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ASSISTANCE IN ESTABLISHING AN ENVIRONMENTAL LABORATORY TO CONTROL THE AGRO-INDUSTRIAL DEVELOPMENT IN THE EASTERN PART OF THE COUNTRY

SI/ECU/88/802/11-01/11-02/11-03
REPUBLIC OF ECUADOR

Terminal Report*

Prepared for the Government of the Republic of Ecuador
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Arístides Rocha, Sergio Miranda da Cruz
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agro-industrial planning and economic analysis,
respectively

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SUMMARY

In response to a request of the Government of Ecuador to the United Nations Industrial Development Organization (UNIDO) for technical co-operation in the field of environmental control in agro-industrial development, the project "Assistance in Establishing an Environmental Laboratory to Control the Agro-Industrial Development of the Eastern Part of the Country" (SI/ECU/88/802) was approved in July 1988. The field work, carried out by experts in environmental engineering, agro-industrial planning and economic analysis, took 2.7 man/months and was carried out from October to December 1988.

The finding of the project -- the immediate purpose of which was to determine the feasibility of installing an environmental-control laboratory in the eastern part of the country -- was that it is necessary to co-ordinate and centralize existing action and information in the field.

It was also agreed that this co-ordination should be reflected in practical terms in the establishment of an Environment Management System, backed up from the beginning by an Environment Management Centre.

It was also recommended that, given the cost of the necessary infrastructure, the Centre be national in scope, and that it be set up gradually, starting with a structure of centralized laboratories and field operations (initially in the eastern part of the country), and that maximum use be made of human and material resources already available in Ecuador.

It was reckoned that the installation of the proposed laboratories-structure would represent an investment of roughly US $1,500,000.

It was also recommended that the Centre be set up as an independent institution, directed at its strategic level by a multidisciplinarian body of administrators consisting of representatives of Ministries, the private sector and other institutions involved in the country's environmental problems.

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INTRODUCTION

Among civilized peoples, technological development has led to the adoption of new methods of industrial production, and processes for the extraction of minerals as raw materials, the use of fertilizers in the soil (thereby giving maximum yields in agriculture and rational breeding of animals for consumption), and to a virtually unlimited population concentration, with a deep impact on nature.

Owing to the lack of conservationist awareness, human activity in all directions and environments is contributing more and more to the upsetting of natural systems, and to the qualitative deterioration of the biosphere. The principle environmental damages are: devastation of forests; incorporation of chemical elements and compounds alien to the natural environment (soil, water and air); excessive nutrients; modifications in hydrological and climatic characteristics; particular changes in land and water ecosystems as a result of the removal of one or more elements from the trophic systems, or by the introduction of species foreign to them.

A. Environmental impact, pollution and contamination

The term "environmental impact" refers to changes occurring in the natural environment through man's activity.

Pollution is the general term given to the ecological impacts and changes due to the incorporation of substances and energy into the environment.

Until the beginning of this century, pollution was usually caused by the introduction of highly concentrated biodegradable drainage discharges or by the burning of organic matter. Meanwhile, as Branco[2] (1984) points out: "to the burden of pollution brought about by the marked increase in industrial activities and in other means of production, characteristics of this century, another one is added, which accentuates the danger of organic and inorganic wastes coming from industries, as well as from the treatment of soils for agricultural uses, through the use of synthetic fertilizers, herbicides, insecticides, heavy metals, and other substances extremely harmful to the ecosystems and to man".

Indeed, the word "pollution" comes from the Latin "polluere" which means to dirty, to soil, referring to aesthetic and sensorial effects provoked by waste matter in the environment. In general, the term most often used in Spanish, especially in Latin America, to refer to the same phenomena, is "contamination" from the Latin "contaminare", meaning to mix, infect, dirty, soil.

B. Extent of the problem

While intense scientific and technological research over the past decades has made it possible to acquire a vast amount of knowledge and thereby to establish methods of evaluation and correction of undesirable effects, the problem of environmental impact, pollution or contamination of waters, soil and air, is going from bad to worse in the entire civilized world. This is explained by the population explosion; extension of sewage systems, bringing greater amount of drainage wastes into the general water supply; spreading of industrial complexes; use of synthetic products; etc.

These facts imply that governmental entities, together with the private sector must undertake action aimed at covering a wide range of physical and social aspects, including the provision of a basic infrastructure for environmental control, increase and organization of production, maintenance of health and social welfare levels.

Failure to perform the above-mentioned activities due to the non-existence of a standard-setting institutional system (or failure to do so even though such a system may exist), can lead to a break in the balance in the ecosystem and its rapid degradation, in view of the irreversible process of economic exploitation of certain regions, such as the Eastern Amazon Zone of Ecuador.

The Ecuadorian Amazon Region is a watershed, biogeographical zone, or province (from the legal viewpoint), with an area of 123,000 square kilometres, or 1.6 per cent of the Amazon area (7,828,000 square kilometres).

Despite the extreme importance of the Region in Ecuador's development, it still accounts for 87,000 square kilometres of the forests and woodlands of the 180,000 square kilometres existing in the country. That is why much care must be taken for its development. These figures, compiled by Persson, Rutney, Laudart and Custode, apply to the seventies (Diagnóstico de la Fundación Natura*, July 1987).

The activity carried out between 20 and 30 October 1988 through visits, contacts, surveys and field trips showed that a good deal of the data needed for the Amazon Region are available, especially for the eastern part of Ecuador.

As will be seen, and in the light of existing data, it is urgently necessary to co-ordinate actions designed to bring about sound exploitation of the environment, harmonizing economic development, preservation of the environment and generating resources and a better quality of life for the population.

RECOMMENDATIONS

1. In the eastern region of the country, in order to identify the degrees of environmental fragility, acceptable disturbance and the potentialities of the area, and thereby lay the bases for a harmonic economic (and especially agro-industrial) development of the region, the creation of a structured system at the institutional level, whose key objective is the environmental management of the Province of Napo, is recommended.

2. Owing to the cost of the required infrastructure it is recommended that the proposed system be national in scope, starting, naturally, with the Province of Napo (the object of this mission) but not restricted to this province in the future.

3. It is recommended that the functioning of the proposed system be backed up by a Centre, which could be called Environment Management Centre.

4. The Environment Management Centre should be structured so as to cover, directly or indirectly, the fields of action necessary for the functioning of the system, which are:

(a) environmental control;
(b) protection of natural resources;
(c) environmental evaluation;
(d) environmental information and documentation;
(e) environmental assistance and education;
(f) environmental planning and legal regime;
(g) research in and development of farming, livestock-breeding, extractive operations;
(h) research in and development of industrial activities;
(i) socio-economic studies and research;
(j) environmental research.

5. Administratively, these fields of activity could be reflected in the setting up of departments or divisions in the Centre, which could initially be:

(1) field operations;
(2) laboratories (water, soil and air analyses);
(3) studies of farming, livestock and extractive activities (environmental aspects);
(4) studies of industrial activities (environmental aspects);
(5) socio-economic studies;
(6) information and documentation;
(7) environmental research;
(8) administration.

6. The installations in the eastern part of the country (area concentrated upon by this mission) would be used only as a unit for the gathering of samples and would operate within the Field Operations Division.

7. It is recommended that the Centre function as a co-ordinator of the above fields of action, as a number of the activities in the various fields are now being carried out in one way or another by the most diverse institutions in the country.

8. Owing to limited resources (human, material and financial) it is recommended that the System, and therefore the Centre, be implemented gradually.

9. Gradual implementation implies establishing priorities; the following are recommended: (a) environmental evaluation, and (b) problems of plant-disease control affecting the main agro-industrial activity of the region. Thus, the following grouping of areas of action might be envisaged:

I. Control, protection and evaluation;
II. Information and documentation, assistance and education, planning, and legal regime;
III. Research and studies.

