION



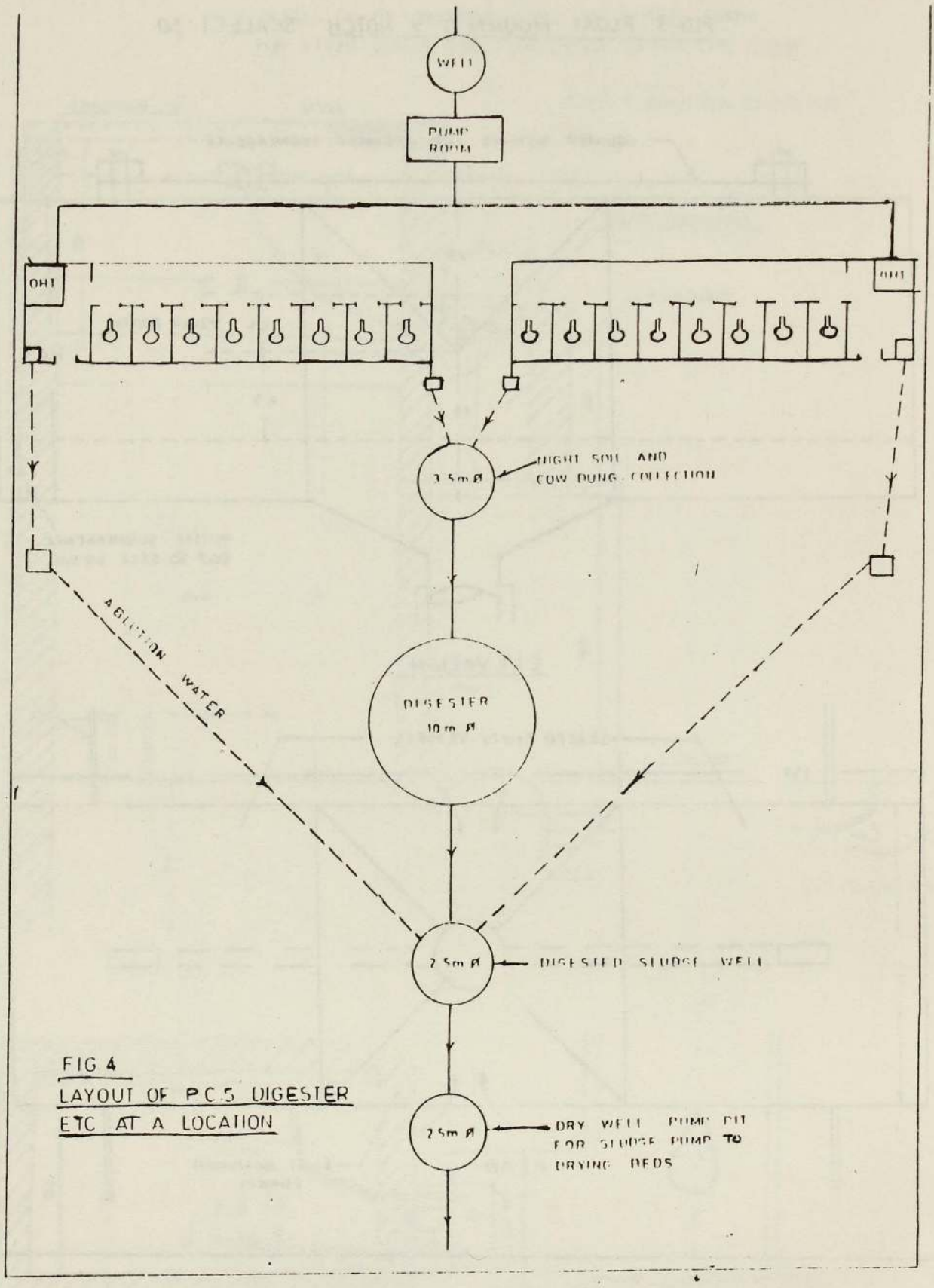


FIG 4
LAYOUT OF PCS DIGESTER ETC AT A LOCATION

ment project, none of the resources are exhausted, depleted or deteriorated.

(c) Resources enhanced

The following are the resources considered enhanced by the project. (i) Health Improvement in the project site and (ii) Increase in Land value.

(i) By building and providing well maintained public Conveniences, open defecation is discouraged and it is expected that health and hygiene of the site will imporve. To obtain an estimate of public health benefits, background data on the incidence of the gasto-enteric diseases in the site was collected, and based on quantifications, it is estimated that about Rs.1.93 Millions would accrue by way of the benefits consequent on control of these diseases.

(ii) For computing land value enhancement at the Project site resulting from the provision of Public Conveniences it is expected that the cleaner and healtheir environment is likely to increase the land value to the tune of an additional Rs 10/m^2 in respect of the areas occupied by houses. However, this is likely to be a point of dispute or debate.

(d) Products and residues created

There are products or residues created by the project. These cosists of treated effluent from stabilization pond etc. Please see Table II for detailed computation.

(i) In respect of treated effluent from the stabilisation ponds, eventhough no direct use of this resource can be identified now, still this is a potential resource of a good quality water, suitable for growing coconuts, etc. It is hence valued at a nominal price of Rs.0.25/100 litres which a user of the effluent can be expected to pay.

(ii) For digested sludge for farm use as manure and as land fill, a nominal value of Rs. 1/ton has been provided on the assumption that handling and carting charges will be borne by the user.

(iii) The value of Bio-gas used for domestic purposes, street lighting and as fuel for machinery, has been assumed to be comparable to commercially available indane gas.

(iv) A value of Rs10/Kg of fish from the fish ponds has been assumed at site. The handling and carting charges are expected to be borne by the users.

Cost of the Project

The total estimated cost of the project for serving the population of 26,000 using the present 29 public conveniences and, in addition, constructing 23 more public conveniences and providing a digester and auxiliary facilities for each paid of the public conveniences works out to Rs.45.05 millions; this included the capitalised cost of Operation and maintenance of the system for period of 30 years.

Costed Benefits of the Project

The quantified total cost of the benefits from the project works out to Rs.71.43 millions.

Cost Benefit Ratio of the Project

The exercise indicates that the cost-benefit ratio for this project would be 1:1:6 for the economic as well as the environmental cost-benefit and, therefore, the enlarged cost-benefit. Considering the levels of prevailing sanitation in an area particularly serving the economically weaker sections, any such project has to be considered as welcome and implemented in view of the social commitment for the down-trodden. The B/C ratio of 1.6 for the proposed project is a pointer to the concept of better management of sanitation measures making it more attractive even economically.

However in most cases involving decision making in regard to public investments on infrastructure type of projects, it does become necessary to convence the decision making authority in more realistic and necessarily quantitative terms. The environment assessment as carried out vividly illustrates an appropriate methodology.

It is to be distincly appreciated that the entire project becomes realistic and beneficial and would be more than welcome from the view point of the slum inhabitants at the project site.

The necessary computations are presented in Tables I to IX.

Table 1

ENVIRONMENTAL ANALYSIS STATEMENT FOR NIGHTSOIL MANAGEMENT FOR A COMMUNITY

PUBLIC CONVENIENCE
AT MADRAS

Country	INDIA
Nature	
Title	Night soil management from community public convenience in a part of Madras city
Time span	30 years
Physical boundary	A cluster of slums known as Vyasarpadi lake area slum lying South of Erukkancheri High Road forming part of Municipal Corporation Division Nos. 24, 25 & 27.
Cost	Overall cost covering treatment and disposal of night soil from public conveniences and production and supply of Bio-gas etc.

Initial capital cost	Rs. 4.64	(in Millions)
Envisaged maintenance cost (30 years)	Rs. 40.20	(")
Land value treated as cost	Rs. 0.21	(")
	Rs. 45.05	

Products & values	Treated sewage	Rs. 1.380	(in millions)
	Biogas	Rs. 61.230	(in millions)
	Dried sludge as manure	Rs. 0.720	(in millions)
	Fish	Rs. 8.100	(in millions)
		Rs. 71.430	(in millions)

Remarks

The calculation of costs and benefits are with reference to the base year 1982. The project under assessment analysis the advantages and disadvantages - economic and environmental - that the test site would have by the implementation of the project. The date used are based on current schedule of rates for materials and works. The time span has been assumed 12-30 years. Price discounting has been avoided and annual values are multiplied by 30 to arrive at equivaluent capitalised cost.

Table II
RESOURCES USED IN THE PROJECT

		Quantity	Value in Rs.
1.	Land cost	40850 m^2	210,500
2.	Civil Works	(as detailed in foot note)	4,148,800
3.	Machinery	-do-	494,000
4.	Operation and maintenance cost (capitalised for 30 years)	-do-	40,158,000
		TOTAL	45,011,300
			or 45.02 million

			Rs.
i)	For P.Cs and digester etc.	1250m^2 (50m x 25m) @ Rs. 10m^2	12,500
ii)	For drying beds and dried sludge storage space	25000m^2 (2 nos. 100 x 80 m & 2 Nos. 100 x 45m) @ Rs. 5/m^2	125,000
iii)	Sludge stabilisation and fish ponds	14,600m^2 (1 x 110 x 110 & 1 x 50 x 50) @ Rs. 5/m^2	73,000
		TOTAL	210,500

2. Civil works

(i)	Modification to existing P.Cs including raising of seats, basement, construction of O.H. tanks, addition of buildings, construction of man holes etc. complete in all the 26 locations	225,000
(ii)	Generator room @ Rs. 10,000/- each for 26 locations	260,000
(iii)	Pump room @ Rs. 5,000/- each for 26 locations	130,000
(iv)	Digester - masonry circular including concrete plugging of floor and plastering etc. complete @ Rs. 30,000/- each for 26 ocations	780,000
(v)	Steel dome gas holder including fabrication and erection at site @ Rs. 25,000/- each for 26 locations	650,000
(vi)	Appurtenant works like homogeniser, dung platform, digested sludge well and sludge pump well etc., @ Rs. 8,000/- for each location, for 26 locations	208,000
(vii)	Pipe connections G.T. & stoneware, P.V.C. Ball valve, Gully trap etc. complete between various items @ Rs. 2,500/- each, for 26 locations at the digester site	65,000
(viii)	Sludge pumping main - P.V.C. of sizes for a length of (3,840 + 1,740m) @ Rs. 60/m (average)	334,800
(ix)	P.V.C. pipe line for transporting gas to place of use 500m @ Rs. 30/m for 26 locations	390,000
(x)	G. I. lamp post for street lamps including erections and lamps - 780 nos. @ Rs. 200/- each	156,000
(xi)	Drying beds including media, side walls, under drains, open masonry feed channel, etc. complete 16,000M^2 (100 x 80 x 2) @ Rs. 50/m^2	800,000
(xii)	Sludge stabilisation and fish ponds (only bunding)	150,000
	TOTAL	4,148,800

3. Machinery

i) Pump and motors

Water Pump	1HP	-	1 No.
Sludge Pump	3 HP	-	1 No.
Homogeniser pump	1 HP	-	1 No.

