

POPULATION, TECHNOLOGY, NATURAL RESOURCES
AND THE ENVIRONMENT

Eco-development: a contribution to the definition
of development styles for Latin America

"Planning means
thinking of
alternatives"

M. Kaleski

INTRODUCTION

At the Founex Seminar ^{1/} and the Stockholm Conference, stress was laid on the need to consider the rational management of the environment and of natural resources as an additional dimension rather than a new form of socio-economic development. The quality of life, save in the exceptional conditions of a country which is not only rich but also has an equitable structure of income distribution, cannot be achieved without accelerated economic growth whose results are equitably distributed.

The first necessary step is to eliminate pollution resulting from poverty, and at the same time to adopt measures to prevent economic growth and industrial development from having unfavourable repercussions on society and the environment and thus cancelling out the beneficial effects of the growth of the product. In other words, awareness of environment problems means seeking different methods and uses of growth rather than a zero growth rate. The question therefore is to devise new development styles aimed at harmonizing economic and social growth with rational management of the environment, so as to put into practice the above-mentioned objective of adding an environment dimension to the concept of development and development planning.

^{1/} Development and Environment, report and working papers of a panel of experts convened by the Secretary-General of the United Nations Conference on the Human Environment (Founex, Switzerland, 4-12 June 1972), Paris and The Hague, 1972.

The aim of the present paper is to translate into concrete terms the concept of "eco-development" ^{2/}, a type of strategy which is considered feasible for several parts of Latin America and which could therefore be useful in regional planning ^{3/}, especially as regards the peopling of uninhabited areas ("extending the economic frontier"). Before dealing with this subject, however, it is useful to define in broad terms the interrelationships between population, resources, technologies and the environment.

^{2/} The term "eco-development" was used by M.F. Strong, Executive Director of the United Nations Environment Programme (UNEP), in his statement at the first meeting of the Governing Council of the United Nations Environment Programme (Geneva, June 1973).

^{3/} The following ideas are partly inspired by the results of a mission carried out in eastern Peru in 1972 with Henri Meót and Victor Wolski. (See report of the preliminary UNDP/ILPES mission in connexion with the Development Programme for Eastern Peru, ILPES, Santiago, 20 October 1972).

A. A HEURISTIC MODEL FOR INTRODUCING THE ENVIRONMENT DIMENSION ^{4/}

1. General framework: definitions and models

In the examination of environmental problems, the environment is seen to be closely bound up with natural resources. In actual fact, these problems cover two different aspects: the balance of resources, whose supply is limited in this space-ship called Earth, and the quality of the environment, which, on the one hand, is an important element in the quality of life and, on the other hand, influences the availability and quality of renewable resources ^{5/}. In the final analysis, pollution could limit the supply of renewable resources such as air and water to the point where, in order to meet its needs, mankind would have to sacrifice the capacity of renewal of these resources. In this case, which is fairly remote on the world plane but frequent in local contexts, the distinction between renewable and non-renewable resources ceases to be important. In general, however, this distinction is still extremely useful in the study of environmental problems. Thus, the use of plentiful renewable resources whenever possible instead of scarce non-renewable resources is an obvious guiding principle in any strategy for the harmonization of development with the rational management of the environment. The same distinction is applicable in connexion with energy resources.

The vagueness of the actual concept of the environment is clear for all to see. To specialists using the systems approach, the environment is whatever does not form part of the purposive system studied yet influences its behaviour ^{6/}. Since environment policies aim

^{4/} The following symbols will be used in this paper:

P: Population

T: Technology

Y: Product

M: Environment

R: Natural resources

^{5/} The well-known report of the Massachusetts Institute of Technology, sponsored by the Rome Club (Limits to Growth, Boston, 1972), offers a choice between two apocalyptic visions of the end: through the depletion of resources or through pollution, or possibly through a combination of the two.

^{6/} West Churchman, The Systems Approach, New York, 1968.

at integrating the environment into the purposive system, however, it might hence be asserted that the environment as such ceases to exist insofar as these policies are effective.

An important point emerges from the above definition: the distinction between the primary objectives of the purposive system, consisting of development policies, and the ecological and social effects of the action devised to attain the principal objectives. It is therefore necessary to determine these effects and, possibly, to redefine the objectives so as to be able to control the repercussions on the environment, to which little or no importance would be attached in a traditional approach.

At a different level of conceptualization, the United Nations Environment Programme refers to man's total habitat, applying a broad definition of human ecology. In reality, this definition is so broad that it covers the content of several social and natural disciplines. A more restrictive interpretation is therefore required. The human environment is considered to be made up of three sub-groups:

Natural environment = N

Environment created by man (technostructures) = H

Social environment = S ^{7/}

What interests us in each case is the impact created on living and working conditions by different social agents ^{8/} (social classes, but also enterprises) ^{9/}, including the conception these agents have of the quality of the environment. It is essential to study this conception because it does not depend exclusively on the material factors of N and H. Therefore, the evaluation of the human environment calls not only for consideration of the different social agents but also for the handling of a group of indicators which range from physical and chemical measurements of the quality of water and air to psycho-sociological

^{7/} As Tomás Maldonado points out, the human environment is also composed of men and thus raises the problems of individual, community and competitive life (Environnement et Idéologie, Paris, 1972, p. 15).

^{8/} In this respect, Frederick Engels' book on the situation of the working class in England can be considered as a precursor in environmental studies.

^{9/} The concept of positive and negative external economies is also partly germane to the problem dealt with here.

surveys and include indicators of the availability and accessibility of urban infrastructure and equipment, housing, social services, etc.^{10/}

We consider that, far from being mutually exclusive, the two definitions complement each other. The first stresses the need to explain the interrelationships between specific measures, on the one hand, and society and nature considered as a whole, on the other. This would seem to be an invitation to the planner to make a thorough study of the globalizing sciences, i.e., ecology, social anthropology and, of course, history, which adds the indispensable advantage of making it possible to take a view that embraces whole eras or processes.

The second definition provides a framework for analysing the quality of the environment proper, which is a more restricted but nevertheless fundamental subject since it adds a new dimension to stylistic (or normative) planning^{11/}.

Let us now discuss the interrelationships between P, T, R, Y and M.

Diagram 1 presents the traditional view of the economy of development. The population exploits its resources with the available techniques and obtains a product which forms the basis for its sustenance and its wider reproduction. The dotted line indicates the T-P relationship which recently began to be analysed at a specific level (social philosophy). This is not the place to discuss the different theoretical interpretations of the dialectic process deriving from demographic pressure and resources, whether it leads to technical progress, to changes in socio-political structures or to both things at once, when it does so, and in what sense (progress or "involution"^{12/}).