Operationally, the Centre (and its divisions and departments) could likewise be adjusted in keeping with already formed groupings.

10. It is recommended that activities involving research and studies requiring a structure that is also expensive should fall within the infrastructure already existing in the country.

11. Environmental control and evaluation would take up practically all the material resources needed in getting the first phase of the Centre under way. That is why it is recommended that during this phase special attention be given to this element by the Ecuadorian authorities.

12. In order to conduct environmental control and evaluation, a centralized structure of laboratories should be instituted, with a field installation in the eastern part of the country to carry out meteorological observations, and laboratory and field analyses. These activities would entail an investment of roughly US $1,500,000.

13. It is recommended that the Centre (the operational base of the System) be organized administratively as an independent institution, headed at the policy-making level by a multi-disciplinary body of administrators representing the various related ministries, the private sector and other institutions involved in the country's environmental problems.

I. PHYSICAL, BIOLOGICAL AND SOCIO-ECONOMIC FEATURES OF THE REGION

Publications such as those listed under "IV. Bibliography" (and relevant available bibliography) attest to the large amount of technical and scientific literature containing studies on the Region of Napo Province. Valuable information is thus available on the physical, biological and socio-economic features of the environment, albeit incomplete.

Nonetheless, and in support of the proposal made in Chapter II of this report, a brief description follows of the various aspects of the environment.

It is an overriding necessity for the social and economic development of the country to apply a policy of sound exploitation of its natural resources; it is more and more necessary to know these resources better so as to enable the respective institutions to plan ahead and carry out specific projects which will be of benefit to the productive zones, and to the country in general.

It should be borne in mind that the biological aspects of the environment, flora and fauna, should be highlighted, since they are of major importance in the Amazon Region because of their abundance and the complex relationship of its biota.

A. Physical features

Ecuador is situated on the western coast of South America. The country is divided into three natural regions, each with its own different features. In its central part, the Cordillera de los Andes -- the Andes Mountain chain -- crosses the country from north to south. Regional differences are not merely geomorphological or geological. They reflect the overall natural environment (water resources, minerals, flora, fauna), and their relationships with the social and economic characteristics of each region.

Three naturally different zones are:

- The eastern region, with the rather monotonous structural relief of the Amazon basin, with its own climatic characteristics and flora and fauna.
- The region characterized by the large mountainous range of the Andes Cordillera in the centre.
- The coastal region in the west, with its gentle relief and large alluvial plains.

The Ecuadorian Amazon Region borders on the Colombian and Peruvian Amazon regions on the northeast and southeast respectively.

The boundary drawn up under the Rio de Janeiro Protocol of 1942 after the border dispute with Peru, gave Ecuador even less access to the Amazon basin. Of the Amazon countries, Ecuador possesses the least territory in the region: only 1.6 per cent of all Amazonia.

Napo Province has the following geomorphology:

The Eastern Cordillera

The region constitutes an impressive mountainous barrier that follows the general direction of the Andes.

The highest peaks vary between 4,000 and 4,500 metres with very steep slopes that drop rapidly towards the Amazon.

The morphology of the eastern slope of the Cordillera is quite uneven: hills with steep slopes, sharp elongated peaks, uneven vertical slopes, with gradients of over 70 per cent. This region is characterized by large active volcanos, among them one of the country's most active: Sangay, on the eastern flank of the Cordillera.

All the rivers that descend towards the Amazon basin originate in the Cordillera region. They cut through ancient rocky outcroppings, forming deep gorges, accenting even more the heterogenous lay of the land. There are three large sub-basins in the area: the NAPO, the Pastaza and Bajo Ucayali sub-basins.

The zone is subject to heavy rainfalls of over 5,000 mm with a permanent thick mist and drizzle.

The Sub-Andean Zone

This region forms the western border of the great Amazon plain.

The sub-Andean zone is made up of clearly defined moderate reliefs, characterized chiefly by a large variety of forms of reliefs.

Heavy hydric erosion has led to the formation of derived reliefs, forming narrow and deep canyons through which the rivers of the sub-mountainous system run, generally through faults or fractures, and then flow into the two large rivers which limit and cut Napo Province from west to east: the Quijos river in the north, and the Napo in the south.

The Amazon Basin

In the east, lower than 250 to 300 metres in altitude, lies a rather monotonous landscape: the Amazon Plain, an endless juxtaposition of small, gentle hills.

It should be noted that the Amazon river system has a complex history, and is characterized by very different formations.

As for the study dealing with the geology of the region, the Region[5] concerned includes the sub-Andean zone of the Cordillera Real and part of the Amazon Basin, whose base consists of metamorphic rocks over which a series of geological and tectonic processes have developed, such as orogenies and marine and continental sedimentary phases, culminating in volcanic action and quaternary depositions.

Formations in this area range in age from the Precambian to the present era; the oldest arise on the flanks of the Cordillera Real. Cretaceous formations predominate in the Sub-Andean or Napo uplift, while Tertiary formations are more extensive in the Eastern plain.

Glacial deposits and volcanoclasts can be found near the volcanos. Quaternary depositions have accumulated along the rivers.

Some of the Cretaceous and Jurassic formations appear to be mother-rocks or to bear oil.

Likewise, the interrelationship between sedimentary and intrusive rocks, and other petrographic relationships, especially on the flanks of the Cordillera Real and the Sub-Andean zona, provide favourable conditions for the formation of commercially exploitable metal- and non-metal-bearing deposits.

The main direction of the faultage runs parallel to the Cordillera de los Andes, mainly in the sub-Andean zone. A series of folds in the Eastern Plain follow the same direction, providing conditions favourable to the accumulation of hydrocarbons.

Prospects for the exploitation of mineral resources in Napo Province are promising, as for example, metallic, non-metallic and radioactive minerals, raw materials for cement, lime and pottery, coal, hydrocarbons, glass, precious and semi-precious stones.

The climate in the Ecuadorian Amazon Region is always humid in the Cordillera and the highlands, and rainy tropical in the plains or Ecuadorian Amazon[5].

Climate of the Region:

- Temperatures ranging from 9°C to 25°C.
- Average rainfall is high, almost always more than 3,000 mm yearly, distributed regularly throughout the entire year, and in some cases about 6,000 mm.
- High relative humidity (around 90 per cent), with only 2.5 to 3 hours sunshine daily.

Data available from the meteorological and pluviometric network are deficient both in the quality of the information provided and in its distribution.

This dearth of information adversely affects statistical studies, such as altitude/precipitation correlation, as well as calculations concerning annual and monthly precipitation averages, and isohyetal lines, although there is some degree of uniformity in these phenomena in the region[5].

Agriculture is mainly devoted to subsistence crops, such as cassava, maize, papaya, bananas and other crops.

Cash crops are but few, and vary in amounts planted (coffee, African palm, tea and Quito naranjillos).

Some of the main crops of Napo Province, by way of illustration:

MAIN CROPS IN NAPO PROVINCE:
PERCENTAGE OF LAND PER CROP

Coffee	48.8%
African palm	21.9%
Hard maize	10.8%
Bananas	4.3%
Cassava	3.2%
other crops	11.2%

Source: UNEP[21], 1986

Coffee is the principal crop grown in area under cultivation[2], even though adequate technical assistance has not been provided to the producers; in general, the productivity and quality of the crop are not very high. Favourable conditions on the coffee market over the past few years have given a boost to its growth in the region.

The African palm is the most important cash crop. In the heart of the agro-industries, it has been heavily promoted by the State. The African palm is the only potentially profitable entrepreneurial crop[21].

Other crops are not produced in sufficient amounts to merit inclusion. They are referred to in the bibliography.