5 HP @ Rs. 1000/HP in 26 locations — 130,000

ii) Bio-gas run generator for producing electricity for running pumps - to produce 7 KVA @ Rs. 14,000/- each for 26 nos. (this can be at option as pumps directly run on bio-gas and diesel mixure above 3 HP are available) — 364,000

494,000

Total of Civil works & Machinery (4,148,800 + 494,000) — 4,642,800

4. Operation and maintenance cost (per annum)

i) Pump mechanic 1 No. @ Rs. 600/month @ Rs. 1,600/- p.m. for each location
Semi-skilled labour 2 Nos. @ Rs. 350/- for 26 locations per year
month Scavanger 1 No. @ Rs. 300/month — 499,200

ii) Unskilled labour 2 Nos. @ Rs. 350/month at drying bed stite per year for controlling of sewage to beds — 8,400

iii) Dried sludge collection and disposal; on lease basis - Hence no labour charge — ..

iv) Oil and lubricants @ 5% of machinery cost i.e. 5/100 x 494,000/year — 24,700

v) Replacement and renewal of machinery & 1/15th cost of machinery proportionate cost/year is 1/15 x 494,000/year — 32,900

vi)	Animal dung-wet weight of $5^{1}/_{4}$ tons/day at each location at Rs. 15/ton . . . for 26 locations/year	747,400
vii)	Repairs to civil works including white and colour washing and chemicals like bleaching powder etc. @ Rs. 1000/each location for 26 locations/year	26,000
	TOTAL	1,338,600

Therefore capitalised O & M cost, assuming 30 years useful life for the project, is Rs. 1,338,600 x 30 = 40,158,000/-

Table III
PRODUCTS AND RESIDUES CREATED
(These are goods and services which confer a benefit or involve a cost)

1. Directly from the development process:

	Description	Quantity	Rate	Value in millions of Rs./Yr.	Capitalised value over 30 years
(a)	Treated effluent	0.5 mld or 182.5 million litres per year	0.25/1000 lit.	0.046	1.38
(b)	Gas	290 m^3/day from each location; to serve 215 families/ day/location; for 26 locations	1.00/family/day	2,041	61.23
(c)	Dried sludge as manure	5 tons/day or 23725 tons/year	1.00/ton (nominal)	0.024	0.72
(d)	Fish sales	27 tons/year	10000/ton	0.270	8.10
				2.381	71.43

2. Indirectly — Nil

Table IV
RESOURCES EXHAUSTED / DEPLETED / DETERIORATED

Item	How	Quantum	Losses	Value
Nil	Entire project is an environment - enhancement project hence no resource is exhausted/depleted/deteriorated.			

Table V
RESOURCES ENHANCED

Item	How	Quantum	Rate at	Value in millions of Rs.
*1. Health improvement	(a) Reduced incidence of gasto-intestinal diseases	1222 person/year	Rs. 30/incidence	1.10
	(b) Man hour saved (capitalised) for 30 years	19,552 hours/year	Rs. 1.417/hour	0.83
2. Increase in Land value	Land value of residential, out of the total area of 1.5 km^2 will be enhanced by the cleaner environment resulting from Public Conveniences	(35% of total area is residential) i.e. 5,25,000m^2	Rs. 10/m^2	5.25
			TOTAL :	7.18

* Please see Appendix VIII.

Table VI

REQUIRED ADDITIONAL PROJECT COMPONENTS - FOR RESOURCE RESTORATION, MAINTENANCE, EXPANSION (POTENTIAL ACTIVITIES)

Suggested activity item and description	How	Cost	Quantum	Value Gains (+) Losses (-)
Not applicable since there is no resource depletion and there is no scope for expansion of the project				

Table VII

CERTAIN INFERENCES FROM THE HEALTH & SOCIO-ECONOMIC SURVEY

(1)	Monthly income per family	Rs. 340 (average)	
(2)	Animal wealth per 1000 population	Cows	42 nos.
		Buffaloes	134 nos.
		Pigs	64 nos.
		Goats	216 nos.
(3)	Incidence of diseases (GASTRO-ENTRIC) among adults per 1000 population per year 236 nos.		

Table VIII
HEALTH BENEFITS ANTICIPATED FROM THE PROJECT IMPLEMENTATION

(a) Health survey has revealed that 236 persons/1000 population (adults alone) suffer from gasto-enteric diseases annually. It has been estimated that at least 20% of this is directly attributable to the prevailing insanitary condition of the area and a cleaner environment will bring down the incidence by at least that percentage i.e. 236 x 20% per 1000 population or 47 cases/1000 population.

No. of cases reduced on account of implementation of the project/year	47 cases/1000 population
Total cases/year	$47 \times \frac{26,000}{1000} = 1222$ Nos.
Cost of medical facilities for one case	30 Rupees (assumed)
Annual Public Health benefit by implementation of the project	1222 x 30 = Rs. 36,660
Capitalising over 30 years, benefit accrued	36,660 x 30 = Rs. 10,99,800
	= 1.10 million Rupees

(b) Man hour lost at 2 days/person for 1000 population/year

$47 \times 2 \times 8 = 752$ hours

Total man hours lost

$$752 \times \frac{26{,}000}{1000} = 19{,}552 \text{ hours}$$

At an average monthly income of Rs. 340/- month, value of man hour last year

$$\frac{19552 \times 340}{30 \times 8} = \text{Rs. } 27{,}699$$

Capitalised over 30 years

8,30,970 Rs.
or 0.83 million Rs.

Benefit accrued by preventing the loss is

0.83 million Rs.

Total health benefit capitalised

1.10 + 0.83 million Rs.

= 1.93 million Rs.

TABLE - IX

SUMMARY - DECISION MAKING

		Value in Rs. in Million
1. The Project	Mainly concerning habitat/settlement with regard to Madras City	45.05
	Total cost over 30 years products: Treated sewage, bio-gas dried sludge and fish	71.43
2. Resources/indirectly affected/products and residues created	Apart from land, machinery & equipment used, night soil is also converted to gas and sludge for potential use	45.05
	Main products and residues created are treated effluent, sludge, gas & fish	71.43
3. Resources/ exhausted/ depleted	-	-
4. Resources enhanced	Improvement in land value and in health of the people	7.18
5. Required additional project components for resource restoration	-	Nil
6. Decision making	The environmental cost benefit would be as follows :	

Environment Cost /Benefit

(All cost and benefit figures are in million Rs).

A. 1. The economic cost/benefit on the investment as initially planned is 45.05 : 71.43 i.e. 1: 1.6

2. The resources depleted is nil- accordingly, the resulting net benefit will be Rs.71.43.

B. 1. The cost of resources enhanced is not separate from the project costs (45.05) and hence is not separately stated.

2. Since all the project resources are indigenous, the GDP equivalent is the net benefit from the Project (Rs.71.43).

C. 1. The total cost of the project (that is the original economic investment cost plus the cost of resources enhanced) equals Rs.45.05.

2. The total project activities output of the original economic investment plus the result of resources enhanced equal Rs.71.43.

D. 1 Since the entire project envisages environmental improvement the environmental cost/benefit ratio is 45.05/71.43.

2. There is no separate enlarged cost/benefit ratio other than 1:1.6 for the environmental imporovement project.

Code No. 3:1:2:15

Year 1987

Degree M.E.

Title of thesis : Environmental Impact Assessment of a tannery industry

Author : D.S. Nagaraja Rao

Supervisor : R. Guruswamy

Keywords : Impact assessment, assessment methodology, UNEP test model, tannery industry, TALCO tannery unit, effluent, ground water, subsurface water, land degradation.

Abstract

Environmental Impact Assessment studies of TALCO tannery unit, Minnur, Tamil Nadu (having a capacity of processing 500 hides/day), was made using UNEP test model format methodology. The discharge of the untreated effluent into the Minnur tank and the indiscriminate disposal of solid waste and residues from the tannery unit have caused highly unaesthetic conditions in and around the unit and degradation and deterioration of the environmental resources viz, land, groundwater and subsurface water causing health hazards to the community in the vicinity.

Increased salinity of the Palar river subsurface water has rendered the subsurface water unfit to be a source of drinking water. From the present studies, it was found that the above resources could be restored, enhanced and maintained by treating the effluent from the tannery to satisfy the prescribed standards before discharging it into the nearby Minnur tank. Economic, environmental and enlarged cost-benefit ratio worked out for the project were 1:1. 775, 1:2.695 and 1:1.794 respectively. Construction of a treatment plant was found to not only restore the degraded natural resources but also to yield a higher enlarged cost- benefit ratio of 1:1.794.

Code No. : Year 1989

Degree - M.E.

Title of Thesis : Environmental Impact Assessment of Water Stroage Reservoir

Author : Y.Rajappa

Supervisor : Dr. R. Pitchai

Keywords : Public Investment Project, Irrigation cum Water Supply Improvement Project, Environmental Impact Assessment, Cost Benefit Ratio, Test Model Presentation.

Abstract:-

Environmental Impact Assessment of Southuparai Reservoir Project being implemented at an estimate cost of Rs.1910/- lakhs is taken up in this study. The project area is located at about 97 Km west of Madurai city in Tamil Nadu State of South India. The project is under construction and expected to be completed in the year 1993.

The project envisages the construction of 2.831 M.cum (100 M.cft) capacity of reservoir which will provide irrigation facilities for 1170 Ha (2892 AC), besides improving water supply to Periyakulam Municipal Town with a population of 44310 as per the census year 1981.

By implementing the project, there will be a net additional food production of 1626 M.T. and the water supply to Periyakulam Municipal Town will be improved. But, at the same time, the reservoir project involves the submergence and deforestation of 35.94 acres of reserve tropical forest area.

The environmental analysis followed the UNEP Test Model Format and traced the resources used and transformed in the project and summarised the cost and benefit aspects of providing the facilities.

The analysis indicates that the net effects of the Reservoir Project would be beneficial. The environmental assessment as carried out in this thesis is found to be an appropriate methodology for assessment in such cases.

Economic/Environmental Impact Assessment of a Water Supply Project

Dr. G.B. Jaiprakash Narain[1] and S. Raja Chandra Sekaran[2]
(1993)

Abstract

The demand for protected water is increasing proportionally with the increase in population, the rising standard of living and the enlarged economic activity. Water supply projects are given first priority among the other projects in the developing countries, as protected water is a must for living and enhanced industrial activities. Particularly in our country, where the water resources are limited, these projects are given priority with a view to conserving and utilising the available water efficiently.

When the water supply projects are executed, there are both beneficial and adverse changes in the related ecosystem. A detailed review is essential to study the various aspects of the water supply project inclusive of environmental aspect, which helps to arrive at a more reasonable decision. Environmental impact assessment is a powerful tool, and forms an important part of environmentally sound development planning for decision making.

In this paper, environmental impact assessment of augmentation of water supply to Madurai city has been attempted. The 'UNEP' Test Model Format, which is more suitable for the conditions prevailing in the developing countries, is used for the assessment.

The rough cost-benefit ratio of the project works out to 1:1.08. The economic cost-benefit ratio, taking into consideration the resources depleted and the resources enhanced by the project, works out to 1:1.07. The environmental cost-

1. Professor
2. M. E. Student
} Centre for Environmental Studies, College of Engineering
Anna University, Madras 600 025, INDIA.

benefit is evaluated as 1:2.61, and the enlarged cost-benefit works out to 1:1.26. The project, accordingly, appears to be economically and environmentally viable and improves the standard of living of the people of Madurai city.

1 *Introduction*

Environmental Impact Assessment is the evaluation of the various impacts and resultant natural and induced changes, as simply and precisely as possible, for optimising the total benefit to the development and to the environment, the latter considered as the basis for sustainable development. For this, a comprehensive analysis of the environmental impacts of a proposed project is essential. The steps involved in E.I.A. are as given in Table 1.

2 *'UNEP' Test Model Format*

In this present study, the 'UNEP' Test Model Format, which is more suitable for the conditions prevailing in the developing countries like India, is used for the assessment. This model, formulated during March 1979, refers to ideas for an alternative assessment system based more fully on resource use, more closely related to development planning, and more directly associated with decision-making. The environmental assessment format is given in Table 2.

TABLE 1 STEPS INVOLVED IN E.I.A

Sl.No	Item	Description
1.	Project	This includes aim, scope and description of the project.
2	Identification and evaluation	This includes identifying the parameter involved in this project.
3	Suggestions	This gives suggestions regarding control, treatment and alternative site, etc.
4.	Analysis and assessment	Cost-benefit aspects of the project will be studied and assessment made.
5	Impact statement	Preparation of the project in a report form on environmental implications.

TABLE 2 UNEP TEST MODEL FORMAT

Item No.	Description
I	The Project - Base line Data-Background information
II	Resources Directly used/Consumed-Indirectly affected products and residues created (Directly, Indirectly)
III	Resources exhausted, depleted-deteriorated (Directly,Indirectly)
IV	Resources enhanced - By products-others
V	Required additional Project Components Restoration, Maintenance and Expansion
VI	Summary - Decision making - Cost/Benefit Presentation
	Appendix:
	1 Computation - Technical Notes
	2 Categories - Resources of the Environment

3 *Impact of Water Supply Projects*

Water supply projects are considered to be single purpose projects. Regardless of the function of the water supply project, there is a rather broad range of potential impacts including alterations in visual appearance and overall aesthetics of the area, removal of land from present use, diversion of the water from present use, changes in unique, natural and artificial resources, alteration in adjacent property values, potential induced growth in residential, commercial and industrial landuses in the surrounding area and increase in the availability of local water resources.