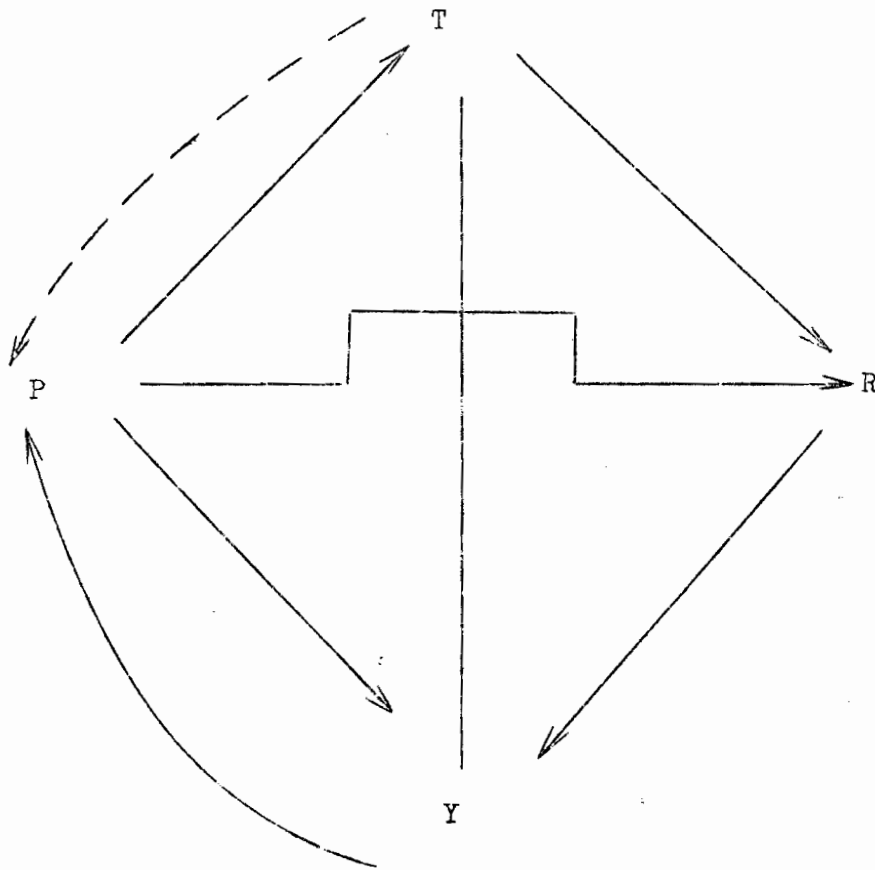
^{10/} It seems likely that interesting information could be obtained by studying the time-budget of the different activities of various social agents.

^{11/} See the definition of stylistic (or normative) planning and its relationship with contextual, strategic, operational and institutional planning in the excellent paper by Francisco Sagasti which is to be published in Social Sciences Information, 2/1973.

^{12/} Clifford Geertz talks about "agricultural involution" in his celebrated study on agricultural conditions in Java.



D I A G R M . 1



/ We shall



We shall content ourselves with a single comment: it does not seem feasible to reduce the wealth of situations described by anthropologists and historians to a single model. The systematic organization of accumulated knowledge would therefore be most advisable, both in general and in the specific Latin American context.

Let us now introduce variable M. In this new situation, which is presented in diagram 2, the planner's view has been enriched by a series of relationships:

$Y \rightarrow M$, $T \rightarrow M$ and $R \rightarrow M$ are the environmental effects of production and its consumption, the technologies employed and the use of resources; $P \rightarrow M$ is the environmental effect of human settlements.

Let us now see the feed-back effects. $M \rightarrow R$ represents the degradation of natural resources caused by pollution; $M \rightarrow Y$ is the effect of environmental conditions on production processes; and, lastly, $M \rightarrow P$ is the direct environmental component of the quality of life.

2. Operational variables

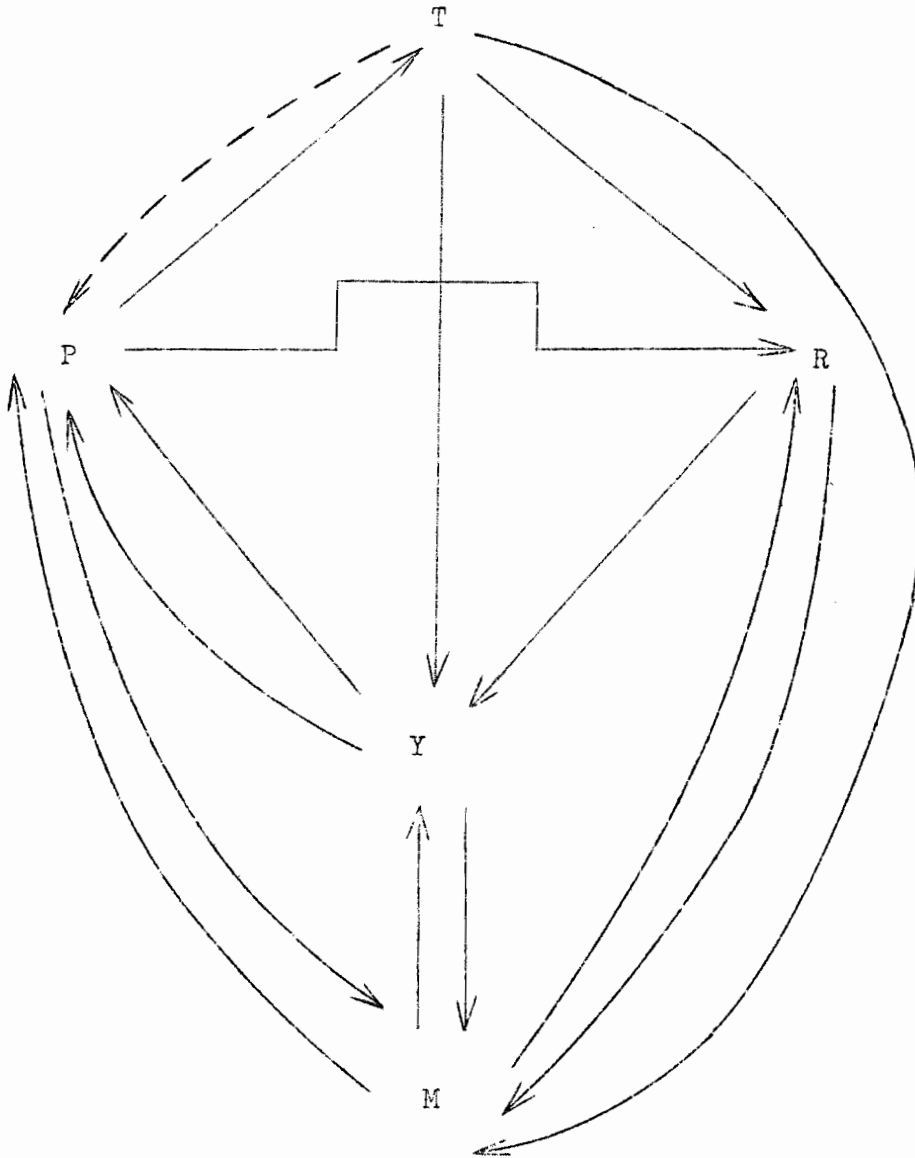
Diagram 2 is merely intended to indicate the relationships which should be considered, in addition to those traditionally handled by planners, in a strategy for harmonizing development with environmental management, and to suggest the type of analysis necessary in each specific situation. In view of the level of generality of our approach, it is not possible in this paper to indicate the controls that would have to be established in order to achieve the desired harmonization. All we can do is to indicate the critical spheres of possible action where the operational variables should be examined. Briefly, these critical spheres are as follows:

(a) The pattern of consumption, which in its turn depends on income distribution and on the group of social values included in the style of development.

(b) The socio-political system, and in particular, the treatment given to social costs: in a market economy enterprises endeavour to secure maximum profits for themselves while spreading the costs over others, whereas in socialist and mixed economies the State can, in theory, change this rule.



DIAGRAM 2





(c) The technologies used: in particular, a distinction should be made between the use of technologies that are not harmful to the environment ^{13/} and the introduction of pollution control technologies to supplement production technologies which cause pollution, thus leading to an undesirable cycle of increased production, pollution and pollution control ^{14/}.

(d) The pattern of utilization of natural resources and energy, with emphasis on the elimination of destructive practices, the recovery of scarce products and the use for productive purposes of waste which constitutes a potential pollutant; similarly, under more sophisticated environment policies, there should be emphasis on the saving of scarce resources incorporated in durable goods and equipment by controlling their rate of obsolescence so as to avoid excessive rotation dictated by styles of consumption and the incessant race towards higher labour productivity.

(e) The pattern of space use: the same production and activities will have different effects according to their location.

(f) The size, rate of growth and distribution of the population: the environmental effects of faulty spatial distribution, combined with the unequal distribution of employment and income, seem to have more influence on environmental problems in Latin America than the rates of growth, since, with few exceptions, the overall size of the population presents no particular problem. Incidentally, demographic pressure on resources depends not on the number of inhabitants, but on their number weighted by per capita consumption. Thus, 200 million inhabitants of the United States are equivalent to at least

13/ Technologies which do not harm the environment constitute a broader universe than that of the "soft technologies" defined in very restrictive terms by Peter Harper and other leaders of the ecological movement in the United Kingdom. Harper is only satisfied by technologies of low capital intensity which neither pollute nor use potentially scarce renewable resources and which, moreover, are simple enough to be used on a small scale by non-specialists (see the paper by Harper and my comments in the UNESCO periodical Prospects (in the press)).

14/ Pollution control is an economic activity and as such is included in national income calculations, but like armaments it contributes nothing towards satisfying man's positive needs. Inflation of national income by including expenditure of this kind creates a false impression of wealth.

10,000 million Indians, even if one inhabitant of the United States is estimated to consume only 50 times as much as an Indian ^{15/}. Furthermore, Barry Commoner has reached the conclusion that the main factor in the environmental deterioration observed in the United States since the war has been technological change rather than the growth of population or income ^{16/}. Despite the attacks against him by P. Ehrlich and others, it seems to us that his conclusion is justified, although we do not fully agree with all his arguments, especially as regards the possibility of easily finding non-polluting substitutes of comparable quality for most of the products indicated by him ^{17/}.

The operational variables pertaining to these critical spheres of action can be combined in different ways in various development strategies which could even be classified according to the degree to which they exploit the environment ^{18/}. It is therefore clearly the wrong approach to start by trying to equate long-term environmental management with only two variables - the growth rate of the product and that of the population - on the basis of the trivial argument that exponential growth in a finite medium must at some time reach its limit. Without going to the extremes of an unfounded "epistemological optimism" ^{19/}, and while recognizing the dangers of an obscurantist growthmanship which ignores the social and environmental effects of the growth of the product, we think there is still scope to devise development strategies which are viable even from the environmental

^{15/} See an estimate of this kind in Richard Falk, The Endangered Planet, New York, 1972.

^{16/} Barry Commoner, The Closing Circle, New York, 1972.

^{17/} Commoner is quite right in insisting that the United States could produce the same quantity of wheat with fewer fertilizers and insecticides if it sowed a bigger area, but housewives would resist the substitution of ordinary soap for detergent. It would, of course, be quite reasonable to suggest as part of an environment policy that certain products be abandoned and replaced by others, but this would involve a change of values, rather than merely the substitution of equivalent products.

^{18/} R.G. Wilkinson, Economic Development, London, 1973.

^{19/} This is the title of a chapter in a book on scientific prospects by the well-known Soviet physicist Kousnetsov.

point of view ^{20/}. The developing countries, in particular, have a chance to avoid the mistakes made by the industrialized countries and to take preventive measures which involve a low social cost and can even perhaps be compensated for by net advantages. This is valid, a posteriori, for open spaces where it should be possible to adopt an ecological approach from the very outset of the population process, but unfortunately the real situation of Latin America's economic frontiers is very different.

Three types of studies on Latin America are necessary in order to determine exactly how much scope there is:

(a) Determination of the environmental effects and the destruction of natural resources resulting from growth and land use strategies in various countries of the region. This analysis should show the different patterns of interrelationship of the variables given in diagram 2, and thus determine the interaction of social and natural processes within the context of Latin America's historical development.

(b) Study of the possible degree of variation of the operational variables.

(c) Construction of models of different development styles, dealing with the environment dimension in its two aspects: balance of natural resources and energy resources on the one hand, and the quality of life on the other.

3. Some theoretical consequences of the introduction of the environment dimension

To what extent does the environmental revolution ^{21/} force us to reconsider the economic theories of and traditional approaches to planning? Since consideration of this subject is comparatively recent, we shall merely indicate some promising lines to follow.

^{20/} In the words of Ronald G. Ridker, "while population growth and perhaps economic growth ultimately must come to a halt on this finite planet, there is still considerable room to choose when, where and how". (Resource and Environmental Consequences of Population Growth in the United States. A Summary, Resources for the Future, Washington, February 1973, p. 19).