Cattle-raising is rudimentary and practised only on a small scale. Neither technical assistance nor veterinary services are provided, despite a high rate of diseases[21]. In the Napo region cattle-breeding is widespread on land that can no longer be used for farming.

The environmental impact of this activity is part of the general impact generated by land use, and must be evaluated together with the other uses.

As has been pointed out, the major part of the hydrographic system of the Ecuadorian Amazon originates in the Eastern Andes of Ecuador[21].

The rivers of the region are fed mainly by rain, underground slopes, surrounding humidity and the thawing of the glaciers.

Erosion control is the key to preservation of the forest and protection of the soil. The forests also ensure a high degree of evapotranspiration, completing the water cycle.

The river with the highest flow rate is the Rio Napo with an annual average of 2448m^3/s, followed by the Pastaza with 1013 m^3/s.[8]

The rate of flow of the rivers, such as the Napo and Pastaza, varies between 4 to 9 km/h, depending upon the season when there is more or less rain. The Amazon River flows at a rate of 2 km/h.

The study of the soil potential was based on morphoedaphological maps, by classes and within the usual limits.

Owing to the character of the region, a soil potential appraisal based on the traditional classification of soil fitness would classify more than 90 per cent of the region in the category of land unsuitable for agriculture and animal-husbandry[21].

Besides, this region has unique rain, soil and biotope features which are still very little known, making it therefore difficult to predict with certainty their appropriate use and evolution, in the light of their present uses. This theme remains as one of the priorities for experimentation and study, and for the analysis of the alternatives in environmental management of the region.

B. Socio-economic aspects

The process of land use evolves in different ways, including, inter alia, present demographic pressure, the policy of putting to use the entire territory of Ecuador, and the need to produce (oil and agriculture).

The difficulty of access to ownership of the land (formalities take up to 8 to 10 years on average), favours harmful operation practises, such as extracting the most valuable natural resources, and then "selling" the land to settlers who start farming it out with a complete disregard for elementary care, in such matters as erosion control or environmental quality. Within a few years livestock breeding takes over.

In addition to this process of land use, the settlement of the region is now based on oil exploitation, which has had an important effect on the region's development: especially in the tracing and building of roads, in the infrastructure, location and equipment of urban areas.

In the Napo region, oil prospecting and exploitation in the first half of the seventies brought about a population migration. At the beginning it was not a permanent shift, but linked to the floating population in the petroleum sector, it then gave rise to service activities in the new urban centres.

Moreover, the start of large-scale oil operations speeded up the occupation of the region, due fundamentally to the opening of roads in virgin areas, and the development of the infrastructure linked to these activities.

In Napo Province, the uneven development of the region and the influence of oil are notorious when comparing the situation and type of problems in this province with those in neighbouring regions.

Another important process in land use is the advantage in developing the "living frontiers" programme through human settlements in the border fringe of Ecuador.

Given the purpose of this report, briefly outlined are the educational, demographic and economic characteristics of the population of the province -- 115,110 persons, according to the 1982 IVth Population Census.

Within the total population of Ecuador, the proportion of the population from Napo Province is on the rise. In 1962, the province accounted for 0.5 per cent of the total national population, 1 per cent in 1974, and 1.4 per cent in 1982, according to the 1982 Census.

The annual average growth rate between the dates of the censuses -- June 1974 to November 1982 -- was 7.3 per cent, less than that recorded between the 1962 and 1974 censuses (8.2 per cent). While there is a slowdown in the growth rate, it is still above the national average, which is 2.5 per cent.

Considering that the Region covers almost 20 per cent of Ecuador's surface and barely 1.4 per cent of the total population, this is clearly a case of under-use of the territory, despite the above-mentioned increase.

The distribution of the population over the past two decades is striking. Although the growth rate in the urban area is greater, the rural population exceeds the urban.

TOTAL POPULATION PER AREA (INHAB.)

	1962	1974	1982
Urban	1,809	4,260	20,011
Rural	22,253	57,926	95,099
TOTAL	24,253	62,186	115,110

Source: Diagnóstico de la Provincia de Napo[5]
INEC -- National Institute of Statistics and Censuses, Population Censuses, 1986.

There is no questioning the importance of migratory movements in the process of population occupation of a territory. This influence is reflected for example in modifications in socio-economic characteristics, and in breakdown by sex and age.

In Napo Province, as in every region that holds out attractions, there is a large migratory movement.

As for the educational aspects of the population, the illiteracy rate in Napo Province is high. Despite the drop between 1974 to 1985, the number of illiterates is very high. There is a positive increase each year in the level of education, influencing the improvement in material, working and living conditions.

ILLITERACY RATES

YEARS	TOTAL	URBAN	RURAL
1982	19.8	6.5	23.0
1983	19.6	11.9	21.5
1984	18.6	12.9	20.0
1985	16.2	12.9	17.1

Source: Diagnóstico de la Provincia de Napo[5] IVth Population Census 1982. Prepared by CONADE/Cultura from 1983 to 1985.

The distribution and structure of the population of Napo Province is predominantly male. Nonetheless, the substantial variation in the period from 1974 to 1982 suggests that possibly the men/women ratio will balance out in the next few years.

As in the rest of the country, the main feature of the population is that it is very young. There is a high proportion of children, adolescents and young adults, and a low population of persons 65 years of age or more. In the short run, this population tends to increase owing to the maintenance of high fertility levels, migration to the Province, and the decline in infant mortality. In the long run, the picture of the population structure may change as the birth rate is declining at present.

The working population offers a good field for study to find out the relevant aspects of the economic and social life of a population, providing an inventory of human resources.

In 1982, 29 per cent of the total population was economically active. The present table takes little account of persons working outside their homes. That is why the rate of women in the rural population considered as being gainfully employed is less than in reality.

Napo Province has developed essentially in the primary sector of the economy. Although there was a 6 per cent decline from 1974 to 1982, agriculture, hunting, forestry and fishing are still the main activities of the region. The primary sector employs more than half of the working population, or 55 per cent.

This situation is reflected in the following table:

STRUCTURE OF THE WORKING POPULATION BY SEX
IN VARIOUS SECTORS OF THE ECONOMY - 1974-1982 (in %)

SECTOR	PROVINCE		MEN		WOMEN	
	1974	1982	1974	1982	1974	1982
Primary	61.5	55.5	62.9	58.8	49.8	28.8
Secondary	15.2	12.9	16.5	13.8	3.8	5.9
Tertiary	19.5	28.0	16.9	24.2	41.4	58.5
Unclearly specified activities	2.5	1.1	2.4	1.1	3.8	0.9
New worker	1.3	2.5	1.3	2.1	1.2	5.9
TOTAL	100	100	100	100	100	100

Source: Diagnóstico de la Provincia de Napo[5] - IVth Population Census - 1982.

C. Biological aspects

Considering the extent of the Amazon region, from the ecological viewpoint there is a high degree of heterogenity of fauna and flora, although it is difficult to characterize and analyze their diversity.

Moreover, the distribution of the plant kingdom has much more direct relationship with the environment than the animal kingdom (although its mobility makes movement possible with some degree of independence).

To draw up a policy and programme for control and preservation, it is obviously important to know the flora, fauna and their inter- and intra-specific relationships, their importance in the links of the food chain, and their co-relationship with the environment.

There is a relation between climatic, physical and biological parameters which determine ecosystems with very characteristic structures (complex and fragile relationships). Thus, what man has done must be scrupulously investigated, as any activity can lead to serious problems in the actual execution (plant disease, erosion, etc.).

C.1 Flora

The Amazon region is home to the so-called "Pleistocene forest refuges", in which endemic flora of particular biological interest has developed, as in the zones of Napo, Baeza, Sacua, and Pie Occidental de los Andes.