Environmental impact studies for water supply project include five important components, such as identification of impacts, conducting of baseline studies, prediction of impacts on various environmental factors, quantitative and value assessment of the predicted impact and identification and evaluation of mitigation measures.

Due to the water supply project, there are some beneficial impacts, such as improvement in protected water supply, public health, fire protection, tourist flow, electrical energy savings, employment opprtunities. There are some adverse impacts, such as permanent physical transformation, loss in food production, changes in the ground water table, health problems, recreational activities and waste water flow. Sometimes, the project causes resettlement of population displaced, which leads to economic, health and social problems. Therefore, a careful social, economic and ecological evaluation prior to implementation is called for. General ecological impacts associated with water supply projects include effects in the headworks area, treatment area, transmission route area and project use area. The impacts are as follows:

i. Disturbance of natural state.

ii. Changes in water temperature alter aquatic life

iii. Erosion and sedimentation phenomena in head works area

iv. Impact on wild life clearance of forest or farm along transmission alignment

v. Changes in recreational potentials of the area, viz, sites, noise and air pollution

vi. Increased people pressure on surrounding area, pollution and waste disposal problems

vii. Change in economic, social and political life of the area with resultant secondary ecological impacts.

In water-related projects, there are a number of activities, which may influence water-related diseases. The movements of people due to the project also have related health hazards,

both through the introduction of new disease into the area and through increased transmission of existing disease among the immigrants, who may have no immunity. However, it may be noted that the enhanced protected water supply improves the public health and protects from the water-related disases.

4. *Back Ground Information of the Project*

Madurai city is the oldest historical city, located on the banks of Vaigai river at a distance of about 480 km South-west of Madras. It is one of the largest cities in Tamil Nadu with a population of 820,891 as per 1981 census. Madurai city has a protected water supply scheme with Vaigai river as source from the beginning of the century. However, the present average daily supply (45 mld) is inadequate to meet the present demand (90 mld). Hence Madurai city has been selected under International Development Association projects for augmentation of water supply to fulfill the needs of the people. The project is expected to be completed in March 1993. The salient details of the project are given in Table 3. An environmental impact assessment of the project has been attempted using the 'UNEP' Test Model Format and the results of the case study are presented as per items I to VI of the model (Table 4 to Table 11) .

TABLE 3 SALIENT DETAILS OF THE PROJECT

Sl.No.	Description	Remarks
1	Sub-project cost	Rs.606.37 millions
2	City benefitted	Madurai
3	Population details	
	1981 (Present stage)	820,891
	1996 (Intermediate stage)	1,281,000
	2011 (Ultimate stage)	1,700,000
4	Water requirement	
	For 1981	90 mld
	For 1996	139 mld
	For 2011	185 mld
5	Source	Vaigai River
6	Raw water transmission main	16.60 km long
7	Capacity of treatment works at Pannaipatti	71.6 mld
8	Clear water transmission main	48.80 km long
9	Pumpsets 1 no of 300 HP pumpset	Duty of 19,125 lpm against 48 m head
10	Feeder main and branch feeder main	12.60 km lomg
11	Proposed service reservoirs	13 no
12	Distribution system network	121.70 km long

TABLE 4 PROJECT SUMMARY
(Item I of Test Model Format)

Sl.No.	Item	Description
1	Country	India
2	Nature	Water supply
3	Title	State Government project with World Bank aid
4	Time span	30 years
5	Physical boundary	Water is drawn from the pick-up weir near Vaigai dam. Raw water is conveyed to Pannaipatti treatment works. Clear water is gravitated and distributed to Madurai city. The only beneficiary is Madurai city. It lies in latitude of 9°55' N and longitude of 78°07'E.
6	Cost of the project	The total cost of the project is Rs.606.73 millions

TABLE 5 RESOURCES DIRECTLY USED AND CONSUMED BY PROJECT
(Item II A of Test Model Format)

Sl.No	Description	Value (Rs. in million)
1	Civil works including labour, cost of machinery and equipment	478.653
2	Land for the project components	6.374
3	Civil works, labour and materials for maintenance of the project	121.343
	Total	606.370

TABLE 6 PRODUCT AND RESIDUE CREATED DIRECTLY BY PROJECT
(Item II B of Test Model Format)

Sl.No	Description	Value (Rs. in million)
1	Revenue from the enhanced water supply for	
	i, Domestic purposes	440.408
	ii. Commercial purposes	54.514
	iii. Industrial purposes	30.422
2	Revenue from the shops and offices in the multi-purpose service reservoirs	17.849
3	Revenue from the auction of trees along the alignment	0.150
4	Revenue from the fodder grass grown in sewage treatment plant	42.923
5	Revenue from the tourist flow	67.916
	Total	654.182

TABLE 7 PRODUCT AND RESIDUE CREATED INDIRECTLY BY PROJECT
(Item II C of Test Model Format)

Sl.No	Description	Value (Rs. in million)
1	Improvement in public health	1.893
2	Improvement in fire protection	209.693
3	Saving in electrical energy	15.530
	Total	227.116

TABLE 8 RESOURCES EXHAUSTED/DEPLETED/DETERIORATED BY PROJECT
(Item III of Test Model Format)

Sl.No.	Description	Value (Rs. in million)
1	Land acquired for the project	14.050
2	Water diverted to the project	335.797
3	Productivity loss (due to heavy traffic in flow) in waiting at a highway junction	2.509
4	Loss due to change in recreational sites and activities	8.023
	Total	360.379

TABLE 9 RESOURCES ENHANCED BY PROJECT
(Item IV of Test Model Format)

Sl.No.	Description	Value (Rs. in million)
1	Employment opportunities	
	i. In Goverment sector	66.907
	ii. In Private sector	13.747
2	Increase in land value of the residential, commercial,industrial and agricultural areas	273.916
	Total	354.570

TABLE 10 REQUIRED ADDITIONAL PROJECT COMPONENTS FOR RESOURCES RESTORATION, MAINTENANCE AND EXPANSION
(Item V of Test Model Format)

Sl.No.	Description	Value (Rs. in million)
1	Laying of new sewer system and construction of new sewage treatment system to meet the increased waste water flow	86.964
	Total	86.964

TABLE 11 SUMMARY - DECISION MAKING
(Item VI of the Test Model Format)

Sl.No.	Suggested activity item and description	Value (Rs. in million)
1	Product and residue created directly by the project	654.182
2	Resources directly used, consumed by the project	606.370
3	Product and residues created indirectly by the project	227.116
4	Resources exhausted, depleted and deteriorated by the project	360.379
5	Resources enhanced by the project	354.570
6	Required additional project components for resources restoration, maintenance and expansion	86.964

5 *Summary of Impact Assessment*

The project brings forth both beneficial and adverse effects either directly or indirecly

5.1 Beneficial Effects

i. Due to the project, there is an increase in the water supply to domestic, commercial and industrial uses.

ii. About 40 shops and 20 offices in the proposed 3 multi-purpose service reservoirs are to be rented.

iii About 200 trees were auctioned along the project alignment.

iv. The waste water is subjected to primary treatment followed by anaerobic lagoons. The Corporation has proposed to discharge the treated effluent to the existing sewage farm, in which fodder grass is grown.

v. The increase in the protected water supply eventually leads to a proportionate increase in the tourist flow per year.

vi. Additional protected water supply improves the public health and increases productivity of the people.

vii. As additional water is allotted for fire protection in the project, the occurrence and spreading of fire accident will be prevented.

viii 285 electrical pumpsets (about 4 HP each) drawing ground water from various borewells to meet the inadequate water supply may become redundant when the project is implemented, thus saving in electrical energy.

ix. The land value in the project-use area, and the employment opportunities in Government and private sectors, will also increase due to the project.

5.2 Adverse Effects

i. A total extent of, 57.58 ha. of land (wet and dry) has been acquired for the project, resulting in loss of food production.

ii An additional quantity of 25.5 million cumec of water is diverted for the project from the water now used for agricultural purposes leading to loss in paddy production and resultant loss in the employment opportunities to the agricultural labourers.

iii There is a considerable loss in working hours of the travellers in waiting at the 'Kalavasal' traffic junction, for about 6 months during execution of the project, through which the transmission main is routed.

iv In the project area, the corporation acquired 2 parks, 3 play grounds, 7 open spaces and demolished one middle school for construction of service reservoirs. Alternative facilities have to be created for these activities.

v. Additional sewage treatment plant has to be constructed for treating the additional sewage produced due to the project.

6 *Conclusion*

The environmental impact assessment of water supply project to Madurai city has been analysed and the cost-benefit results are presented in Table 12. The results of the project are found to be encouraging, and it helps to improve Madurai city in all respects.

TABLE 12 COST-BENEFIT PRESENTATION

Sl. No	Item	Cost (Rs.in millions)	Benefit (Rs. in millions)		Cost/Benefit
1	Rought cost benefit	606.370		654.182	1:1.08
2	Economic Cost benefit	606.370	Original benefit	654.182	
			Output depleted	-360.379	
				293.803	
			Enhanced resources	+354.570	
				648.373	1:1.07
3	Environmental cost benefit	Resources restoration and maintenance 86.964	Indirect benefits	227.116	1:2.61
4	Enlarged cost benefit	693.334		875.489	1:1.26

7 *References*

i. Rau, J.C. and Wotten, D.C. 1980, "Environmental Impact Analysis Hand Book", McGraw Hill Book Company. New York

ii. Tamil Nadu Water Supply and Drainage Board, sub project report 1992, World Bank project circle, Madurai

iii. U.N.Asia, Pacific Development Centre 1983, "Environmental Assessment of development projects"

iv. Raja Chandrasekara, S. 1993, "E.I.A. of augmentation of water supply to Madurai city" - A thesis submitted for M.E. degree, C.E.S., Anna University, Madras.

ANNEX 4

Forms of Environmental Audit

Western experience, which is dominantly the one available, shows no proper clarity or finality in Environmental audit (in the way that one may refer to Financial auditing). So far, experiences have reflected various approaches, for the better part ad-hoc in nature.

Apart from some broadbased environmental auditing, issues of 'Waste Audit' assumed prominance, understandably in view of the advanced industrial milleu in which it developed. It evolved as a systematic presentation, under a 'Material Balance' approach, being a full account, and balance, of all inputs and outputs of a process (in an adaptation of the natural law of 'conservation of mass').

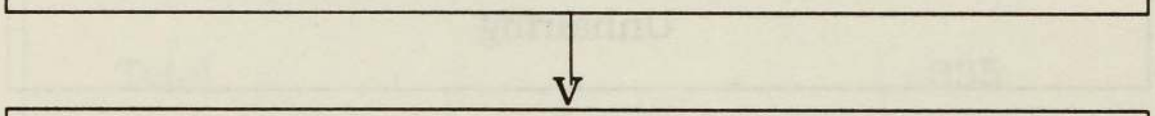
While not being a full Environmental Audit system, particularly for developing countries, its analysis of a major component production process is significant. UNEP and UNIDO together, beginning with an earlier work by the Ontario Wastes Management Corporation in 1987, presented the results of an expert group convened by them in a 1991 Publication, which included both analyses and select case studies.

Below is an extract of the central portion of one case study, namely a Tannery, processing hide into finished leather for shoes, illustrating the results of the Audit through the 'material balance' approach referred to.

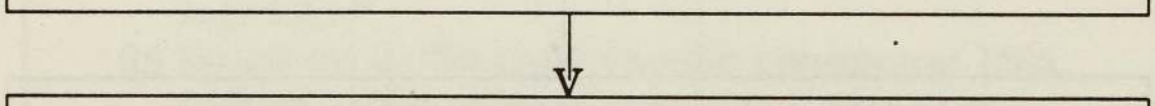
Deriving A Preliminary Material Balance for Unit Operations

A preliminary material balance of data associated with operations within the tannery was first drawn up on an overall input/output materials basis. The information was tabulated as set out below.