^{21/} Here, we are interpreting conceptually the title of Max Nicholson's book, The Environmental Revolution, London, 1970.

First, an attempt is being made to reinterpret basic concepts such as those of production and consumption. We have already mentioned the concept of the "environmental exploitation rate" introduced by Wilkinson, while Georgescu Roegen invites us to reconsider the whole production process in the light of the physical theory of entropy. In order to do this, economic production processes must not be analysed completely irrespective of the physical processes which support them ^{22/}, particularly that of the circulation of energy. After two centuries, as a result of the present concern about the environment, the writings of the physiocrats seem to have taken on new interest. Lastly, in expanding input-output tables to include the disposal of waste, Allen Kneese came to the conclusion that the concept of final consumption has lost all meaning ^{23/}.

The expansion of input-output tables is part of the task of reviewing statistical instruments in order to record environmental effects. One school of thought suggests a monetary evaluation of these effects (based on the cost of preventing them, eliminating them or even compensating for the damage done), with a corresponding correction of national product indexes, which would thus reflect net well-being.

The simplistic idea that market values can be invented for everything is meeting with increasing opposition however ^{24/}. Writers who adopt a critical attitude towards neo-classical theories stress the need to go beyond pseudo-economic calculations and instead

^{22/} Georgescu Roegen, The Law of Entropy and Production, Cambridge, Massachusetts, 1971.

^{23/} Kneese, Ayres and D'Arge, Economics and the Environment: a Materials Balance Approach, Washington, 1970.

^{24/} See, for example, A.M. Okun: "What you can and do measure as national income statisticians is the output resulting from market-oriented activity. The key to market-oriented activity is the presence of price tags. These are the essential ingredients in any objective standard of measurement that you can apply. Price tags enable you to sum up in a meaningful way physicians' prescriptions and phonograph records and pounds of steak and packages of beans. You can add up all the things that money can buy. But if you were to be seduced by your critics into inventing price tags which neither exist nor can be reasonably approximated for things which money can't buy, you will have sacrificed any objective yardstick". (Survey of Current Business, July 1971, p. 130).

rehabilitate the normative dimension in economic thought ^{25/}. In the sphere of social accounting, this would mean modifying national accounting of income, which would only have a limited role as an indicator of the level of economic activity, and adding a system of different social indicators of social welfare, together with a third system of accounts designed to show the net worth of nature with the purpose of assessing the consumption of stocks of non-renewable natural resources and the degree of reproduction of renewable resources ^{26/}.

Emphasis on the normative approach would mean rejecting the traditional cost-benefit methods ^{27/} and trying to improve on them

^{25/} See, for example, the articles by Kapp and Sachs in The Political Economy of Environment, Paris and The Hague, 1972.

^{26/} These systems of accounts are being studied in France by the National Institute of Statistics and Economic Studies (INSEE). Among the institutions and writers that have concerned themselves with social indicators are Jacques Delors, Bertram Gross and the United Nations Research Institute for Social Development (UNRISD)

^{27/} See, for example, the article by Streetan in The Political Economy of Environment, *op. cit.* An extreme position is that reflected in the following words of Ian McHarg: "The economists, with some conspicuous exceptions, have become the spokesmen for the merchants' creed and in concert they ask with the most barefaced effrontery that we accommodate our values to theirs. Neither love nor compassion, health nor beauty, dignity nor freedom, grace nor delight are true unless they can be priced. If not, they are described as nonprice benefits and relegated to inconsequence, and the economic model proceeds towards its self-fulfilment - which is to say more despoliation. The major criticism of this model is not that it is partial (which is conceded by its strongest advocates), but more that the features which are excluded are among the most important human values, and also the requirements for survival. If the ethics of society insist that it is man's bouden duty to subdue the earth, then it is likely that he will obtain the tools with which to accomplish this. If there is established a value system based upon exploitation of the earth, then the essential components for survival, health and evolution are likely to be discounted as they are. It can then come as no surprise to us that the most scabrous slum is more highly valued than the most beautiful landscape, that the most leathsome roadside stand is more highly valued than the richest farmland, and that this society should more highly prize tomato stakes than the primeval redwoods whence they come." ("Values, process and form", in Robert Disch (compiler), The Ecological Conscience. Values for Survival, Englewood Cliffs, New Jersey, Prentice Hall, 1970, pp. 21-36.

within the naturally much broader context of the assessment of the environmental and social effects of technologies.^{28/}

Lastly, mention should be made of a recent and very interesting attempt by Wilkinson^{29/} to redefine development in ecological terms. For this writer, development means passing from one ecological niche to another which holds out greater opportunities and a new basis of resources, but which presents different technological and social problems and requires a process of adaptation in order to achieve a new ecological balance. According to Wilkinson, technological progress is induced by the challenge of the new problems which are progressively raised by new ecological conditions. This is undoubtedly an interesting theoretical effort, but it is unilateral. As we have already stated, we consider that the planner's thinking should be enriched not only with ecological but also with anthropological knowledge. Only in this way is it possible to achieve a truly unified approach and at the same time to eliminate not only the mono-disciplinary and sectoral approaches but also the conflict between socio-economic and environmental and substantive and spatial considerations.

B. ECO-DEVELOPMENT: THE CONCEPT AND ITS APPLICATIONS

The concept of eco-development derives from the theoretical considerations examined briefly in previous sections and the idea is to adopt a unified approach to regional and local planning. We shall now define the concept, illustrate its possible applications, and identify the institutional framework required.

1. Definition of the concept

We shall give the name of eco-development strategies to those which are designed for particular eco-zones with a view to:

- (a) Making fuller use of the specific resources in each eco-zone in order to meet the basic needs of its inhabitants while safeguarding the long-term prospects by the rational management of those resources instead of their destructive exploitation.

^{28/} A special issue of Revue Internationale des Sciences Sociales, published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), contains several articles on this subject (Vol. XXV (1973), No 3, in the press).

^{29/} Economic Development, op. cit.

/ (b) reducing

(b) Reducing to a minimum the negative environmental effects and even, as far as possible, using waste products for productive purposes

(c) Designing adequate technologies for achieving these goals.