In his paper for the Fundación Natura, op. cit., Sensu Pozo (1987) points out that the current classifications of "life zones" in the Ecuadorian Amazon Region are based on data from remote sensors or from climatological data (Holdridge system). He stresses that a synthesis of the various types of data is necessary for a better and more thorough understanding. This same research worker, who collected data available from both methods, drew up the following classification:

(a) Humid Tropical Forest - 6,749,247 hectares.
(b) Very Humid Tropical Forest - 231,142 hectares.
(c) Rainy Pre-mountainous Forest - 365,494 hectares.
(d) Very Humid Pre-mountainous Forest - 1,858,476 hectares.
(e) Humid Pre-mountainous Forest - 976,957 hectares.
(f) Very Humid Mountainous Forest in the Andean slopes between 2,000 and 3,000 metres altitude.

As a rule, the biomes described above have a reasonable degree of specific diversity in their different and particular ecosystems, all with drainage, erosion and soil-leaching problems - especially in the case of very steep slopes. There is intense intervention by man, transforming forests into grazing land, subsistence crops (maize, cassava, bananas, potatoes, sugar cane, rice, plantain, Quito naranjillos) and/or logging and the wood industry.

Subsistence monocrops, such as coffee, and the industrial exploitation of the African or palm-oil tree, prevail in the region. In Eastern Ecuador there is also monoculture of tea and deterioration of secondary forests.

The essential problem in the exploitation of the Ecuadorian Amazon Region is that the structure of the forests, their characteristics and functioning are as yet not well known. Nonetheless, there is undoubtedly a specialized bibliography available with inventories and descriptive catalogues of the vegetation, which could be used in diagnosing the flora.

In the documentation used in preparing this study, the following studies were of great interest: "Plantas útiles de la Amazonia Ecuatoriana", J.P. Lescure, H. Balsev and R. Alarcón[13], 1987, consisting of 407 pages with a critical inventory of data available in Quito; "Catálogo de la Flora del Nororiente Ecuatoriano", Gonzalo Campuzano[3], 1976, containing a detailed description of 275 species; and "Algunos Recursos Vegetales del Territorio WAC (AUCA)", by Anibal Arévalo et al., whose description also gives indigenous names and uses of and notes on the plants.

Although man's activity is very intense, there still exists vegetation that is typical of the Amazon region in all the previously mentioned forests. In Diagnóstico de la Fundación Natura[8], op. cit., N. Myers, 1980, has estimated that the number of phanerogamous vegetable species (trees with leaves, flowers and fruit) may be more than 20,000. D. Neil, Diagnóstico de la Fundación Natura[8], stressed that in the Humid Tropical Forest alone, situated in the zone between 100 and 600 metres, with average yearly temperatures exceeding 23°C and yearly rainfall of between 2,000 and 4,000 mm, around 3,000 arboreal species can be found, consisting of 375 genera, of which 70 per cent are new entries.

There are various species of trees of commercial value in the Amazon region, notably the following:

Biosimum utili	Sande
Calaphyllum longifolium	Maria
Carapa quianensis	Tangaré
Cedrela sp.	Cedar
Chorophora sp.	Mulberry
Cordia alliodora	Laurel
Dialyanthera sp.	Cuangaré
Hyeronima chocoensis	Mascarey
Mora oleifera	Nato
Myrosidum balsamum	Balsam
Platyniscium pinnatum	Mahogany
Pouroma chocoensis	Grape
Simphonia glosulifera	Machare
Tabebuia sp.	Guayacán
Wirola sp.	Chalviande

This vast forest patrimony, together with the great possibilities of wood production in the Ecuadorian Amazon Region and the prospect of profiting from these resources, constitute a potential ecological threat. Various projects are already being developed or drawn up to exploit this woodland complex. Several years ago a feasibility study was made of the Northeastern zone on wood/livestock exploitation by the COFANES Forestal y Ganadera S/A, 1977. Fortunately, the project was not carried out, thus preserving 86,000 hectares in the Aguarico River basin.

Other projects for the development of livestock-breeding may also represent a risk to the ecology of the region, such as the one put forward by the "Bureau Central d'Etudes pour les Equipements", and by the "Bureau pour le Développement de la Production Agricole", as well as other projects that have already been carried out.

In the Amazon Region, the degradation of grazing land has led to totally unproductive savannas. Moreover, many gramineae are very blight-prone, as for example to the disease caused by the Homoptera (Cercopidae family), generally called "salivazo" (Aneolomia sp.). There is also a very aggressive weed, the graminea known as "espadúa" (Paspalum sp.).

C.2 Fauna

The animals of the Ecuadorian Amazon Region have not been fully inventoried as yet; many of the existing species are unknown. The forest animals, fish and arthropoda in general are of great importance, especially in view of their use as food for settlers and natives, the problems of agriculture, and their importance to public health.

There are not so much data available for animals as for plant life. It is therefore difficult to quantify exactly the possible impact of widespread use of native faunistic resources.

In general, indigenous hunting is carried out on a small scale. The native villages do not export food, since the focus of their production is always to meet their own needs. Sad to say, throughout history and owing to the contact of certain ethnic natives with settlers, the natives began to change their ways, becoming more commercial. In some cases, they took a conservationist position, and in others initiated trading practices that had even more predatory effects.

Thus, as in the case of the flora, the fauna of the Ecuadorian Amazon Region is not free from the ecological problems affecting all of the Amazon basin.

For this reason, in addition to developmental studies, basic studies should be made as well as serious investigation of the possibilities of the ecological impacts caused, inter alia, through settlement, reconversion of forest land into pastures for monocrop production (as the African palm), timber-cutting and petroleum extraction, etc.

The fauna, it must be noted, is distributed diversely, according to the area being considered. Different habitats and biotopes may be distinguished, depending on vegetation, soil, climatic conditions, etc.

That is why, from the ecological viewpoint, the study of the fauna must be grounded in the knowledge of existing environmental conditions and in the study of the interdependence of the species, while seeking to analyze the homeostatic capacity of the system in general.

A study by R. Barriga (Diagnóstico de la Provincia de Napo[5]) has shown that of 1,000 mammal specimens gathered in the field, there were 95 species, 58 genera and 28 families. 462 species of fish have been identified in the northeast region, a sign of reasonable diversity and a complex trophic system.

It must be pointed out that, in view of the impossibility of having more conclusive faunistic data, bibliographic data were checked, interviews were held with the inhabitants, and even a short inventory was drawn up, a copy of which is at UNIDO headquarters in Vienna.

It should be noted that the purpose of this brief catalogue, beyond the shadow of a doubt, is to bring out that there still exists a wide diversity of animal life from the ecological, energy and health viewpoints already mentioned; but it must be borne in mind that the pressure being exerted on the environment could mean its total or partial destruction, causing autecological and synecological imbalance.

Through changes in eating habits, socio-cultural aspects have also been affected by environmental changes and the consequent destruction of different levels of the trophic systems.

D. Environmental aspects of public health and workers' health

D.1 Environmental effects of the oil industry

It is necessary to consider the effects on the environment of the oil industry in the region because of the great potential for inducing environmental changes which stem directly from this activity.

It would go beyond the purpose of this work to present a description of the direct impact caused by prospecting, boring and transportation of oil, and of the effects of environmental pollution caused by this product. This aspect is well covered in the specialized bibliography.

At the same time, owing to the importance of this industry to Ecuador from the energy, economic and strategic viewpoints, a growth in this activity can be expected in the Amazon region of the country.

Environmental problems may be expected to increase; these have been identified quantitatively in "Diagnóstico de la Provincia de Napo"[5], 1988.

The siting of wells for prospection and boring, and the tracing of pipelines, based on thorough technological and economic studies, generally include the environmental variable as an element that can influence the direct costs of the project.

According to the diagnosis, the opening of service roads and the sinking of new wells have served to attract local people to settle in this region.