Inputs	kg/d
Raw Hide	40,000
Chemicals (other than curing salt present in raw hides)	19,693
Water	2,450,000
Total	2,509,693



Overall Tannery Operations

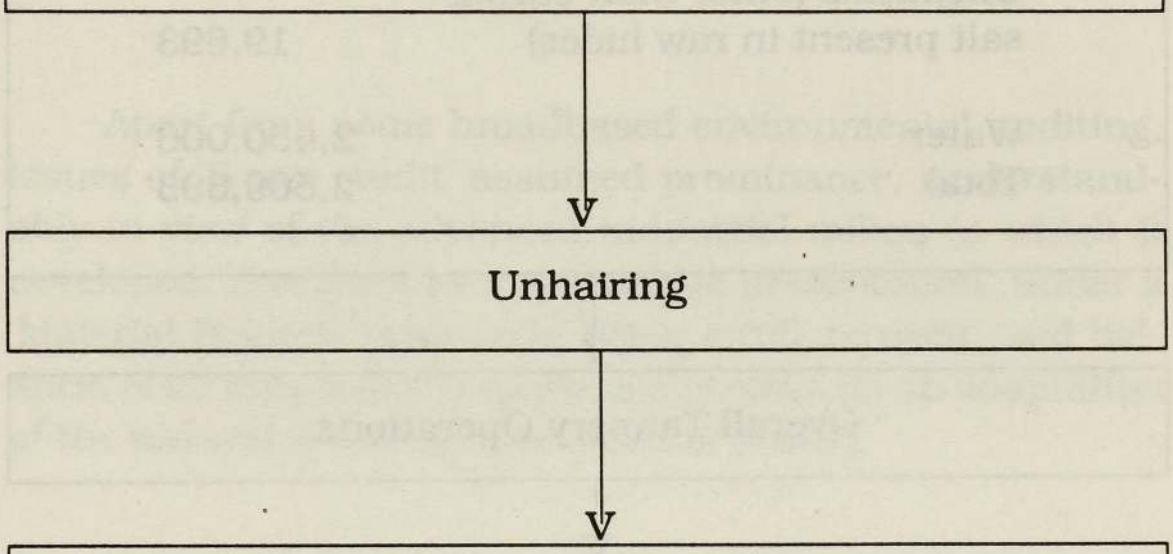


Outputs	Kg/d
Trimmings and Shavings	14,600
Fleshings	9,200
Pickled Split Layer	13,500
Finished Leather	5,600
Wastewater	2,600,000
Gaseous Emissions	Not quantified but not considered to be a major output
Total	2,642,900

A material balance was then drawn up on a unit operation basis with specific reference to chromium and sulphide. A material balance for the wastewater treatment plant was also compiled.

Inputs	kg/d S"
Unhairing	430 (a)

(a) Based on 1,720 kg/d sodium sulphide containing 25% S"



Outputs	kg/d S"
Unhairing Reliming Delime and Bating	412 (a)
Rinsewaters	5 (b)
Total	417

(a) Based on 103m³/d unhairing liquors at 4,000 mg/l S"

(b) Based on 1,944 m³/d rinsewaters containing 2.5 mg/l S"

Inputs	kg/d Cr
Chrome Tanning	332 (a)

(a) Based on 2,076 kg/d Tanolin containing 16% Cr^{3+}

↓

Chrome Tanning

↓

Outputs	kg/d Cr
Chrome Tan & Press Liquors	83 (a)
Chrome Leather	249 (b)
Rinsewaters	3 (c)
Total	335

(a) Based on 33 m^3/d chrome liquors at 2,500 mg/l Cr^{3+}

(b) Based on 2,076 kg/d Tanolin containing 16% Cr^{3+} and 75% chrome absorption into hide.

(c) Based on 1,944 m^3/d rinsewaters containing 1.5 mg/l Cr^{3+}

↓

Inputs	m^3/d
Raw Rinsewater	2,600

↓

Wastewater Treatment Plant

↓

Outputs	m^3/d
Primary Effluent	2,200
Primary Sludge	56
Total	2,256

Evaluating the Material Balance

The waste audit team were confident that they had obtained an adequate material balance (within 5-10%) for the tannery as a whole as well as for the specific chromium and suplhide chemicals used.

The material balance for the wastewater treatment plant was also considered reasonable taking into account that some water seepage was possibly occurring through the base of the crude lagoons, thus contributing to the 13% difference between inflow and total outflows recorded.

Refining the Material Balance

It was considered that the material balance information obtained was sufficient to meet immediate requirements but that it would be useful to carry out a further waste audit once any waste reduction measures had been implemented.

ANNEX 5

A

Proposal

for

Establishment

of

An International University-Level Institution

For Teaching and Research

In

Environment and Development

As a Unified Discipline

LOCATION: SRI LANKA

Contents

I. Title

1. "The Post-Graduate Institute for Environment and Development" (P.I.E.D.) of Sri Lanka.

2. In time, the P.I.E.D. concept is expected to establish itself in several countries.

   In that event, their local titles may suitably recognise to mutual advantage, linkages with Institutes in other countries as desired.

3. The specific site of P.I.E.D. need not be within the physical campus boundaries of one University.

II. Degrees

1. B.A./or B. Sc. in Environment & Development Management - 2 years.

2. M.Sc in Environment & Development (M.Sc. E.D.)- $1^1/_2$ years.

3. Ph. D. in Environment & Development (Ph.D. - E.D)

   - 2 years for graduates

   - 1 year for Masters/Degree holders.

   (For contents of subjects, courses and examinations, see below).

III. Faculty/Structure

1. The Institute will function as an 'autonomous' arm of (a) A Joint Council of Universities in Sri Lanka; or (b) the University concerned.

2. It will be governed directly by a Board of Governors headed by H.E. The President of Sri Lanka, & consist of representatives from the Universities in Sri Lanka (and, in time, abroad). The Director of the Institute will be a member.

3. The Staff will include the Director, his Deputies and Associates, and Professors and Lecturers of "Departments" of the Institute (see below under "Subjects/ Curricula") who would be

   (a) partly the Institute's own staff,
   (b) partly, staff of Universities of Sri Lanka and
   (c) partly, staff from Universities abroad (on Funding, see below).

4. Students would be drawn worldwide, and therefore composed (a) of Sri Lankan students and (b) increasingly, of students from as many countries abroad as possible.

5. "Core" Buildings would exist for the Institute, including some residential, for staff and students.
   As much, or more, accommodation is expected to be 'inbuilt', and available, in the facilities already used by local staff (3 (b) above) and students (4 (a) above).

IV. Funding

1. Presidential or Government grant, as appropriate.

2. Modest UCG, Sri Lanka, support (Primarily for any local components)

3. Grants/Donations - O.E.C.D. Countries; other Donor Countries, Agencies.

4. U.N.D.P, U.N.E.P, UNESCO etc. funding supports.

5. Foreign staff, students "on contributory funding" basis by the countries concerned.

   (LDCs to be supported from 3 & 4 above)

6. Others (including Fees)

Note (a) Facilities at University Campus to be "on no charge" basis.

(b) Local University Staff to be on a "complementary" charge basis (i.e with the Institute paying only the `differential', if so, between its own and a University's emolument.)

N Will need initial Governmental support for convening a first meeting of select Embassy representatives in Colombo.

All other follow up action can then be undertaken by the organizers without burdening the authorities.

V. Subjects/Curricula

(Note - All subjects at I to III below, will be taught at 'General' and 'Advanced' levels. For course details, see below.)

Group I - The Bio-spheric Environment.

(i) Galaxy - Outer Space - Planet Earth
(ii) The 'Eco Systems',
Air - Water - Soils - Deserts - Oceans.
Rangelands - Forests-Grasslands-Croplands-
Coastlands-Off shores - Islands-Seas.
Genetic resources - 'Animal' resources.

Group II - the Human Environment"

(i) . 'Habitat': Origins-History-Prospects.
. Agriculture, Forestry, Fisheries.
. Industry, Commerce, Services.
. Cities, 'Infra-Structures'.
. Power, Irrigation, Transport, Construction.

(ii) Resources -
- Non-renewable, Renewable, Residues, Wastes
- Exhaustion, Depletion, Deterioration, Enhancement.
- Over use, under-use, wrong use.

(iii) . Discoveries, Inventions, Innovations
. Gains, Losses, Opportunities
. Mass threats, Mass gains (Welfare).

Group III - The Economic Environment

. The Production system, Inherent natures.
. The Market Mechanism, Planned Economy Mechanism, Command Economy Mechanism.
. 'Qualitative' Environment Management-'Quantitative' environment management.
. Equilibrium & the 'steady state 'economy. (Sustainable Environment & Development)

Group IV - Methodologies of Sustenance.

(i) Principles & Methodologies (Macro/Micro)
- Resources Balance Sheets Exercises;
- Integrated Envt.-Econ. c/b. Presentation;
- Expanded Envt.-Econ. Accounting System (SEEA-U.N.);
- Environmental ('Green') Audit

(ii) Applied Economic-Environmental 'discipline', (Cases).

VI. Courses

1. Lecture components for Degree & M.Sc. Examinations will be as follows:

   (a) 'General' level lectures - 3 lectures for each 'Group'.

   (b) 'Special' level lectures - 9 lectures for each 'Group'.

   (See under 'Subjects' above, for description of 'Groups')

2. All students will follow lectures at the 'general' level in all Subject groups, excepting their own specialisations.

   In their specialisations, students will follow the special level lectures of their own choosing.

   In addition, all students will follow the single set of special level lectures for Group IV.

3. Students will choose one Subject 'Group' from each of the Groups I, II, or III for their special study. There will be one Teaching Course only for Group IV.

4. M.Sc. Students (for their Dissertations) and Ph.D. Students (for their Theses) will undertake their research, in the normal way, under guidance, on the subject of their own choosing.

* * * * *

5. Students following other "Disciplines" with their own Degrees, will be strongly encouraged to follow a `half-Semester' (one Term) set of 'non-examination' Lectures (not exceeding 8 in all) covering Section V above.

   Examination Papers could in time contain, as appropriate, 'options questions' based on the foregoing.

VII. Examinations

1. B.Sc- (a) 3 Papers (one for each Group I-III)
   (b) 2 Papers (on Group IV)
   (c) 3 Papers (on chosen Special Subjects)
   (d) 1 Paper (Essay)

2. M.Sc. (a) (b) & (c) above - at post-graduate level.
   (b) Dissertation.

3. Ph. D. - Thesis.

* * *

Sponsors (for and on behalf of organizers)

Individuals, Comitted Leaders, Academics, or NGOO, etc;

The Vice Chancellor/s University/Universities concerned.

A Bibliography *

---

*Most writings are on backgrounds, concepts and principles, or issues of 'valuation'.
Those on methodology are few.

Abelson, P: Cost-benefit Analysis and Environmental Problems. Saxon House, Teakfield Ltd-Westmead, Farnborough, Hants., England. 1979.

Adam Smith - The Wealth of Nations.

Adams W.M: Green Development. Environment and Sustainability in the Third World. London Routleoge. 1990.

Alfsen, K., Bye, T. and Lorentsen, L: Natural Resource Accounting and Analysis. Statistisk Sentralbyra, Oslo - Kongsvinger. 1987.

Al Gore, Earth in the Balance, Earthscan, London - New York, 1992.

Amartya K. Sen - The Choice of Techniques (3rd Ed, Oxford 1967).

Anderson, D: The Economics of Afforestation - A Case Study in Africa. The World Bank Occasional Paper Number 1/New Series. The John Hopkins University Press, Baltimore, Maryland, U.S.A. 1987.

Anderson, H: Moving Beyond Economism: New Indicators for culturally specific, sustainable development. Re-defining Wealth & Progress: New ways to measure Economic, Social & Environmental Change, New York, Bootstrap Press. 1989.