Eco-development is above all an approach which invites the planner to change his traditional view of the development process. It stresses the diversity of situations and hence of paths to development, the possibilities of complementarity between proposed activities so as to prevent the wasting of resources and minimize the waste products generated, and the need to rely more heavily on internal efforts and the originality of local projects. The greatest change occurs in the technological style, although eco-development should not be reduced only to this aspect. It is not a question of limiting the area of possibilities to the extremely small group of "soft technologies", although these should be used wherever possible, nor is it a question either of rejecting certain highly capital-intensive technologies when there are no feasible less costly alternatives and such technologies promote eco-development ^{30/} in that they have been developed in accordance with ecological criteria. Instead of adapting the eco-system to imported technologies which have been tested under different cultural and ecological conditions and which tend to destroy the system and have disastrous social effects, the idea is to adopt a new attitude and to design technologies suited to the conditions of the natural and social environment in which they are to be used. We consider that, for both ecological and socio-economic reasons, a special role should be played by "combined technologies" which, with the catalytic

30/ A recent Japanese research project illustrates the feasibility, in some cases, of technologies which are based on the ecological approach but involve high capital intensity; thus, for example, in order to eliminate sulphur from the oil which Japan imports from the Persian Gulf countries, it was suggested that the exporters should produce asphalt. So as to utilize the surplus asphalt a machine was invented which injects this product one metre deep in the desert, thus creating an impermeable layer and permitting the large-scale cultivation of hydroponic crops. As these need fresh water, however, instead of desalinating sea-water it was considered preferable to undertake genetic research with a view to adapting certain plants to brackish water.

contribution of spearhead technologies, would enable fairly traditional activities based on the use of renewable natural resources to continue by opening up new markets for the products of such activities through their endowment with new qualities (the impregnation of timber and the chemical treatment of natural fibres are good examples) ^{31/}.

Clearly, eco-development also involves a change in the order of priorities and in the style of scientific research. Instead of following alienating fashions dictated by foreign scientific centres, research specialists should adopt a different scale of values which gives more importance, in particular, to the solution of local problems, the simplicity of the techniques proposed, and their evaluation from the ecological and cultural angle rather than exclusively by their efficiency in terms of achieving maximum performance. At the same time, great importance is attached to the participation of the local population in research activities and an effort is made to take advantage of the indigenous population's knowledge of eco-systems through ethnecology (which of course includes ethnobotany).

2. Area of application

Let us now examine briefly some possible applications of the concept of eco-development in the fields of nutrition, housing, energy, industrial exploitation of renewable resources and conservation of resources.

(a) Nutrition

A great deal has been written and much research has been carried out in connexion with the possibilities of finding novel local solutions, at least of a partial nature, to the problems of

^{31/} There are even grounds for thinking that the developed countries might be interested, as part of their own environment policies, in opening up their markets to such products as substitutes for others based on resources which are non-renewable, polluting, or both. See Méthodologie d'évaluation de produits à matières substituables en fonction des impacts sur l'environnement, a study prepared by CIRED (EPHE) for the Ministry of the Environment, Paris, 1973.

food supply. The green revolution ^{32/}, however, has brought to ever-greater prominence a philosophy involving the wide dissemination and uniformity of agricultural development. This does not mean, of course, denying the dissemination potential of certain species, but the ecological dangers of such a course of action should not be underestimated ^{33/}, nor should opportunities be wasted because of a hankering to adopt only reputedly "miraculous" imported solutions. While not trying to be original at all costs, eco-development endeavours to stave off the tendency towards uniformity, exploring little-known or little-practised possibilities but at the same time not forgetting the need also gradually to develop crop farming and live-stock production on the basis of established but under-utilized methods such as raising pigs on yuca or cattle on sugar cane, in areas where yuca and sugar cane can be produced cheaply in large quantities.

It is advisable, therefore, to reject certain assumptions inherited from past European experience whereby crop-farming is considered in terms of open areas and single-crop farming, while stock-raising is considered in terms of closed, and of course cleared, areas. We have already forgotten how the forests which covered nearly the whole of Europe in the Middle Ages were managed in order to extract from them both human food and animal feed. Generally speaking,

^{32/} We shall not take into account here the negative social effects - greater polarization of wealth and scant creation of employment - which many writers attribute to the green revolution.

^{33/} The writer who is of Polish origin, recalls that the introduction of the potato into Poland completely altered the nutritional habits and structure of the rural population. On the other hand, it should not be forgotten that Ireland suffered a great tragedy in the last century when disease attacked its potato crop and caused death or emigration of millions.

we are stamped by a cultural tradition according to which the forest is an enemy, the habitat of all that is harmful, and an obstacle to agriculture ^{34/}.

What must be done is to utilize to the full the natural capacity for photosynthesis, completely irrespective of the form the natural productive process may take. This leads to the following possibilities:

- the selection of local plants and local genetic varieties with satisfactory productive potentialities;
- the use of aquiculture, in salt or fresh water (the "blue revolution"), as a potential source of direct feed ^{35/}, or for the extraction of protein, possibly for human nutrition and certainly for fish feeding. There are even excellent possibilities of converting into valuable resources the aquatic plants which infest artificial lakes and threaten them with eutrophication ^{36/};

^{34/} In a book on the economy of the latter part of the Middle Ages, Georges Duby describes the "barbarian" (as opposed to the Roman) agricultural system, in which crop-growing land and the space for pasture, forests and forage crops were closely linked. (Georges Duby, Guerriers et Paysans. VII-XII siècle, Paris, 1973). See also the following comment by Jacques Le Goff: "A great mantle of forest and moors broken by more or less fertile cultivated clearings - a sort of opposite extreme to the Moslem East, which is a world of oases in the middle of the deserts. There wood is scarce, here it is plentiful; there trees mean civilization, here they mean barbarism. The religion born in the East under the shade of the palm-trees emerges in the West as detrimental to trees, which are considered as the refuge of pagan genii and are chopped down without mercy by monks, saints and missionaries. All progress in the mediaeval West consists of clearing, combating and vanquishing weeds, bushes and, when necessary and when technical equipment and courage permit, forests of full-grown trees, the virgin forest, Perceval's vaste foret, Dante's Silva oscura."

^{35/} In view of the danger of complete annihilation of the livestock in Niger due to persistent drought, it was decided to sow aquatic plants in the Niger River in order to produce feed (personal letter to the author).

^{36/} At the eleventh Congress of the International Commission on Large Dams held in Madrid in June 1973, the Soviet delegation reported that the first installations for extracting feed protein on an industrial scale from aquatic plants grown in artificial lakes were being constructed in the Ukraine.