Although this use of the land does have a positive side from the strategic point of view, a disorganized implementation may lead to serious environmental problems and precarious conditions in the quality of life in the new settlements, a fact that has already been noted.

To this picture can be added the surge in conflicts due to the establishment of this activity and to cultural clashes with existing communities or others drawn to the area of influence of the project.

The implementation of the study on environmental impact and health prior to the new oil projects will reveal what has to be done to carry out the plans and complementary projects in a fitting and orderly manner. Moreover, it will ease decision-making concerning technological and spatial alternatives of lesser impact.

One other aspect resulting from environmental impact studies is the drawing up of contingency plans for emergencies, such as breaks in the pipeline, fires and accidents. Such occurrences generally have major negative impacts, which can be lessened by the adoption of previously thought-out measures.

D.2 Workers' health in the palm-oil agro-industry

An evaluation of occupational health problems in the palm-oil agro-industry covers the growing and processing stages, because of their interdependence.

In the growing stage, risks to workers' health occur initially in the extraction operation of the plant due to unintentional contact with dangerous wild animals. Snake bites are the most frequent risk in new plantations. The most frequent accidents incurred by workers in this stage are due to falling trees, cuts from tools, injuries caused by falls into ravines or holes, skin damage caused by sharp branches, thorns and insect bites. Farm machinery can also cause accidents, mainly when carrying workers in tractors or trucks.

Poisoning from weed killers, insecticides and fungicides is rare, but the danger should not be minimized.

Planning of accident prevention measures should include control and supervision of clearing operations.

The use of personnel protection equipment, such as gloves, arm protectors, and the use of special tools, reduce skin injuries during picking. Mechanization in cleaning, preparing and cultivating the soil provide conditions for reducing accidents caused by falls in ravines or holes to a minimum. It is essential to maintain agricultural machinery properly, and to use safe equipment.

Lastly, the need for health training and education of rural workers is extremely important, as is the need to provide decent housing, sanitation and support services — decisive factors in safe working conditions.

Introducing these latter measures is a challenge, since in general the work force that is used has no permanent work relationship with the employing industry: these workers are either under a temporary contract or taken on through labour contractors. This situation lessens the motivation of the industry to institute the above-mentioned measures, and renders difficult any control over working conditions and responsibility in case of accident. Social measures depend in general on broader government plans, which very often are not in tune with the needs of the communities located in the area of project's area of influence.

The chief risks of accidents in the palm-oil extraction industry are the result of the following conditions:

(a) Fire in the plant or where products are stored; the burning of vegetable oils can emit highly irritating fumes;

(b) Electrical installations are a major risk in damp areas or in the presence of water vapour. In these conditions all equipment and conducting material must be adequately protected. Special attention must be paid to manual and lighting equipment;

(c) Machines are dangerous because of their moving parts, which must be perfectly maintained and efficiently protected. These measures, taken regularly, are advised in particular for steam-generating machinery, in order to avoid risks of explosion and casualties;

(d) Handling of materials can cause accidents and injuries, mainly to the hands and feet of operators. Training in correct methods of transportation and handling, use of material to protect hands and feet, checking of cutting edges in tanks and recipients reduce the risk of accidents. Storage in piled-up drums is dangerous because of the risk of falling, which can cause serious accidents. A correct method of storing, training and supervision of this activity is needed in order to reduce this type of problem;

(e) Workers are subject to falls in slippery areas or on stairs. These accidents can be prevented by proper maintenance in such places, or by the installation of anti-slipping surfaces, regular cleaning of the facilities, placing of gripping devices on stairs and other dangerous areas, proper warnings, and the use of suitable footwear;

(f) Burns may be caused by contact with equipment operating at high temperatures, or by the spattering of hot oil. The use of appropriate individual equipment, including face protectors, reduces sharply the possibility of this kind of accident;

(g) Exposure to uncomfortable heat conditions, noises and poor ventilation may occur during various stages in production, causing cramps, physical tiredness and headaches. This situation leads to a drop in production and to conditions conducive to accidents. Heat reduction by insulating hot tanks and steam pipes, together with efficient general ventilation (spot ventilation where steam is released) will minimize these problems. Use of individual protective equipment abates the effects of industrial noises;

(h) Skin diseases, such as dermatitis, may occur due to contact with oils, fibres and other products, mainly to sensitive individuals. To mitigate this problem it is necessary to install and use toilet and washing facilities, use individual protective equipment, and have regular medical check-ups -- together with training, choice and supervision of workers exposed to these working conditions.

D.3 Environmental ramifications of the palm-oil agro-industry

The evaluation of the environmental ramifications of a project must identify the alterations that this project produces in selected parameters, within its area of influence, taking into account its setting-up, operational and deactivation phases.

In the case of the palm agro-industry, alterations are initially brought about in the setting up of the agriculture sub-project. (See general considerations on the palm-oil agro-industry, Annex I).

The clearing of plant life for the subsequent preparation of the soil and cultivation gives rise to physical, chemical and biological imbalances. The elimination of the biomass over extensive areas provokes alterations in the micro-climate, causing a localized increase in temperature and a drop in air-moisture levels The modification in the total rainfall balance, and the amount of rain reaching the soil and evapotranspiration lead to an increase in surface runoff water. This increase causes more soil leaching, cuts down on fertility, and can start erosive processes, leading to greater removal of solids, organic material and nutrients to bodies of water. Accordingly, the following processes may take place:

(1) Blockage of bodies of water in localized points, altering the water pattern, thereby making possible the appearance of new flood areas and erosive processes in the river beds and banks.

(2) Increase in turbidity of the water, interfering with the passage of light and affecting the photosynthesis of the primary products.

(3) Alteration in the quality of the water through the increase in suspended and dissolved solids, which can affect the equilibrium of aquatic life.

(4) Reduction in the level of dissolved oxygen in the water through an increase in the process of biodegradation, due to its introduction of more organic matter in the system.

(5) Modification in the equilibrium of aquatic organisms due to the greater availability of certain nutrients, thereby abetting the proliferation of some species (eutrophication), which can affect the quality of the water (for example changes in the colour and penetration capability of sunlight).

All these changes in water quality can adversely affect the use of surface water resources in the public supply system, requiring more treatment and increasing costs for water supplied to the community.

Some measures may be taken to minimize the effect and occurrence of these processes:

(a) The flora-clearing plan must take into strict consideration the amount of surface land to be cleared. It is also necessary to install an efficient surface-water drainage system, equipped with hydraulic energy dissipators, when necessary;

(b) Maintenance of a fringe of vegetation along the rivers; trees in rows;

(c) Monitoring the changes brought about, evaluating the effectiveness of the measures taken, and directing the implementation of new steps, when necessary.

Fertilizers and agrotoxicants are used in oil palms in the growing and maintenance stages. A wrong application can cause these components to reach the bodies of water. The resulting problems are an increase in the nutrients in the water and its contamination with toxic substances, which may enter the food chain or wipe out important species.

Moreover, the replacement of tropical plant life by a monoculture leads to radical ecological changes through the disappearance of niches and a reduction in specific diversity.

The introduction of factories generally implies some moving of earth, which provokes to a greater or lesser degree the transport of solid matter to the bodies of water, due to the heavy rainfall in the region.

At the same time, temporary urban settlements (outside labour) can introduce contagious diseases through direct contact or through carriers in individual natives when the conditions for assistance and basic sanitation are lacking.

In the starting-up phase as well as in the operational, the traffic of vehicles on unpaved roads raises large amounts of dust, despite the existence of an efficient method of natural control: the frequent rains in the region.

Other potential sources of atmospheric pollution in the operation of the factory may be:

(i) Emission of odours at various points in the process, mainly in operations at high temperatures;

(ii) Emission of solid matter (particles) from the treatment of bunches and separation of the fibres;

(iii) Emission of products of combustion from burning fibres and shells in boilers to generate steam. These emissions are made up chiefly of particles, CO and CO_2. In general, extraction of palm oil is not a great potential source of atmospheric pollution, thanks to the localization of the project within the planting area.