Archibugi, F., and Nijkamp, P. (eds.). Economy and Ecology: Towards Sustainable Development. Kluwer Academic Publishers, Dordrecht. 1989.

Ayres, Robert U., and Allen V. Kneese. "Production, Consumption, and Externalities", American Economic Review 59 (3, June): 282-97. 1969.

D'Arge, R., Ayres, R., and Kneese, A.,: Economics and the Environment: A Materials Balance Approach. Baltimore. 1972.

Arrow, Kenneth J. and Anthony C. Fisher, "Environment Preservation, Uncertainty and Irreversibility", Quarterly Journal of Economics LXXXVIII.

Arrow, Kenneth - Environmental Reservation, Uncertainty & Irreversibility (with A.J. Fisher, Am. Econ. Rev. 1970).

Ashford, Nicholas A., Christine Ayers, and Robert Stone "Policy Issues for consideration in Transferring Technology to Developing Countries" Ecology Law Review, 12 : 4.

Barbara Ward - One Earth (1973).

Barbier, E.,: "Natural Resources Policy and Economic Framework", in Tarrant. J. et al (ed.) Natural Resources and Environmental Management in Indonesia. USAID Jakarta. 1987.

Barbier, E.B., Economics, Natural Resource Scarcity and Development - Conventional and Alternative Views. Earthscan, London. 1989.

The Bariloche Model - A Latin American World Model (ECLA, 1981).

Barnett, H.J., and Morse, C., Scarcity and Growth: The Economics of Natural Resource Availability. Johns Hopkins University Press, Baltimore. 1963.

Barret, S., "The Problem of Global Environmental Protection". Oxford Review of Economic Policy, Vol.6, No.1. 1990.

Bartelmus, Peter, and Jan W. van Tongeren. "Draft Framework for Environmental Satellite Accounting". U.N. Statistical Office, New York. Processed. 1988.

Baumol, W.J. and Oates W.E.,: The Theory of Environmental Policy, Externalities, Public Outlays and the Quality of Life. Prentice Hall, Englewood Cliffs, New Jersey. 1975.

Bergman, L.,: General Equilibrium Effects of Environmental Policy: A CGE-Modeling Approach. EFI Research Paper 6415. Stockholm School of Economics. 1990.

Berkes, F.,: "The Common Property Resource Problem and the Creation of Limited Property Rights". Human Ecology 13(2). 1985.

b156N

Berry, B.J. The Social Burdens of Environmental Pollution, Cambridge. M.A., Ballinger. 1977.

Binswanger, H.P.: Brazilian Policies that Encourage Deforestation in the Amazon. The World Bank, Environment Department Working Paper No.16. 1989.

Bishop R.C. and Anderson S.O. Economics, Institutions and Natural Resources: collected works of S.V. Ciriacy-Wantinp, Boulder, Co., Westview Press. 1985.

Blades, Derek W. "Subsistence Activities in the National Accounts of Developing Countries with Special Reference to Latin America." Review of Income and Wealth 21 (4, December): 391-410. 1975.

Blaikie, P.,: The Political Economy of Soil Erosion in Developing Countries, Longman, London. 1985.

Blaug M: Economic Theroy in Retrospect. London, Heineman. 1962.

Blomstrom, M. and Hettne, B.: Development Theory in Transition. The Dependency Debate and Beyond: Third World Responses, Zeb Books, London. 1984.

Bohm, P.: Social Efficiency: A Concise Introduction to Welfare Economics. The MacMillan Press Ltd. London. 1973.

Bojo, J.: Cost-Benefit Analysis of Soil and Water Conservation Projects. A Review of 20 Empirical Studies. Paper presented to the 6th International Soil Conservation Conference,

Kenya and Ethiopia, 6-18 November, 1989. Stockholm School of Economics, Stockholm. 1989.

Bojo, L.,: The Economics of Land Degradation. Theory and Applications to Lesotho. The Economic Research Institute. Stockholm School of Economics, Stockholm. 1991.

Bojo, Males & Unemo, "Environment and Development: An Economic Approach". Kluwer Academic Publishers, 1992.

Boserup, E.,: Population and Technology, Basil Blackwell, Oxford. 1981.

Boulding - The Meaning of the Twentieth Century (Harper & Row, 1964).

Brandt, W - Programme of Survival and Our Common Crisis.

Brealey, R., and Myers, S.: Principles of Corporate Finance. McGraw Hill International Book Company, London. 1984.

Brookshire, D.S., d'Arge, R.C., Schultze, W.D.,: Methods Development for Assessing Air Pollution Control Benefits, Vol. II, EPA. Springfield, Va. 1979.

Brookshire, D.S., Eubank, L.S., Randall, A., : "Estimating Option Prices and Existence Value for Wildlife Resources". Land Economics 59(1): 1-15. 1983

Brown, L.R. State of the World. Washington D.C. Worldwatch Institute (see also 1989, 1990 + 1991 editions). 1988.

Brown, S.P.A.L: 'A Note on Environmental Risk and the Rate of Discount". Journal of Environmental Economics and Management, Vol. 10; 282-286. 1983.

Brown, L.R.: Building a Sustainable Society. New York, Norton. 1981.

Carlsson, A.,: Estimate of the Costs of Emission Control in

the Swedish Energy Sector. Stockholm School of Economics. Research Report No. 91-7258-273-1. Stockholm, Sweden. 1988.

Chambers, R.: Sustainable Livelihoods, Environment and Development: Putting Poor Rural People First. Institute of Development Studies. University of Sussex. Mimeo. 1988.

Christainsen, Gregory, Frank Gollup, and Robert H. Haveman. "Environmental and Health-Safety Regulations, Productivity Growth, and Economic Performance". Assessment report prepared for the Office of Technology Assessment and the Joint Economic Committee of the U.S. Congress. Processed. 1980.

Ciriacy-Wantinp S.V. Resource Conservation: economics and policies. Berkeley, CA, University of California. 1963.

Clark, B.D., Chapman, K., Bisset, R. and Wathern, P.,: Environmental Impact Assessment in the USA: A Critical Review. Department of the Environment, 2 Marsham St. London SW1P 3 EB. 74pp. 1978.

Clark C.W.: Mathematical Bionomics: the optical management of renewable resources. New York, Wiley. 1976.

Clawson, M. and Knetsch, J.L.,: Economics of Outdoor Recreation. The Johns Hopkins Press, Baltimore. 1966.

Coase, R.H.: "The Problem of Social Cost". Journal of Law and Economics, Vol.3, No.1, 1-44. 1960.

Coddington, A., Opachoor, H, and Pearce D.,: "Some Limitations of Benefit-Cost Analysis in Respect of Programmes with Environmental Consequences", in Problems of Environmental Economics. OECD, Paris. 1972.

Conroy C: Litvinoff M.: The Greening of Aid: Sustainable Livelihoods in Practice. London, Earthscan. 1988.

Cooper, C.,: Economic Evaluation and the Environment. Hodder and Stoughton, London. 1981.

Costanza R. (ed.) Ecological Economics: The Science and Management of Sustainability. New York, Columbia Press. 1991.

Cummings. R. and V. Norton, "The Economics of Environmental Preservation: Comment, American Economic Review, 64.

Daly, H. (ed.): Economics, Ecology, Ethics. W.H. Freeman & Company, New York. 1980.

Daly, H.E. Toward Some Operational Principles of Sustainable Development. Ecological Economics, Vol.2. 1990a.

Daly, H.E. Cobb, J. For the Common Good: Re-directing the Economy Towards Community, the Environment and a Sustainable Future. Boston, Beacon Press. 1989.

Daly H.E. (ed.) Economics, ecology, ethics: essays toward a steady state economy. San Francisco, Freeman. 1973.

Daly H.E. Steady-state economics. San Francisco, Freeman. 1977.

Daly H.E. and Umana A.F.(eds.) Energy, economics and the environment. Boulder, Co. Westview. 1981.

Daly H.E. The Steady-state economy: alternative to growth mania. London. The Other Economic Summit. 1984.

Dasgupta, P., Marglin, S. and Sen, A.,: Guidelines for Project Evaluation. UNIDO. United Nations, New York. 1972.

Dasgupta, P. and Heal, G.,: Economic Theory and Exhaustible Resources. Cambridge University Press, Cambridge. 1979.

Dasgupta,P., Hammond, P.and Maskin, E.,: "On Imperfect Information and Optimal Pollution Control". Review of Economic Studies, Vol. 47.1980.

Dasgupta, P.,: The Control of Resources. Basil Balckwell, Oxford. 1982.

Dasgupta, P.,: "The Environment as a Commodity". Oxford Review of Economic Policy, Vol. 6, No.1. 1990.

Dasgupta, P., and Maler, K.G.,: The Environment and Emerging Development Issues. Proceedings of the World Bank Annual Conference on Development Economics. The World Bank. 1991.

Data Resources, Inc. "The Macroeconomic Impact of Federal Pollution Control Programs: 1978 Assessment." Report submitted to the Environmental Protection Agency and the Council on Environmental Quality, Washington, D.C. Processed. 1979.

Davis, J - Greening Business: Managing for Sustainable Development MA., Basil Black, 1991.

de Jouvenel, Bertrand. "Proposition a la Commission des Comptes de la Nation". Ministere des Finances, Paris. Processed. 1966.

Denison, Edward F "Welfare Measures and the GNP". Survey of Current Business 51 (1, January) : 1-8. 1971.

Desvousges, W.H., Smith, V.K., and McGivney, M.P.: A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements. EPA. Office of Policy Analysis. Washington D.C. 1983.

Dixon, J.A. and Hulschmidt. M.M., (eds.),: Economic Valuation Techniques for the Environment. A Case Study Workbook. Johns Hopkins, Baltimore. 1986.

Dixon, J.A., with the assistance of Bojo, J.,: Economic Analysis and the Environment. Report to the African Development Bank. 1988.

Dixon, J.A., Carpenter, L.A., Fallon, L.A., Sherman, P.B. and Manopimoke, S.,: Economic Analysis of the Environmental Impacts of Development Projects. Earthscan, London. 1988.

Dravie, Christophe A., Georges Hainnaux, and Jean Louis Weber. "Essai d' Etablissement d'un Compte des Sols en Cote d'Ivoire." Regional African Seminar on Natural Resource Statistics. November, Abidjan. Processed. 1983.

DSE, Deutsche Stiftung fur Internationale Entwicklung,: Environmental Impact Assessment (EIA) for Development. In co-operation with UNEP. 1985.

Durning, A., Poverty and the Environment: Reversing the Downward Spiral Washington D.C. Worldwatch Institute. 1989.

Economic Council of Japan. Measuring Net National Welfare of Japan. Tokyo. 1974.

Elkington, John. The Environmental Audit: A Green Filter for Politics Projects, Processes and Products. Sustainability/ WWF, London/Godalming.

Elkington, John and Burke, Tom. The Green Capitalists. Sustainability/WWF, London/Godalming.

El Serafy, Salah. "The Oil Price Revolution of 1973-74" Journal of Energy and Development 4(2, Spring): 273-90. 1979.

El Serafy, Salah. "Absorptive Capacity, the Demand for Revenue, and the Supply of Petroleum" The Journal of Energy and Development 7 (1, Autumn): 73-88. 1981.

Elzinga, A.,: Evaluating the Evaluation Game: On the Methodology of Project Evaluation, with Special Reference to Development Co-operation. SAREC Report RI: 1981, Stockholm. 1981.

Environmental and Energy Study Institute, U.S. - Partnership for Sustainable Development: A new U.S. agenda for International Development and Environmental Security (E.E.S.I. 1991)

ESCAP (Economic and Social Commission for Asia and the Pacific). 1982. "Review and Appraisal of Environmental Situation in the ESCAP Region". Bangkok. Processed.

FAO,: Environmental Impact of Forestry, Guidelines for its Assessment in Developing Countries. FAO Conservation Guide 7. Rome. 1982.

Feenberg, D., Mills, E.S.: Measuring the Benefits of Water Pollution Abatement. Studies in Urban Economics. Academic Press, Inc., New York, U.S.A. 1980.