- the three-dimensional exploitation of forests for the extra extraction not only of timber but also of food and animal feed. Recent experience has shown the potentialities of forests specially planted for the production of feed. In certain eco-systems these can provide the best solution ^{37/};
- the adoption of agriculture at different levels, particularly in the rainy tropical zones, respecting the architecture of the jungle and even combining plants which have roots of different depths, different nutrient requirements and dephased growing periods (the indigenous market-gardens in Polynesia may have a great deal to teach us in this respect) ^{38/};
- the extraction of protein directly from leaves ^{39/}, which is possible and economic even from weeds ^{40/}, and the cultivation of yeasts on lignin;

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- ^{37/} See the excellent article by James Shelto Douglas "L'agrosylviculture pour accroître la production alimentaire de la nature", Impact: Science et Société, UNESCO, vol. XXIII (1973), N° 2. In Chile good results are being obtained from plantations of a tree of the leguminosae family (Prosopis tamarugo) in the Pampa del Tamarugal, which can maintain 12 sheep per hectare (36 times more than in Patagonia) in a wilderness area. Pierre Gourou, for his part, studied the extraordinary case of the inhabitants of the island of Ukara in Lake Victoria, Tanzania, where over 200 inhabitants per square kilometre live in an area of 74 square kilometres. The islanders have 10,000 cattle which they breed in stables, using the manure for intensive agriculture. The cattle feed consists of various forage crops, including graminaceous plants cultivated in flooded areas and the leaves of 32 species of specially planted trees. (Pierre Gourou, Leçons de Géographie Tropicale, Paris, 1971, pp. 160-161).
- ^{38/} See R.A. Rapaport, "The flow of energy in an agricultural society", Scientific American, September 1971. For information on the smallholdings of the indigenous population in the Amazon area, see Betty J. Meggers, Amazonia: Man and Culture in a Counterfeit Paradise, Chicago, 1971, and Stefano Varese, "Au sujet du colonialisme écologique", Les Temps Modernes, April 1973.
- ^{39/} See N.W. Pirie, Leaf Protein: Its Agronomy, Preparation, Quality and Use, Blackwell Scientific Publications for the International Biological Programme, Oxford and Edinburgh, 1971.
- ^{40/} S.B. Gore and R.N. Joshi, "The exploitation of weeds for leaf protein production", Tropical Ecology with an Emphasis on Organic Production, proceedings of a symposium on tropical ecology, Athens, Georgia, 1972, pp. 137-146.

- the rational management of fauna, which could usefully supplement livestock production or even, as some biologists maintain in connexion with East Africa ^{41/}, provide a more productive alternative, and the management of marine fauna such as turtles ^{42/};
- the domestication of some wild animals such as the guanaco in the austral zone, the tapir in the Amazon area and, of course, the sea cow, which unfortunately is almost extinct but which has been used successfully in Florida to clean canals overgrown with aquatic plants ^{43/};
- the selection of species found in similar eco-systems in order to try to acclimatize them (for example, the Asian buffalo rather than European cattle for the rainy tropical regions of Latin America);
- the intelligent management of nutritional chains, particularly in pisciculture (the writer has seen fish fed with termites in east Peru) and shellfish culture (use of fish meal as feed in nurseries);
- biological pest control.

This is not an exhaustive enumeration and is intended merely for illustrative purposes.

(b) Housing

This problem exists at three inter-related levels: bringing the design of population centres into line with the eco-system, building ecological dwellings, and using local materials - preferably based on renewable resources (provided, of course, that these resources are rationally managed) or on industrial waste - which can be used in a labour-intensive manner and are suitable for self-help construction programmes involving the assistance of only a few specialists. This

^{41/} See Julian Huxley, "Riches of Wild Africa", Essays of a Humanist, Harmondsworth, Penguin Books, 1966, pp. 177-201.

^{42/} The case of the turtles of the Galapagos Islands has been studied by Pierre Gourou (periodical L'Homme, 1966).

^{43/} In principle, the International Biological Programme is to study the protection and utilization of sea cows. See N.W. Pirie, "Weeds are not all bad", Ceres (FAO), vol. 3, No 4, July-August, 1970).

offers perhaps the only prospect of successfully tackling the world-wide housing problem, the deficit in Latin America in 1970 being estimated by the IDB at 15 to 20 million units ^{44/}.

Of the three problems mentioned above, that which has been least studied is the problem of designing population centres which are in line with both the eco-system and with cultural traditions. Urbanistic thinking within the context of the Charter of Athens continues to be highly universalistic and therefore tends to reduce everything to a uniform pattern. Moreover, many population schemes are based on a geometrical view of the organization of space which completely loses sight of the peculiarities of each case and the manifold schemes that may be put into practice. This situation becomes dramatic in certain tropical zones where no effort at all has been made to give cities and population centres an original form adapted to their environment and able to withstand problems of climate (heat, torrential rain, tropical diseases) through the suitable organization of urban space, the utilization of plant cover as protection against sun and rain, the use of biological methods for the treatment of waste water, etc. The great majority of urbanistic rules prevailing today in Latin America are virtually unadapted copies of European models, despite the differences in ecological and cultural situations.

More is known about adapting housing to the climatic and natural environment. According to A. Rappaport, Europeans who settled in Amazonia and had their houses built by the indigenous population achieved better results than the rubber kings, who imported even bricks and marble to build thick-walled mansions which seemed as if they were designed to absorb moisture and gradually decayed ^{45/}. During the colonial era a style of housing was developed in several parts of Latin America, which was fairly well suited to the prevailing ecological conditions ^{46/} but it does not seem to have had much influence on

^{44/} Economic Commission for Latin America (ECLA), "Latin America and the International Development Strategy: First regional appraisal" (E/CN.12/947), February 1973, Part One, p. 57.

^{45/} Ames Rappaport, Pour une anthropologie de la maison, Paris, 1972, p. 31.

^{46/} See Gilberto Freire, A Casa Brasileira, Rio de Janeiro, 1971.

modern designs. Hassan Fathy's ill-fated but highly interesting experiences in Egypt ^{47/} indicate the tremendous potentialities offered by the study and rationalization of traditional housing designs and building techniques in order to achieve solutions that are efficient, cheap, and in keeping with the inhabitants' taste. Nevertheless, the cities of the Third World are filled with cosmopolitan towers and, invoking a falsely modernistic scale of values, the rural population are invited to live in houses which are really less comfortable, since they are smaller and much less functional, than the traditional dwellings.

However, the studies carried out by the Inter-American Housing and Planning Centre (CINVA) of Bogotá and the experiences of Cuba ^{48/} and several other countries represent some progress, albeit only on an incipient scale, in the utilization of local building materials.