Sources of noise are not major environmental problems as they are limited to the workplace.

Therefore the principal problem of environmental pollution from the palm-oil extraction industry is that of sources of water pollution.

Data given in the preliminary study on effluent control at the Huashito palm-oil extracting plant[17], with a 20/30 ton/h capacity at the beginning of 1988, show the following distribution of effluents (approximate data):

- Clarification - 0.5 m^3/ton of treated bunches, (half is plant water from the fruits; the other half, dilution water from the presses).

- Sterilization: 0.2 m^3/ton of treated bunches (50% plant water, and 50% condensed vapour. Uncondensed vapour is released into the atmosphere.

- Others: 0.1 m^3/ton of treated bunches (coming from washing of fruit, tanks, hydrocyclones, condensates, overflows, leaks, etc.).

These wastes constitute the gross effluent, which in measurements made at Huashito, show the following characteristics:

B.O.D. (biological oxygen demand)	37,000 mg/1
Total solids	20,000 mg/1
Fats and oils	4,000 mg/1
Temperature	75-80°C

According to Olie and Teng[15] (1972), an effluent characteristic of this type of industry yields the following:

B.O.D.	20,000 mg/1
p^H	4.5 to 5.0
Oil	5,500 ppm
Total solids	45,000 ppm
Ammoniacal nitrogen	25 ppm

Taking a production of 30 ton/h of pressed bunches, and an average production of 5 h/day, the yield of the daily organic load of liquid effluents amounts to 4,440 kg. B.O.D. (Huashito figures), and 2,400 kg. B.O.D. kg. (figures given in the bibliography). These estimated loads correspond to the waste material of a town with 82,000 inhabitants in the first case, and 44,000 in the latter.

Techniques now available for the treatment of the kinds of effluents described above are very effective in removing pollutants.

There is a great need to establish on a region-wide basis emission levels, and criteria for the drawing-up of projects and environmental quality, so as to ensure agro-industrial growth without endangering the environment.

D.4 Plant disease control

All natural biological systems (ecosystems) have a harmonious flow of matter and energy, the product of inter- and intra-specific relationships of living beings (biocenosis), and of these beings with their physical surroundings (biotope).

There are self-regulating mechanisms that balance this flow in such a way that, despite the internal heterogeneity within the ecosystems, the relations and interchanges are homogeneous.

Through "Biological clocks", or homestasis, suitable speeds, amounts and rates are maintained in the nutrient and energy cycles of each link in the food chain.

In this way, diverse populations of animals and plants, naturally dispersed in the environment, forming communities (as for example the Amazon bioma), have an ensemble of homeostatic mechanisms which enable them to maintain the balance, despite the influence of diverse factors (biotic and abiotic).

When the forest is devastated, or when a certain species is removed from its habitat or natural niche (for example, plants used in agriculture or industry), the stabilizing mechanisms are destroyed, altering the biological relationships (parasitism, symbiosis, commensalism, predacity, etc.) and influencing the energy flow; the introduction of plants and other species makes them more vulnerable to attacks and increases the risks of plant diseases.

That is why it is important for some types of crops to be spaced at certain distances to avoid the devastating actions of pests.

Many industrial ventures, as for example, those involving the rubber tree (Hevea sp.) in Brazil, failed because of the appearance of pests and weeds.

In his quest to lessen these problems, man incorporated the use of synthetic chemical products, pesticides, which if not used wisely cause endless environmental and health problems.

Appropriate basic research must be carried out to pave the way for applied research later on, research that is needed for a full knowledge of the ecosystem, before any enterprise is undertaken. There is a need for an institution that can organize the intelligent use of the land and conduct research on factors which act on the environment. Plant-disease factors are of vital importance.

II. PROPOSED ENVIRONMENT MANAGEMENT SYSTEM

A. Diagnosis

The following diagnosis may be made on the basis of information presented in the preceding chapters:

The Napo region has been the subject of many studies in various fields of knowledge.

These studies are sectoral and compartmentalized.

Data on environmental and socio-economic alterations afflicting the region are insufficient for a critical evaluation of the development model that has been adopted.

Data on environmental impact, and especially the socio-economic and cultural impact of the activities carried out in the region, are virtually non-existent.

There is a need for centralized co-ordination, which at present does not exist, of the data available on the region, to guide the institution of new studies and set standards for action.

The economic activities in the zone, and in the settlements, take place without an integrated and regulated plan for human action in relation to the environmental possibilities and weaknesses.

The extent of the consequences of ecological imbalance is unknown, although some tangible effects have been identified, such as problems of plant disease.

There is a significant body of proposals and projects of great importance to be found in the previously mentioned "Diagnóstico de la Provincia de Napo"[5] and in the "Programa de Manejo Ambiental para el Desarrollo Integrado de la Región Amazónica Ecuatoriano - Informe Final"[21] which do not have adequate institutional and financial support for their implementation.

It is therefore necessary to co-ordinate existing activities and information, as well as to obtain new data in specific areas (natural resources, for example) in order to have an integrated understanding of the region from the environmental viewpoint, and of its development process.

These measures will make it possible to judge the degrees of environmental fragility, acceptable disturbance, and potentialities of the region, which would lay the groundwork for environmental zoning, and promote studies on environmental impact and health.

It is still necessary to develop and introduce conservationist concepts, techniques and practices into the various levels of economic, social and cultural activity that would ensure self-sufficient growth in the region.

B. Proposal

B.1 Conceptual aspects

All these actions required for previously mentioned needs point to the establishment of a structured system at an institutional level whose basic goal would be the management of the environment of the Napo region. Moreover, it would act as a catalyst on environmental actions at state and private levels, as well as on all of society.

The aim of this system is the formulation of environmental policies (regional and national), and a proposal for specific environmental subsidies for a policy and planning of economic and social development.

For its satisfactory operation, the system should:

(a) be efficient so as to give quick replies to requests, including the gathering of budgetary and extra-budgetary resources;

(b) be flexible in adapting its technical and administrative operations to different situations, and to be able to incorporate structural innovations in the light of concrete experience;

(c) be simple by being able to operate at different levels with a minimum of resources (human, material and financial). For example, by a narrower field of direct action, by delegating responsibilities (decentralization), and executive deconcentration (agreements, consortia);

(d) maximize human, material and financial resources already involved in activities now carried out by central, provincial and municipal governments, and their co-ordination with the private sector;

(e) have authority within the provinces and vis-à-vis society; this will depend upon its ability to influence and provide suitable responses;

(f) have sufficient weight to ensure obtaining expected results from governmental action and meet the expectations of society concerning the protection, conservation and rehabilitation of the environment;

(g) be implemented gradually in such a way as to overcome limitations in human and financial resources in order to organize and activate a complete system.

The functioning of the system should be backed up by the operations of a centre, which could be called Environment Management Centre.

The Environment Management Centre should be structured so as to cover directly or indirectly the fields of action necessary for the system to function, which are:

1. Environmental control
2. Protection of natural resources
3. Environmental evaluation (Laboratories)
4. Environmental information and documentation

5. Environmental assistance and education
6. Environmental planning and legal regime
7. Research in and development of farming, livestock and extractive activities
8. Research in and development of industrial activities
9. Socio-economic studies and research
10. Environmental research

There now follow the outlines of these fields of action, including the content, activities and basic needs of each.