Feeny, D., et al.,: "The Tragedy of the Commons: Twenty-Two Years Later", Human Ecology, Vol. 18, No.1. 1990.

Finney, C.E., Western, S.,: "An Economic Analysis of Environmental Protection and Management: An Example from the Philippines". The Environmentalist, Vol. 6 No.1. 1986.

Fisher, A.C.: "Environmental Externalities and the Arrow-Lind Public Investment Theorem", in American Economic Review. 1973.

Fisher, Anthony C. Resource and Environmental Economics Cambridge University Press, 1985.

Fisher, Anthony C. and John Krutilla, "Valuing Long Run Ecological Consequences and irriversibilities" Journal of Environmental Economics and Management 1. 1974.

Flavin, C; Lenson M. Beyond the Petroleum Age: Designing a Solar Economy. Washington D.C. Worldwatch Institute. 1990.

Fleming, W.M.,: Phewa Tal Catchment Management Programme: Benefits and Costs of Forestry and Soil Conservation in Nepal, in: Hamilton, L.S. (ed.), Forest and Watershed Development and Conservation in Asia and the Pacific. Westview Press. Boulder, Co. 1983.

Forsund, F.,: " Input-Output Models, National Economic Models, and the Environment", in Kneese A. and Sweeney, J. (eds.) Handbook of Natural Resource and Energy Economics, Vol. I, North Holland, Amsterdam. 1985.

Frances Cairncross - Costing the Earth (The Economist Books, London 1990).

Freeman, M.,: The Benefits of Environmental Improvement. Resources for the Future. Published by John Hopkins University Press. Baltimore and London. 1979.

Georgescu-Roegen, N.,: The Entropy Law and the Economic Process. Harvard University Press. Cambridge, Mass. 1971.

Giarini O. Dialogue on Wealth and Welfare: an alternative view of World capital formation. Oxford, Pagamou. 1980.

U.S. Council on Environmental Quality, Global 2000 - Report to the U.S. President. 1981.

Godalming, The Young Green Consumer Guide. Sustainability/WWF, London.

Goodland, R. and Ledec, G.,: "Neoclassical Economics and Principles of Sustainable Development". Ecological Modelling, Vol. 38, Nos. 1/2 September. Eldevier Science Publishers. 1987.

Grainger, A.,: Desertification. How People Make Deserts, How People Can Stop and Why They Don't. An Earthscan Paperback published by the International Institute for Environment and Development. London and Washington D.C. 1982.

Groot, R.S. de. "Functions and Social Economic Importance of the Dutch Waddensea." Agricultural University, Wageningen, Processed. 1986.

Gregensen, H.; Draper S., Elz, D. (eds.) People and Trees: The Role of Social Forestry in Sustainable Development. Washington D.C. World Bank. 1989.

Hans Singer - Mutual & Conflicting Interests in Relations with the Third World (Sussex, I.D.S. 1982)

T. Haavelmo - A Study in the Theory of Economic Evolution. (North Holland 1954.)

Haavelmo - Some Observations on Welfare & Economic Growth (in Essays in honour of Sir Roy Harrod, Oxford, Clarendon, 1970.)

Hannesson R.,: "Fishery dynamics: a North Atlantic Cod Fishery". Canadian Journal of Economics, No.2. Canada. 1975.

Hardin, G. and Baden, J.: Managing the Commons. Freema & Co. San Francisco. (Contains the original: Hardin, G., 1968: "The Tragedy of the Commons" in Science, Vol. 162. 13 December). 1977.

Hardin, G. Paramount Positions in Ecological Economics. 1991.

Harrison, P.,: The Greening of Africa. International Institute for Environment and Development and Earthscan, London. 1987.

Hazilla, M., and Kopp, R.J.,: The Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis. Discussion Paper QE 89-11. Resources for the Future, Washington D.C. 1989.

Henry, Claude, "Option Values in the Economics of Irreplaceable Assets". "Review of Economic Studies, Symposium on the Economics of Exhaustible Resources 1974 b."

Hicks J.R. Value and Capital (2nd edition 1946) Oxford, Clarendon Press. 1939.

Hicks J.R. Wealth and Welfare: Collected Essays on Economic Theory. Cambridge, Mass: Harvard University Press. 1981.

Hirsch, Fred. Social Limits to Growth. Cambridge, Mass: Harvard University Press. 1976.

Hoekstra, D.,: Choosing the Discount Rate for Analysing Agroforestry System/Technologies from a Private Point of View. ICRAF. Reprint No. 20, Nairobi. 1985.

Hoekstra, D. and van Gelder, A.: Annotated Bibliography of Economic Analysis of Agroforestry Systems/Technologies. ICRAF, Nairobi. 1985.

Hudson, N.: Soil Conservation. Batsford, London. 1986.

Hufschmidt, M.M., Hyman, E.L.: Economic Approaches to Natural Resource and Environmental Quality Analysis. Tycooly Ltd., Dublin, Ireland. 1982.

Hufschmidt, M.M., James, D.E., Meister, A.D., Bower, B.T. and Dixon, J.A.,: Environment, Natural Systems and Development. An Economic Evaluation Guide. Johns Hopkins, Baltimore and London. 1983.

Hueling R. The use of Environmental Data in the Economic Decision Making Process. Voorburg, Netherlands Bureau of Statistics. 1980.

Hueling R. Results of an economic scenario that gives top priority to saving the environment instead of encouraging production Growth. London. The other Economic Summit. 1984.

Hueting, Roefie. New Scarcity and Economic Growth. Amsterdam; North-Holland. 1980.

Hueting, Roefie. "Report on My Visit to Taipei as an Adviser for the Taiwan 2000 Study". Central Bureau of Statistics, Voorburg, Netherlands. Processed. 1986a.

Hueting, Roefie. "Framework for a Cost-Benefit Analysis for Different Uses of a Humid Tropical Forest Area". Paper presented for the Tropenbos Seminar, September 22-24. Tropenbos, Ede, Netherlands. Processed. 1986b.

Hueting Roefie. "An Economic Scenario That Gives Top Priority to Saving the Environment" Ecological Modeling 38:123-40. 1987.

IIED.: Country Environmental Profiles Natural Resource Assessments and other Report on the State of the Environment. Environmental Planning and Management Project Supported by USAID's Office of Forestry, Environment and Natural Resources, Mimeo. 1988.

INSEE Institut National de la Statistique et des Etudes Economiques et Ministere de 1' Environment. Lescomptes du Patrimoine Naturel-La Documentation Francaise. Paris. 1986.

Irvin, G.,: Modern Cost/Benefft Methods. An Introduction to Financial, Economic and Social Appraisal of Development Projects. The Macmillan Press Ltd., London and Basingstoke. 1978.

IUCN,: World Conservation Strategy, Gland, Switzerland. 1980.

James D.E., Jansen, H.M.R. and Opsehoor J.B. Economic Approaches to Environmental Problems. New York, Elsevier. 1978.

James, D.,: "Environmental Economics, Industrial Process Models, and Regional-Residuals Management Models", in Kneese A. and Sweeney, J. (eds.). Handbook of Natural Resource and Energy Economics, Vol.I, North Holland. 1985.

Johansson, P.O.,: The Economic Theory and Measurement of Environmental Benefits. Cambridge University Press. 1987.

Karl Marx - Das Kapital.

Kenneth Boulding - The Economics of the Coming Spaceship Earth (in Jarret ed. Environmental Quality in a Growing Economy, John Hopkins 1966).

Kenneth Boulding "Social Costs, Neo-Classical Economics, Environmental Planning: A Reply". Social Science Information 11 (1); 17-28. 1972.

Keynes, John Maynard. The General Theory of Employment, Interest, and Money, London: Macmillan. 1936.

Kneese, A.V. Measuring the Benefits of Clean Air and Water. Washington, D.C.: Resource for the Future. 1984.

Kneese, A.V. "On the Valuation of Social Income". Economica (February/May): 1-16, 116-31. 1948a.

Kneese, A.V. "Discussion of the New Department of Commerce Income Series (National Income: A New Version)". Review of Economics and Statistics 30: 151-79. 1948b.

Kneese, A.V. "National Income and Economic Welfare" In Simon Kuznets, ed., Economic Change, London. 1954.

Kim, S.H. and Dixon, J.A.,: "Economic Evaluation of Environmental Quality Aspects of Upland Agricultural Projects in Korea", in Dixon J.A. and Hufschmidt, M.M., (eds.). 1986. Economic Valuation Techniques for the Environment. A Case Study Workbook. Johns Hopkins, Baltimore. 1984.

King, B.B.: What is a SAM? A Layman's Guide to Social Accounting Matrices. World Bank Staff Working Paper No. 463, Washington D.C. 1981.

Maseru, Lesotho. Kingdom of Lesotho,: National Environmental Action Plan. October 1988.

Kneese. A.V., and Bower, B.T.: Managing Water Quality;

Economics, Technology, Institutions, Johns Hopkins, Baltimore. 1968.

Kneese. A.V., and Maler, K.G.: "Bribes and Charges in Pollution Control: An Aspect of the Coase Controversy". Natural Resources Journal. 1973 Symposium Issue. 1973.

Krutilla, J.V.: "Conservation Reconsidered". American Economic Review, Vol. LVII. 1967.

Krutilla, J.V. and Fisher A.C. The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenities Resources. Baltimore, John Hopkins University Press. 1975.

Landefeld, J.S., and J.M. Hines. "Valuing Nonrenewable Natural Resources: The Mining Industries". In U.S. Department of Commerce, Measuring Nonmarket Economic Activity. Bureau of Economic Analysis Working Paper. Washington, D.C. 1982.

Landreth, H. and Colander, D.C.: History of Economic Theory. Second Edition. Houghton Mifflin Co., Boston. 1989.

Layard, P.R.G., and Walters, A.A.: "The Date of Discounting in Cost-Benefit Studies", pp. 263-266 in Journal of Transport Economics and Policy. Volume X. London School of Economics and Political Science, London. 1976.

Leipert, Christian. "Social Costs of Economic Growth". Journal of Economic Issue 20(1): 109-31. 1986.

Leipert, Christian., "What the GNP Does Not Account for". Development: Seeds of Change (3): 58-65. 1986.

Leontieff Leonid - The Future of the World Economy (Report to the United Nations 1979).

Leontief, Wassily. "Environmental Repercussions and the Economic Structure: An Input-Output Approach". The Re-

view of Economics and Statistics 52 (3, August): 262-71. 1970.

Lichfield, N., Kettle, P., and Whitbread, M.: Evaluation in the Planning Process. Pergamon Press. Oxford. 1975.

Lind, R.C.,: Discounting for Time and Risk in Energy policy. RFF. John Hopkins University Press, Baltimore and London. 1982.

Lionel Robbins - An Essay on the Nature & Significance of Economic Science. (L.S.E., MacMillan, 1935).

Lipton, M.,: "Why Poor People Stay Poor", In Hariss (ed.). 1982. Rural Development, Theories of Peasant Economy and Agrarian Charges. Hutchinson University Library. London. 1981.

Little, I.M.D., and James A. Mirrlees. Manual of Industrial Project Analysis in Developing Countries. Vol. II, Social Cost Benefit Analysis, Paris: OECD Development Centre, 1969.

Little, I.M.D. and Mirrlees J.A.,: Project Appraisal and Planning for Developing Countries, Heinemann, London. 1974.

Lundahl, M.,: Peasants and Poverty: A Study of Haiti. Croom Helm, London. 1979.

D.J. Mc Laren (eds.). Planet under stress: The Challenge of Global Change pp. 269-82. Toronto, Oxford University Press.

Magrath, William, and Peter L. Arens. "The Costs of Soil Erosion on Java: A Natural Resource Accounting Approach" World Resources Institute, Washington, D.C. Processed. 1987.

Mahar, D., Government Policies and Deforestation in Brazil's Amazon Region. The World Bank, Washington D.C. 1989.

Maler, K.G.,: "A Method of Estimating Social Benefits from

Pollution Control". The Swedish Journal of Economics, Vol. 73. 1971.