The problem of ecological housing is also a source of concern to the developed countries. Mention may be made, for example, of a spectacular and apparently well executed project carried out by a team of research specialists from McGill University, who built a house very cheaply using sulphur waste from petroleum refining as the main construction material. The following 12 principles were applied in building this ecological house, which was specially designed to suit areas where there is a shortage of water:

- Use of renewable resources such as wood and vegetable fibres;
- Use of materials which would otherwise pollute the environment if discarded in the form of industrial wastes (sulphur waste from petroleum, copper, zinc refineries, etc.);
- Use of materials which can be recycled rather than being discarded at the end of the building's useful life;
- Use of non-polluting wind energy for electric power production;
- Use of as little water as possible for laundry and cleaning purposes, and saving of large quantities of water by means of fine-droplet spraying;

^{47/} Hassan Fathy, Construire avec le peuple, Paris, 1971.

^{48/} See Maruja Acosta and Jorge Hardey, Reforma urbana en Cuba revolucionaria, Caracas, 1971.

- Use of the wind-produced electric power to obtain water from the air through condensation;
- Use of solar energy to purify polluted water or sea-water;
- Use of solar energy for cooking and water heating, thus eliminating the need for fuel;
- Recycling of water and its separation by function according to the degree of purity required: i.e., for drinking and cooking, washing, and other purposes;
- Use of all the rainwater available;
- Avoidance of use of non-renewable resources which are rapidly being depleted; and
- Avoidance of waste by harmonizing the dimensions of all the building components through modular co-ordination ^{49/}.

This model ecological house naturally suggests many interesting avenues in the search for novel and at the same time economic solutions, which can obviously be applied separately, in order to tackle Latin America's housing problem.

(c) Energy

Without approaching the "energy crisis" (or perhaps pseudo-crisis) now facing the industrialized countries in its whole complexity and political dimension, the following four comments may be made on the subject.

(i) Petroleum prices will continue to soar (though this will not necessarily result in a net transfer of income to the producer countries of the Third World where the transnational oil companies are operating), thus bringing about a change in the relative prices of the various fuels which will create some possibilities of substitution which did not exist at the previous petroleum prices; nuclear energy will move into first place, but increasing popular feeling against the installation of atomic power plants could impel some countries to seek unconventional solutions earlier than might have been expected.

^{49/} A. Ortega, W. Rybczynski, S. Ayad, W. Ali and A. Aceso, The Ecology Operation, McGill University, Montreal, 1972.

(ii) Owing to the energy crisis, steps are being taken to reassess the possibility of developing unconventional sources of energy such as geothermal energy ^{50/}, solar energy, wind energy, tidal energy and, lastly, hydrogen obtainable through the electrolysis of sea-water, using nuclear energy, solar energy (in tropical seas), or wind energy. Even writers who doubt whether these novel techniques can be introduced on an industrial scale before the end of the century recognize that the programme of research in this field should be considerably expanded ^{51/}.

(iii) At the same time, special attention is being given to the potential saving of energy by changes in consumption styles, in the organization of transport and in house construction methods ^{52/}.

(iv) Lastly, those members of ecological movements who advocate "soft techniques" say that it is frequently possible to find decentralized solutions on a non-industrialized scale, even for a single farm, which concentrate on the use of renewable resources and cheap techniques. In the case of the model ecological house described above, both solar and wind energy are used. Other methods suggested are small dams and the production of biological gas from organic matter ^{53/}.

While these solutions have at best a philosophical demonstration value in highly industrialized countries covered by a dense electric energy transmission network, their value should not be underestimated in eco-development strategies for many isolated regions of the Third

^{50/} The Chilean Development Corporation (CORFO), with United Nations assistance, is carrying out a project for tapping geothermal energy at El Tatio in northern Chile.

^{51/} This is the opinion expressed by Carroll L. Wilson in "A plan for energy independence", Foreign Affairs, July 1973, p. 659.

^{52/} An official study on energy conservation in the United States covers all these subjects. Its conclusions have been widely disseminated in summarized form (periodical Science, April 1973).

^{53/} Experiments are being carried out in some 5,000 population centres in India on the extraction of biological gas from dung with the simultaneous production of manure. Traditionally, all dung was burnt as domestic fuel. The obstacles to the expansion of this programme seem to be of a social rather than a technical or financial character, (personal letter to the author).

World which, moreover, have favourable climatic conditions for utilizing the sun or organic matter for the production of energy. Furthermore, the saving of energy obtained from commercial sources undoubtedly constitutes an important element in the analysis of development styles, since the majority of the inhabitants of the Third World will never be able to reach such levels of squandering energy as those associated with the production and consumption in industrial societies. Lastly, the possibility should not be excluded that some countries of the Third World will go further than the industrialized countries in the application of novel solutions involving the use of unconventional sources of energy and a more rational organization of their transport systems. This is a definite possibility because, in addition to possessing more favourable natural conditions for the utilization of solar energy, their socio-political structures are perhaps less dominated by the plan of powerful economic interests linked to the development of conventional sources of energy and to the civilization of the private motor car.

(d) Industrial utilization of renewable resources

This is a very broad subject, and must therefore be dealt with here on more general lines.

For obvious reasons, the industrial utilization of renewable resources must wherever possible form part of the eco-development strategy.

This means, above all, attaching great importance to artisan-type activities using local resources. The bamboo civilization in the Far East is an excellent example of what can be done with a renewable resource ^{54/}. The next step is the industrial processing of residues

^{54/} Describing the "plant civilization" of the Far East, Pierre Gourou has written an excellent description of the bamboo technology: "Because of the availability of bamboo, or more exactly, because the Chinese have had the ingenuity to discern its virtues, admirable use has been made of this material in Chinese technology. Bamboo is not unknown in Black Africa, but the traditional technologies of traditional Africa attach little importance to it. In contrast, in the Far East it serves as levers for moving weights, posts, poles, scaffolding, pipes, conduits, blinds, boats, chairs, tables, shelving, boxes, (continues)

from traditional agro-industrial production activities. Sucro-chemistry as developed in countries such as Cuba and Peru clearly indicates how much scope there is in this field. The main concern, however, must be to design complexes of forest industries, with emphasis on complementarity and the full utilization of all the resources in a specific forest area in order to obtain the maximum output per hectare of cut forest and at the same time to facilitate rational forest management with a view to the long-term conservation of resources. Therefore, consideration must be given simultaneously to the production of wood, wood products, pulp and paper, the industrial processing of oilseeds and fruit, and the extraction of essences and protein, the aim in the long run being to build up a whole chemical industry using vegetable matter. Such an industry might one day in some cases replace the petrochemical industry, threatened by shortages of resources and which is at a disadvantage owing to the rising cost of its raw material ^{55/}. It goes without

54/ (continued) screens, fine and thick paint-brushes, combs, brooms, ladders, flexible measuring rods, arrows, bows, parasol spokes, fences, mats, hats, stakes, baskets, lanterns, torches, fans, chopsticks, cages, flutes, staves, ropes, sandals, cylinders for forge-blowers; and inter-nodular section of green bamboo filled with rice and placed on the fire provides when removed, a tastily cooked dish; the new shoots are a delicious vegetable; the leaves form excellent foliage; bamboo provides motifs for painting and the decorative arts, which have successfully interpreted the flexibility and mobility of the stems and the trembling leaves (Pierre Gourou, La terre et l'homme en Extrême-Orient, Paris, 1972, pp. 27-28).