1. <u>Environmental control</u>

1.1 <u>Content</u>
- water resources
- atmospheric resources
- soil
- polluting activities
- agrotoxicants
- basic sanitation

1.2 <u>Activities</u>
- monitoring
- licencing
- supervision

1.3 <u>Basic needs</u>
- specific material resources
- inventory of sources of pollution
- procedure (sampling, collection of information, licencing, inspection)
- emission standards
- project preparation standards
- environmental quality standards

2. <u>Protection of natural resources</u>

2.1 <u>Content</u>
- strengthening of existing conservation units
- strengthening of new conservation units
- protection of the fauna
- protection of the flora
- ecological reserves
- mineral resources
- forest resources

2.2 <u>Activities</u>
- protection
- conservation
- reclamation

2.3 <u>Basic needs</u>
- inventory of natural resources

- rules for the protection and exploitation of natural resources
- integration with entities acting in the field of natural resources

3. Environmental evaluation (laboratory)

3.1 Content
- analytic laboratory support
- analytic field support

3.2 Activities
- climatic measurements
- physico-chemical and biological analyses (microbiological, hydrobiological and entomological)

3.3 Basic needs
- specific material resources
- analytical methodologies

4. Environmental information and documentation

4.1 Content
- data bank
- library

4.2 Activities
- inventories
- document research

4.3 Basic needs
- integration with existing information systems

5. Environmental assistance and education

5.1 Content
- techniques of environmental management
- environmental concepts and practices

5.2 Activities
- technical training
- education
- counselling
- assistance
- extension and popularization

5.3 Basic needs
- regionally-adapted environmental management techniques
- knowledge of the socio-economic-cultural profile of the population
- integration with formal and non-formal existing systems of education

6. Environmental planning and legal regime

6.1 Content
- natural resources
- corpus of legal instruments
- regional development plans

6.2 Activities
- harmonization of sectoral plans
- environmental zoning
- planning of environment protection areas
- proposal of environmental norms concerning actions of public and private sectors
- proposal for the establishment of environmental quality patterns and emission patterns
- co-ordination of the evaluation of environmental impact studies

6.3 Basic needs
- diagnoses
- information on the physical, biological and socio-economic-cultural environment
- integration with institutes, universities and bodies working in the field of environment

7. Research in and development of farming, livestock and extractive activities

7.1 Content
- natural resources
- production techniques
- requirements for siting these activities
- plant-disease control
- workers' health

7.2 Activities
- promotion
- co-ordination

7.3 Basic needs
- integration with centres for research and technological development
- knowledge of the characteristics of the physical, biological and socio-economic-cultural environment of the region

8. Research in and development of industrial activities

8.1 Content
- production techniques and processes
- requirements for siting these activities
- standards for the preparation of projects
- emission and environmental quality patterns
- workers' health

8.2 Activities
- promotion
- co-ordination

8.3 Basic needs
- integration with centres for research and technological development
- knowledge of the physical, biological and socio-economic-cultural characteristics of the region

9. Socio-economic studies and research

9.1 Content
- socio-economic indicators
- socio-economic impacts of development projects

9.2 Activities
- promotion
- co-ordination

9.3 Basic needs
- integration with study and research centres
- knowledge of the socio-economic-cultural characteristics
- knowledge of the environmental characteristics of the region

10. Environmental research

10.1 Content
- indicators and patterns of environmental quality
- workers' health

10.2 Activities
- promotion
- co-ordination

10.3 Basic needs
- integration with centres for research and technological and scientific development
- knowledge of the physical, biological and socio-economic-cultural characteristics of the region.

In the Environment Management Centre, the base for the starting-up of the environment management system, the fields of action mentioned could be reflected administratively in divisions or departments of the Centre, which in an early stage could be:

(1) field operations;
(2) laboratories (analyses of water, soil and air);
(3) studies on farming, livestock and extractive activities (environmental aspects);
(4) studies on industrial activities (environmental aspects);
(5) socio-economic studies;

(6) information and documentation;
(7) environmental research; and,
(8) administration

The facilities to be set up in the eastern region of the country (the focus of this study) would be used only as a unit for the collection of samples, and would be operating with the Field Operations Division.

It is further recommended that the Centre co-ordinate these fields of action, as a number of the activities in the various fields are already being performed in one way or another by the most diverse institutions in the country as a whole.

In this way the best possible use would be made of human, material and financial resources already available in Ecuador at the public and private levels.

It also appears to be essential to implement the system gradually, and therefore the Centre as well, as they were conceived globally.

The above implies the establishing of priorities, with emphasis on environmental evaluation (by monitoring its quality and knowledge of the socio-economic-cultural impacts on the region), and the problems of plant-disease control which affect agro-industrial activity.

Accordingly, a grouping could be made of these areas of action in terms of similarity or of greater interdependence, made up of the following groups:

1. CONTROL, PROTECTION AND EVALUATION

2. INFORMATION AND DOCUMENTATION; ASSISTANCE AND EDUCATION; PLANNING AND THE LEGAL REGIME

3. RESEARCH AND STUDIES

Operationally as well the Centre (and its divisions and departments) would be adapted in keeping with these groupings.

With respect to the material resources required for starting up the first stage of the Centre (and so the system, environmental control and analysis actions would account for virtually all these resources.

Research and study actions which, as has already been noted, call for an expensive structure, must actually be centred in the infrastructure already existing in the country, thus underlining the simplicity of the system and the need to make optimal use of the resources (human, material and financial).

Moreover, the fact that the system is based on already functioning structures is a first step in giving legitimacy to the system, enabling it to have an impact in its operation.

B.2 Investments

An estimate has been made of funds needed for setting up a centralized structure of laboratories, with a field installation (eastern region of the country) for meteorological observations and laboratory and field analyses. An investment of approximately US $1,500,000 would be needed to cover these activities.

This structure includes the following installations and equipment:

1. CAMP UNIT (EASTERN REGION OF THE COUNTRY)

1.1 EQUIPMENT:

The station should be located in a place typifying the climatic/meteorological conditions of the region under study.

The parameters to be measured:

- Atmospheric pressure
- Temperature
- Humidity
- Rainfall
- Wind direction and velocity
- Insolation

This unit should have a data processor with input into a micro-computer, and with an Epron cartridge.

It is estimated that the cost of the equipment needed would be about: US $70,000

1.2 BUILDINGS

Construction of the facilities needed to house the equipment is estimated at: US $5,000

2. ANALYTICAL LABORATORY

Purpose: to analyze industrial waste, used waters, natural waters, soils and air quality.

EQUIPMENT:

The laboratory should be equipped to determine the following parameters:

(a) Physical
- odour
- p^H
- water temperature
- air temperature
- colour

- turbidity
- conductivity
- transparency
- soil permeability
- soil granulometry
- other soil-related parameters

(b) Chemical:

- fats and oils
- BOD
- COD
- DO
- TOC
- nitrogen series
- phosphorus series
- sulphates
- metals
- heavy metals
- alkalinity
- hardness
- residual series
- organochlorated pesticides
- organophosphorated pesticides
- phenols
- cyanide
- chlorides
- sulphide

(c) Biological:

- phytoplankton
- zooplankton
- benton
- total coliforms
- faecal coliforms
- ichthyofauna

(d) Biotests on fish and microcrustaceans

(e) Plant-disease parameters

It is estimated that the cost of a laboratory to handle this condensed range of parameters would be: US $600,000, broken down as follows:

Vitreous and reagent material	US $ 40,000
Spectrophotometer for colorimetric analysis	US $ 25,000
Atomic absorption spectrophotometer	US $ 80,000
Element analyzer CHN	US $ 75,000
Liquid chromatograph HPCL	US $ 55,000
Gas chromatograph	US $ 30,000
Auxiliary equipment (scales, microscopes, etc.)	US $ 60,000
Parts	US $ 90,000
Micro-computer	US $ 30,000
Air-pollution measuring equipment (impactors, sounds, sampler)	US $150,000

2.2 BUILDINGS:

The cost of facilities needed to house a laboratory having the above functions is estimated at: US $300,000

3.	MOBILE LABORATORY (water, air, soil):	US $150,000
4.	OFFICES:	US $100,000
5.	VEHICLES:	US $ 40,000
6.	CONTINGENCY COSTS	US $200,000
	TOTAL	US $1,500,000

B.3 Organization

To handle this broad programme a well-qualified staff will be needed to deal with environmental-management back-up activities and provide adequate administrative support.