Maler, K.G.,: Environmental Economics. A Theoretical Inquiry. John Hopkins University Press, Baltimore and London. 1974.

Maler, K.G. and Wyzga, R.E.,: Economic Measurement of Environmental Damage. OECD, Paris. 1976.

Maler, K.G.,: "A Note on the Use of Property Value in Estimating Marginal Willingness to Pay for Environmental Quality." Journal of Environmental Economics and Management, No. 4. 1977.

Maler, K.G. :"Welfare Economics and the Environment", in Kneese, A.V. and Sweeney, J.L. (eds.), Handbook of Natural Resources and Energy Economics, Vol.1. Elsevier Science Publishers, Amsterdam. 1985.

Maler, K.G., :"The Acid Rain Game", in Folmer, H., and van Ierland, E., (eds.). 1989: Valuation Methods and Policy Making in Environmental Economics. Elsevier, Amsterdam. 1989.

Maler, K.G.: National Income Accounts, Research Paper, Stockholm School of Economics, Stockholm, Sweden. 1990a.

Maler, K.G., : Sustainable Development. Research Paper. Stockholm School of Economics, Stockholm, Sweden. 1990b.

Maler, K.G.: "International Environmental Problems". Oxford Review of Economic Policy, Vol.6, No. 1. 1990c.

Maler, K.G., and Olsson, C., : "Cost Efficiency of Sulphur Abatement". European Journal of Agricultural Economics. 1990d.

Maler, K.g.,: "National Accounts and Environmental Resources" Environmental and Resource Economics, Vol. I.,

No. 1 Kluwer Academic Publishers, Dordrecht, The Netherlands. 1991.

Mandelbaum - Industrialisation of Backward Areas. (Inst. of Statistics, Mono Series 2, Oxford 1945).

Markandya, A., and Pearce, D.,: Environmental Considerations and the Choice of the Discount Rate in Developing Countries. The World Bank. Policy Planning and Research Staff, Environment Department Working Paper No.3. 1988.

Marshall, Alfred. Principles of economics. 8th ed. London: Macmillan. 1920.

Matsaba, T.G.K., : A Case for Fuelwood Production in the Kingdom of Lesotho. Department of Forestry and Wood Science. University College of North Wales, Bangor, Gwynedd, United Kingdom. 1985.

McCay, B.M., and Acheson, J.M. (eds.). : The Question of the Commons. The Culture and ecology of Communal Resources. The University of Arizona Press. Tucson. 1987.

McKenzie, G. Measuring Economic Welfare: new methods. New York, Cambridge University Press. 1983.

The Club of Rome - Limits to Growth (The Predicament of Mankind) D.H. Meadows et al., 1972.

Meister, A.D.,: Overview of Environmental Regulation & Use of Economic Instruments for Environmental Planning and Management. Workshop on designing a regional training programme for integration of environmental considerations in development planning. Kuwait, 21-25 October, 1989. Massey University Palmerston North, New Zealand. 1989.

J.S. Mill - Principles of Political Economy. (London, Parker, 2 Vols., 1852).

Miller, Ted R., "Benefit-Cost Analysis of Health and Safety:

Conceptual and Empirical Issues", Working Paper, The Urban Institute, Washington D.C. 1986.

Mishan E.J. The Costs of Economic Growth, London Staples Press. 1967.

Mishan E.J. Cost-Benefit Analysis. Third ed. Allen & Unwin, London. 1982.

Mishan, E.J. "GNP: Measurement or Mirage?" National Westminster Bank Quarterly Review (November): 2-13. 1984.

Mitchell, R.C. and Carson, R.T.,: Using Surveys to Value Public Goods. The Contingent Valuation Method. Resources for the Future. Washington D.C. 1989.

Myrdal, Gunnar. The Challenge of World Poverty. New York: Random House. 1970.

Newcombe, K.,: An economic Justification for Rural Afforestation: The Case of Ethiopia. The World Bank Energy Department Paper No. 16. (August 1984).

Norgaard, R.B. Environmental Economics: An Evolutionary Critique and a Plea for Pluralism. Berkeley C.A. University of California, div. Agricultural Science Working Paper 299. 1984c.

Odum, E.P. Fundamentals of Ecology. 3rd edition. Philadelphia: W.B. Saunders. 1971.

OECD, : "Atmospheric Corrosion of Materials," in: The Costs and Benefits of Sulphur Oxide Control, Paris. 1981.

Olaf Palme - Our Common Security.

Olson, Mancur. "The Treatment of Externalities in National Income Statistics." In Lowdon Wingo and Alan Evans, eds., Public Economics and the Quality of Life. Baltimore, Md:

Johns Hopkins University press for Resources for the Future. 1977.

Overseas Development Administration. Evaluation Report EV 392.,: Initial Evaluation of the Social Environmental Impact of the Victorian Dam Project. Stag Place, London, England. 1986.

Page T.: Conservation and economic efficiency: an approach to materials policy. Baltimore, M.D. Johns Hopkins Press (and Resources for the future). 1977.

Pearce D.W. An incompatibility in planning for a steady state and planning for maximum economic welfare. Environment and Planning. 1973.

Pearce D.W. (ed.) The economics of national resource depletion. London, Macmillian. 1975.

Pearce D.W. Environmental Economics, London, Longmans. 1976b.

Pearce, D.W. "The Limits of Cost-Benefit Analysis as a Guide to Environmental Policy", in Kyklos, Vol. 29. 97-112. 1976.

Pearce, D.W, : Natural Resource Management in West Sudan. A Report by the Government of Sudan and the World Bank, Mimeo. 1987.

Pearce, D.W. : "The Sustainable Use of Natural Resources in Developing Countries" in Turner, R.K. (ed.), Sustainable Environmental Management. Principles and Practice, Belhaven Press, London. 1988.

Pearce, D.W. and Nash, C.: The Social Appraisal of Projects. A Text in CBA, Macmillan. 1981.

Pearce D.W: Markandya, A; Barbier E. Blueprint for a Green Economy. London, Earthscan Publications. 1989.

Peskin, H.M., Seskin, E.P., : Cost-Benefit Analysis and Water Pollution policy. The Urban Institute, Washington D.C., U.S.A. 1975.

Peskin H.M. National Accounting and the Environment, Oslo, Central Bureau of Statistics. 1972.

Peskin, Henry M. "National Income Accounts and the Environment" Natural Resources Journal 21 (July): 511-37. 1981.

Peskin, Henry M., and Janice Peskin. "The Valuation of Nonmarket Activities in Income Accounting" Review of Income and Wealth 24 (1, March) : 71-91. 1978.

Peskin, Henry M. "National Accounting and the Environment". Resources for the Future. Washington, D.C. Processed. 1987.

Pigou, A.C.: The Economics of Welfare. Macmillan, London. 1920.

Popper, Karl. Objective Knowledge: An Evolutionary Approach. Revised Edition. Oxford, U.K: Oxford University Press. 1979.

Price, C., : "To the Future: with Indifference or Concern? The Social Discount Rate and its Implications in Land Use". Journal of Agricultural Economics, Vol. XXIV, No.2. pp. 393-398. 1973.

Prince, R.,: "A Note on Environmental Risk and the Rate of Discount: Comment". Journal of Environmental Economics and Management, Vol.12, 179-180. 1985.

Pyatt, G., and Round, J.I.,: Social Accounting Matrices - A Basis for Planning. The World Bank, Washington, D.C. 1985.

Raiffa, H., : Decision Analysis, Random House, New York. 1968.

Rapport, David, and Anthony Friend. "Toward a Comprehensive Framework for Environmental Statistics: A Stress Response Approach". Statistics Canada, Ottawa. Processed. 1979.

Redclift, M.,: Sustainable Development: Issues and Options, Methuen. London. 1987.

Reiling, S.D. and Anderson, M.W.,: The Relevance of Option Value in Benefit-Cost Analysis. Life Sciences and Agriculture Experiment Station. University of Maine at Orono, Technical Bulletin 101. 1980.

Repetto, R.,: "Economic Incentives for Sustainable Production". The Annals of Regional Science, Vol. XXI, No. 3. p. 44-59. 1987.

Repetto, Robert, Michael Wells, Christine Beer, and Fabrizio Rossini, "Natural Resource Accounting for Indonesia". World Resources Institute, Washington, D.C. Processed. 1987.

Repetto. R. and Gillis, M. (eds.).: Public Policies and the Misuse of Forest Resources, Cambridge University Press. 1988.

Repetto, R., Magrath, W., Wells, M., Beer, C., and Rossini, F.: Wasting Assets, Natural Resources in the National Income Accounts. World Resources Institute, Washington, D.C. 1989.

Robert W. Hahn - Economic Prescriptions for Environmental Problems (Journal of econ. Perspectives, Spring '89).

Ricardo, David, On the Principles of Political economy and Taxation. 3rd ed. London: John Murray. 1821.

Rosen, S., and Thaler, R.: "The Value of Saving a Life: Evidence from the Labour Market". in Terleckyj, N.E.(ed): Household Production and Consumption. Colombia University Press, New York. 1976.

Rosenfield. PIL., Bower, B.T.,: Management Strategies for Reducing Adverse Health Impacts of Water Resources Development Projects. Discussion Paper D-3. Resources for the Future. Washingtion D.C. 1978.

Ross, M.S., and D.G. Donovan. "World Tropical Forestry Action Plan: Can It Save the Tropical Forests?" Journal of World Forest Resources Management 2: 119-36. 1986.

Ruggles, Nancy D., and Richard Ruggles. The Design of Economic Accounts. New York: Columbia University Press for the National Bureau of Economic Research. 1956.
Ruggles, Richard, and Nancy D. Ruggles. National Income Accounts and Income Analysis. New York: McGraw Hill. 1970.

Saith, V. Kerry, Technical Change, Relative Prices, and Environmental Resource Evaluation, Resources for the Future, 1974.

Samuelson, P.A.,: "Evaluation of Real National Income". O.E.P., Vol.2. No.1. 1950.

Schumacher, E.F.,: Small is Beautiful. A Study of Economics as if People Mattered. Spheres Books Ltd., London. 1973.

SGN. Stockholm Group for Studies on Natural Resources Management,: Perspectives of Sustainable Development. Some Critical Issues Related to the Bruntland Report. Stockholm Studies in Natural Resource Management, No.1. 1988.

Shecter, M., Golan L., and Kim, M.,: "Valuation of Morbidity Reduction due to Pollution Abatement: Direct vs. Indirect Measurement". Paper presented at the Conference on "Environmental Policy in a Market Economy". Wageningen. The Netherlands. 1987.

SIDA,: SIDA's Guidelines for Project Support, Stockholm. 1987.

Simon, J.: The Ultimate Resource, Martin Robertson, Oxford. 1981.

Smith, V.K. (ed). Scarcity and Growth reconsidered. Baltimore, Johns Hopkins. 1979.

Smith, K.V., : "A Conceptual Overview of the Foundations of Benefit-Cost Analysis", in Bentkover, J.D., Covello, V.T. and Mumpower, J., (eds.) Benefits Assessment. The State of the Art. D. Reidel Publishing Co. Dorderceht, The Netherlands. 1986.

Smith, K., Desvousges, W.H., : Measuring Water Quality Benefits. Kluwer Academic Publ. Group, Dordrecht, The Netherlands. 1986.

Soderbaum, P., : "Economics, Ethnics and Environmental Problems", Journal of Interdisciplinary Economics, A.B. Academic Publishers. 1986.

Somerton, D.A., June, J.,: "A Cost-Benefit Method for Determining Optimum Closed Fishing Areas to Reduce the Trawl Catch of Prohibited Species". Canadian Journal of Fisheries & Aquatic Sciences V 41(1). 1984.

Southgate, D., : The Economics of Land Degradation in The Third World. Environmental Department Working Paper No.2, World Bank, Washington, D.C. 1988.

Southgate, D. and Pearce, D., : Agricultural Colonization and Environmental Degradation in Frontier Developing Economics. Environment Department Working Paper No.9, World Bank, Washington D.C. 1988.