55/ In a book written over a quarter of a century ago, the American naturalist Marston Bates anticipated many of the current discussions about the utilization of forests, even at a complex industrial level. Note also his highly perceptive comment on the imitative transfer of technology: "If the West is unable to adapt its own economy to developments in nature within its own environment, it will find it difficult to help other nations to effect similar adjustments within their own environments". (Les tropiques. L'homme et la nature entre le Cancer et le Capricorne, Paris, 1953, pp. 227-228).

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saying, of course, that forest industry complexes should be so designed as to avoid water pollution or other pernicious effects on the environment.

(e) Conservation of natural resources

As already emphasized above, the conservation of natural resources is an integral part of eco-development strategies. Considerable use can be made of labour-intensive methods in this field of activity, as shown, inter alia, by the example of China ^{56/}. Insofar as reafforestation, water and soil management and other programmes can be implemented through the mobilization of human resources which would otherwise not be engaged in directly productive activities, no resources need to be re-allocated, except for the minimal amount necessary for equipment and possibly for additional food supplies. The environmental objectives are thereby harmonized with the goal of creating employment: in other words, there is additional long-term investment, since the conservation of resources is a sine qua non for sustained development. It is common knowledge that many development projects such as dams, irrigation projects, etc., have had disastrous effects on natural resources, either because they have been poorly executed or for want of foresight regarding the project's overall effects, or again because of sectoral approaches and the effect of selfish private interests. It is therefore a matter of urgency to evaluate these projects from the environment standpoint and then to carry out a programme of public works, using highly labour-intensive techniques, in order to repair the damage already done ^{57/}.

^{56/} See J.B.R. Whitney, "Ecology and environmental control", in China's Developmental Experience, compiled by Michel Oksenberg (Documents of the Academy of Political Sciences, New York, March 1973, vol. 31, No 1, pp. 95-109); see also Chang Kuang-tou, Chen-Chun-Ting, Li Kuei-fen and Liu Ling-Yao, "Construction of dams for water conservancy", Peking, 1973 (document distributed at the eleventh International Congress of Builders of Large Dams, Madrid, June 1973).

^{57/} See the paper submitted by the present author at the Funex Seminar: "Environmental quality management and development planning: Some suggestions for action", Environment and Development, op. cit., pp. 123-139.

3. Institutional preconditions

Eco-development is not just a technological style. Its application depends on institutional change, which is an integral part of the development process ^{58/} and of the evolution of the human mentality. A recent study of the teaching of ecological policy in China underlines the latter point. The Chinese are not using very original environmental and conservation techniques, but they have awakened the broad masses to an awareness of these problems ^{59/}.

The four essential conditions for eco-development are:

(a) A horizontal development authority capable of rising above the sectoral approach and taking advantage of all the complementarity possibilities involved.

(b) The real participation of the population in the preparation of eco-strategies, the necessary research and the execution of the proposed action.

(c) An educational system which, instead of concentrating on the transfer of book knowledge, converts the rural school into a real development agency, where the students learn to participate daily in development activities, to shoulder their responsibilities vis-a-vis the community, and at the same time to think specifically in ecological and anthropological terms;

(d) A system for integrating rural areas into the national economy, so as to prevent producers of primary products from being exploited by a chain of middlemen ^{60/}.

^{59/} J.B.R. Whitney, op. cit.

^{60/} See Otávio Guilherme Velho, Frentes de Expansão e Estrutura Agrária. Estudo Processo de Penetração numa Área de Transamazônica, Rio de Janeiro, 1972, p. 156. This recent study on Marabá, in the Brazilian Amazon region, shows how the settlers are exploited by merchants, and interesting conclusions are drawn concerning the inadequacy of directed land settlement schemes: "A large-scale land settlement policy should have objectives that are less ambitious but on a much larger scale. It should not lay down beforehand the exact direction of the process, but should rather confine itself to guaranteeing the minimum conditions (such as assistance in building local roads, limited credit to keep the worker going until the harvest, guaranteed minimum prices, agricultural assistance, health and educational (continues))

These conditions are difficult to realize. We believe, however, that pending the organization of international co-operation between scientists of different disciplines regarding the concept of eco-development, it is worth while taking steps to organize, here and now, some demonstration projects aimed at devising eco-development scenarios for particular eco-areas which are representative of conditions found in various Latin American countries. This could give the following results:

(a) A preliminary synthesis of the existing information about eco-development possibilities in the regions studied and, concurrently, a clear idea of the gaps in this information;

(b) Suggestions for specific eco-development measures;

(c) Suggestions for future research programmes and their priorities;

(d) Identification of development projects which might obtain support from international financing agencies;

(e) A considerable contribution towards the conceptualization of eco-development and the elaboration of development strategies on the basis of this concept which could be of interest to developing countries in general and of value in defining future UNEP programmes.

Consideration should also be given to the possibility of adding an eco-development component to some regional and rural development projects which are in process of execution or preparation by the United Nations and its specialized agencies. The crux of the problem is to acquire a deeper insight into and learn to handle more efficiently the inter-relationships between social processes and natural processes. The fact that forms of land tenure and social

60/ (continued) assistance, etc.) and guiding the workers, without making them feel any loss of independence, towards making the improvements that are feasible at any given moment. Above all, land ownership should be effectively guaranteed. These apparently more modest objectives could have much more far-reaching results than would appear at first sight". See also M. Nelson, "New land development policy in the humid tropics of Latin America", ILPES, Santiago, 1970 (manuscript).

organization affect the use of the soil and other natural resources opens up interesting prospects for carrying out eco-development studies and experiments in areas where agrarian reform is in progress and it is necessary rapidly to increase the value of the poorest land, which was not being properly exploited under the latifundio system. Moreover, the new forms of rural organization should create favourable conditions for a policy of conservation of natural resources and construction of dwellings using highly labour-intensive techniques. It is in these areas that the best opportunities exist for applying the institutional assumptions necessary for eco-development 61/.

61/ The writer gratefully acknowledges the valuable suggestions made by Mr. F. Barahona, of the FAO Regional Office.