The team of professionals must be multidisciplinary; its range will depend upon the implementation strategy of the System.

As has already been mentioned, gradual implementation should at first concentrate on a few objectives (the most significant ones from the strategic viewpoint) which, if carried out rationally will reinforce the legitimacy of the System vis-à-vis the Government, and above all Society. This will be translated into greater political support and access to resources, since useful results are being produced.

To build an efficient and flexible System, it is suggested that the Centre (the base of operation of the System) be constituted administratively as an independent institution, headed at its strategic level by a multidisciplinary body of administrators, consisting of representatives of the different Ministries involved, the private sector, and other institutions engaged in the country's environmental matters.

As has already been recommended, the Centre should act as a co-ordinator in its various fields of action, making full use of the infrastructure existing in the country, and carrying out essentially the new activities to be created with the System, mainly systematic actions of environment control and analysis.

III. CONCLUSIONS

(a) The Province of Napo, which accounts for almost 20 per cent of the surface of Ecuador, is a region with great potential for the economic development of the country;

(b) This region has been the subject of various studies in different branches of knowledge, but as these are sectoral and compartmentalized studies, and as this is a region with unique rain, soil and biotope features, its appropriate use and evolution in relation to the processes of land use now going on cannot be predicted with certainty;

(c) Economic activities in the zone as well as in the human settlements are evolving without an overall standard-setting plan of human action in relation to the environmental potentialities and weaknesses;

(d) Available data on the environmental impact, and especially the socio-economic and cultural impact of the activities carried on in the region, are extremely limited. Therefore, apart from some tangible effects, such as plant disease problems in crops, the extent of the consequences due to the ecological imbalance in the Amazon region is unknown;

(e) There does exist a substantial body of proposals and projects of great importance, based on the "Diagnóstico de la Provincia de Napo" and the "Programa de Manejo Ambiental para el Desarrollo Integrado de la Región Amazónica Ecuatoriana", which lack sufficient institutional and financial support for their implementation;

(f) Centralized co-ordination of existing actions and information concerning the region is needed so that the available data and the gathering of new information in specific areas can make possible an overall understanding of the region from the environmental viewpoint, and of its development process;

(g) Overall understanding of the region will make it possible to identify the degrees of environmental fragility, acceptable disturbance and potentiality of the environment, which can lay the groundwork for drawing up an environmental zonification scheme, and may by concrete action provide the bases for a harmonious economic development of the region.

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ANNEX I

General considerations on the palm-oil agro-industry[24]

Among the oils of vegetable origin, palm oil has the greatest production potential (ha/year).

Native to West Africa, the African Palm (Elaies quineensis Jacq.) has assumed increasing economic importance in various tropical countries of Asia, Africa, Oceania, and Central and South America. This importance is due to population growth and the consequent rise in consumption of edible oils.

Under ideal weather and soil conditions, as in various regions of eastern Malaysia and Sumatra, production figures of 6 tons of oil and 1,200 kgs. of palmiste per hectare per year are reached, amounts 7 to 10 times greater than the production of other known species (groundnuts, coconut, sunflower and Brassica campestris oleifera).

In the Americas, owing to less favourable environmental conditions, up to 4 tons of oil (ha/year) may be produced.

In Central America, more specifically on the Atlantic coast of Panama and Costa Rica, a hybrid palm was planted over large areas from 1976. This hybrid, made up of Elaeis quineensis and Elaeis oleifera is called Palma Oleífera Americana (Elaeis melanococca).

The main reason for growing this hybrid is its resistance to a disease that is common in the African Palm, lethal bud rot.

Expected output from the African Palm varies between 3 to 4 tons of oil (ha/year).

Characteristics determining the production capacity of an industrial unit for the extraction of palm oil depend upon a number of factors, such as:

(a) Expected annual weight of fresh fruits in bunches to be processed, and expected production of palm oil and palmiste;

(b) Percentage of yearly agricultural production to be processed in the peak crop month;

(c) Number of hours of production in the peak periods.

The first factor refers to agricultural production and is closely linked to certain environmental characteristics. Climate is a key factor in the growth and productivity of the palm; yearly rainfalls of 2,000 mm or more are needed, with a minimum of 1,600 mm per year.

Together with the yearly amounts, an adequate distribution of rain throughout the entire year is needed. A long dry season is extremely harmful to agricultural production. The amount of sunshine is also an important factor. Five hours of actual sunshine per day as a minimum are necessary throughout the entire year. Temperatures must be about 26°C to 27°C (yearly average), average highs around 29°C to 32°C, and average lows from 22° to 24°C.

For the growing of the oil palm it is important for the soil to have a good structure, composition and fertility.

The use of soil and plant conservation practices is essential to obtain a good crop. Also worthy of mention in this respect are regular cleaning, correct drainage, targeted fertilizing and appropriate crops.

The principle local conditions required for setting up industrial installations to extract palm oil are:

(a) The processing plant must be built on solid ground, with a good load support capacity (minimum: 1 kg/cm^2);

(b) Planting must be done in places above the flood levels, with good drainage. The ground-water level must have a depth that does not affect the laying of the foundations;

(c) The processing plant should be centrally located, with respect to the overall area, so as to cut down on transportation costs of bunches of fresh fruits, or the final processed products;

(d) Water supply is an essential factor for this type of process. The use of water in the boiler and for sanitary and household uses reaches 1.35 to 1.50 m^3/ton of processed fruit. The features of the source to be used must be known in order to ensure a supply throughout the year, as well as its quality and seasonal variations, as early as possible, because of the amount of analyses which must be made during the year (p^H, SiO_2, hardness, amount of solids, etc.);

(e) Conditions for the discharge of waste waters must be considered, bearing in mind the quantity of effluents generated, and their ability to produce undesirable alterations in the waters;

(f) It must be stressed that this type of industrial project does not need external sources of energy, since burning indus-wastes (fibres and shells) provides all needed fuel in the form of water vapour and electricity.

Brief description of the process of extracting palm oil

The process begins with the sterilization with saturated water vapour of the fruits in bunches. This operation has two main objects:

(1) Destruction of enzymes which produce free fatty acids.

(2) The cooking of the vegetable support of the fruits to facilitate the separation of the bunches.

The next operation consists in separating fruits and bunches. Efficiency at this stage is conditioned by:

(a) Proper sterilization;
(b) Use of a well-designed fruit separator with a sufficient operating speed.

The next stage is the extraction of the oil, which includes two sub-stages: kneading and pressing. The former is done in digesters at 80-90°C in order to separate the pulp and the nuts, as well as to open the oleiferous cells. The oil is then extracted by pressing with a continuous screw-press.

The extraction unit yields two products:

(a) Liquid portion, a mixture of oil and a bit of solid matter;

(b) Solid portion, containing fibres and nuts.

The oil is separated from water and impurities by clarification. This process involves decantation and centrifugation or sieving. It is a form of vacuum-drying which yields a dry oil ready for storage to prevent acidification.

Treatment of the solid portion is effected in order to separate and grade the palmiste kernels. Fibres and nuts are separated in a cyclone separator, then polished, dried, ground and separated from the shells and the kernels (palmiste), in hydrocyclones.

The shells are used as fuel in the boiler, together with the fibres.

The kernels (palmiste) are dried to ensure proper storing conditions and their subsequent transport to the palmiste oil-extraction unit, or for sale and processing by third parties.

ANNEX II

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