Southgate, D., Sierra, R., and Brown, L., : The Causes of Tropical Deforestation in Ecuador: A Statistical Analysis. LEEC paper 89-09. International Institute for Environment and Development, London. 1989.

Spence, A.M., : "Blue Whales and Applied Control Theory". Ahmad. Y.J., Dasgupta, P., Maler, K.G. (eds.), 1984. Environmental Decision-Making, Volume ll. The United Nations

Environmental Programme. Hodder and Stoughton Ltd., Mill Road, Dunton Green, Sevenoaks, Kent, England. 1974.

Speth J.G. A Luddite Recants: Technological Innovation and the Environment. The Amicus Journal (Spring). 1989.

Spofford, W.O., Russel, C.S. and Kelleyl, R.A.,: Environmental Quality Management Resources for the Future. Washington D.C. 1976. 6156N.

Stevens, J.B., : "Recreation Benefits from Water Pollution Control." Water Resources Research, Vo.2. 1966.

Stiglitz, Joseph E., "The Rate of Discount for Benefit-Cost Analysis and the Theory of the Second Best" in Robert C.Lind et al. Discounting for Time and Risk in Energy Policy, Resources for the Future 1982.

Stocking. M., : The Cost of Soil Erosion in Zimbabwe in Terms of the Loss of Three Major Nutrients. Consultants' Working Paper No. 3. Soil Conservation Programme, Land and Water Development Division, FAO, December. 1986.

Stone , R., The Accounts of Society. Nobel Prize Foundation, Stockholm. 1985.

Stahl, I., Bergman, L., and Maler, K.G. : An Experimental Game on Marketable Emission Permits for Hydro-Carbons in the Gothenburg Area. Research Paper 6359. Stockholm school of Economics. 1988.

Suriyakumaran, C-The Economics of Environmental Planning (Paper, East West Centre, Honolulu, 1979).

Suriyakumaran, C-'The Environmental Dimensions in Development' (Co-Author, Bubl. UN Asia-Pracific Devt. Institute, Bangkok, May 1979).

Suriyakumaran, C - 'Environmental Assessment Statements' (Co-Author. Publ. UNEP Regional Office, Bangkok, March 1980).

Suriyakumaran, C - Speeches on the Environment, 1976 - 1982 (Restricted, 1982).

Suriyakumaran, C - 'Development Co-operation in Theory and Practice' (LSE, Restricted Publ. Dec. 1982)

Suriyakumaran, C - 'Environmental Assessment of Development Projects' (Co-Author. Publ. UN Asia-Pacific Development Centre, Kuala Lumpur, 1983).

Suriyakumaran, C - "Management of Development and Social Change' (ICCDA, 3rd Inter Regional Meeting, `83, Publ. Amstm. '84).

Suriyakumaran, C - 'The Wealth of Poor Nations' (Spons. by LSE; Publ. Croom Helm and St. Martin's Press - Lond., Canberra, N.Y., 1984).

Suriyakumaran, C - 'Nature of the Environmental Problem in South Asia' (The South Asia Journal, New Delhi, Lond., 1989).

Suriyakumaran, C - 'Debts, Deficits and the Development of Developing Countries' (The South Asia Journal, New Delhi, Lond., Dec. '90).

Suriyakumaran, C - 'Environmental Planning for Development' (The Autumn 1991 Lectures at the London School of Economics and Political Science. Publ. CRDS, Colombo, 1992).

Suriyakumaran, C - 'The Earth Summit: Bench-Mark or Non-Event?' (Tata Energy Research Institute, New Delhi, Oct. '92).

Swaney, J.A.,: "Elements of a Neoinstitutional Environmental Economics". Journal of Economic Issues, Vo. XXI, No.4. 1987.

They. J., : "Environmental Accounting in Development Policy:

The French Experience", in: Ahmad, Y.J., El Serafy. S., and Lutz. E. (eds.). 1989: Environmental Accounting for Sustainable Development. The World Bank. 1989.

Thomas, J.F., Bennet, D., : "Planning of Water and Related Land Resources in the Murray River Basin" in Hufschmidt. M.M., Hyman, E.L. 1982: Economic Approcahes to Natural Resource and Environmental Quality Analysis. Tycooly, Dublin, Ireland. 1980.

Tietenberg, T., : The Emmisions Trading Program in Principle and Practice: Regulatory Reform in Air Pollution Control Policy. Resources for the Future. Washington, D.C. 1984.

Tietenberg, T., : Environmental and Natural Resource Economics. Scott, Foresman and Company, Boston. 1988.

Jan Tinbergen - G.N.P. & Market Prices: Wrong Signals for Sustainable Economic Success that Mask Environmental Destruction (with R. Hueting in Environmentally Sustainable Economic Development, U.N.E.S.C.O. 1991).

Tinbergen, Jan, Production, Income and Welfare: The Search for an Optimal Social Order. Whitstable: Harvester Press. 1985.

Turner, R.K. (ed), : Sustainable Environmental Management. Principles and Practice. Belhaven Press, London. 1988.

Ulrich, Werner,. Critical Heuristics of Social Planning: A New Approach, Bern: Paul Haupt. 1983.

U.N. Conference on the Human Environment (The Stockholm Conference Report 1972).

United Nations Conference on Environment and Development - The Earth Summit (1992).

UNEP (United Nations Environmental Programme), "Earthwatch: An Indepth Review. Environmental Data". Report 1, Nairobi. Processed. 1981.

UNEP - Audit and Reduction Mannual for Industrial Emissions and Wastes, Technical Report Seriers No. 7. UNEP Office, 39-43 Quai Andre - Citreon, Paris Cedex 15, France, 1991.

U.N.E.P. - Environmental Perspectives to the year 2000 and Beyond (The U.N. General Assembly 1987).

U.N.E.P. - Ahmad, Y. (ed.): The Economics of Survial. The Role of Cost-benefit Analysis in Environmental Decision-making. UNEP Studies No. 4. 1981a.

U.N.E.P. - Ahmad, Y.J. (ed.): Analysing the Options. United Nations Environmental Programme Studies, 5 Pergamon Press Ltd., Headington Hill Hall, Oxford, England. 1982.

U.N.E.P. - Ahmad, Y. (ed.),: Evaluating the Environment. UNEP Studies No. 6. 1982.

U.N.E.P. - Ahmad, Y.J., Dasgupta, P., and Maler. K.G. (Eds.), Environmental Decision-Making. Volume Two. The United Nations Environmental Programme. Hodder and Stoughton Ltd., Mill Road, Dunton Green, Sevenoaks, Kent, England. 1984.

U.N.E.P. - Ahmad, Y.J., Ei Serafy, S., and Lutz, E. (eds.),: Environmental Accounting for Sustainable Development. UNEP World Bank, Washington, D.C. 1989.

United Nations Reports:

(i) Integrated Economic - Environmental Accounting (Prep. Com. U.N.C.E.D., Geneva 151/PC/40, 1991)

(ii) Survey of Existing Agreements & Instruments & Criteria for Evolution (Ibid., 151/PC/77)

United Nations, Economic Commission for Europe, Environment Statistics in Europe and North America: An Experimental Compendium, New York. 1987.

United Nations., "A System of National Accounts". Publication E. 69, XVII.3. New York. 1968.

United Nations., A Framework for the Development of Environment Statistical Paper, Series M, No. 78, New York. 1984.

United Nations, Survey of Environment Statistics: Framework, Approaches, and Statistical Publications. Statistical Papers, series M, no. 73, New York. 1982.

Uno, K., : "Economic Growth and Environmental Change in Japan: Net National Welfare and Beyond" in Archibugi, F. and Nijcamp, P. (eds). 1989: Economy and Ecology: Towards Sustainable Development. Kluwer Academic Publishers. London. 1989.

USAID,: The Environment. Speical Report. Office of Publications. USAID. Washington D.C. 205 23 U.S.A. 1987.

USAID, : Environment and Natural Resources. AID Policy Paper, Bureau for Program and Policy co-ordination. Washington, D.C. 205 23 USA. 1988.

Veloz, A., Southgate, D., Hitzhusen, F. and Macgregor, R.,: "The economics of Erosion Control in a Subtropical Watershed: A Dominican Case", in Land Economics, Volume 61, No.2. 1985.

G. Von Bohm Bawerk - The Positive Theory of Capital (1891).

Ward, Michael., Accounting for the Depletion of Natural Resources in the National Accounts of Developing Economies, Development Centre Publication CD/R(82) 3010. Paris: OECD. 1982.

Warford, J., : "Natural Resources and Economic Policy in Developing Countries" The Annals of Regional Science, Vol. XXI, No.3, pp. 3-17. 1987.

WECD, World Commission for Environment and Development, : Our Common Future. Oxford University Press, Oxford and New York. 1987;

- World Commission on Environment & Development (The Burntland Commission - Mandate - Key Issues, Strategy and Work Plan, Geneva 1984).

Weber, J.L. "The French Natural Patrimony Accounts". Statistical Journal of the United Nations Economic Commission for Europe 1:419-44. 1983.

Weisbrod, B.A.,: "Collective-consumption Services of Individual-consumption Goods. Quarterly Journal of Economics, Vol. LXXVIII, No.3. 1964.

Weiss, D., : Economic Evaluation of Projects. A Critical Comparison of a New World Bank Methodology with the UNIDO and the Revised OECD Approach. German Development Institute, Berlin. 1978.

Weitzman, M.L.,: "Prices vs. Quantities". Review of Economic Studies, Vol.41. 1974.

Williams, A., : "Cost-Benefit Analysis. Bastard Science" And/Or Insidious Poison in the Body Politic"?, in Wolfe, J.N.(ed). Cost-Benefit and Cost Effectiveness. Allen & Unwin, Oxford. 1973.

World Bank, : Accelerated Development in Sub-Saharan Africa. The World Bank, Washingotn, D.C. 1981.

World Bank, : World Development Report 1984. Oxford University Press; New York. 1984.

World Bank, : World Development Report 1988. Oxford University Press. 1988.

World Bank, : Striking a Balance. The Environmental Challenge of Development, Washington D.C. 1989.

W.R.I. (World Resources Institute) Natural Endowments: Financing Resource Conservation for Development, Washington, D.C. 1990.

CONTENTS :

This Book,

formulates for the first time, a Methodology of environment and development management, making the slogan of 'Sustainable Development' sensible and attainable.

Showing the EIA as both limited and insufficient, the Book sets out a comprehensive 4-stage Package, including the new, Expanded System of Environment Economic Accounting being developed in the U.N. Statistical Office, adding three other essential components, an Integrated c/b Presentation (replacing EIA); a system of Resources Balance Sheets at macro level; and Environmental (Green) Audit at micro level.

Lucid expositions of background, policy and steps for action, along with the 'Package', make the Book a highly practical product, replacing partial or conceptual exercises.

Much of what is contained may as yet not be in standard literature, although outstanding treatments have been made in wide areas of the Subject.

Without doubt, a unique work and essential guide for policy makers and leaders whose task is environmental management.

The Author,

is Visiting Professor of the London School of Economics and Political Science; Chairman, Centre for Regional Development Studies (Sri Lanka); and Hony. Adviser to the Government of Sri Lanka on Environment and Development.

Was formerly, United Nations Deputy Executive Secretary of the Economic Commission for Asia and the Far East; UNEP's global Director for Education Training and Technical Assistance; and its Regional Director for Asia and the Pacific.

Was directly associated in the creation of major U.N. Programmes in Asia, among them the Asian Development Bank (1965); the Asian Trade Expansion Programme; the Asian Clearing Union; the Asian Commodity Communities (coconut, pepper, etc.) the Asian Highway; and the Sub-Regional Associations for Environment Co-operation, of ASEAN, the South Pacific, and South Asia.

Economist, Environmentalist, Administrator, and Author, has lectured widely at home and abroad, and written extensively on development , international trade and financing, environment, devolution and governance, and religion.

Was honoured as Knight Commander of the Most Noble Order of the Crown of Thailand for outstanding services to Asia.

Printed at Ceylon Printers Ltd.