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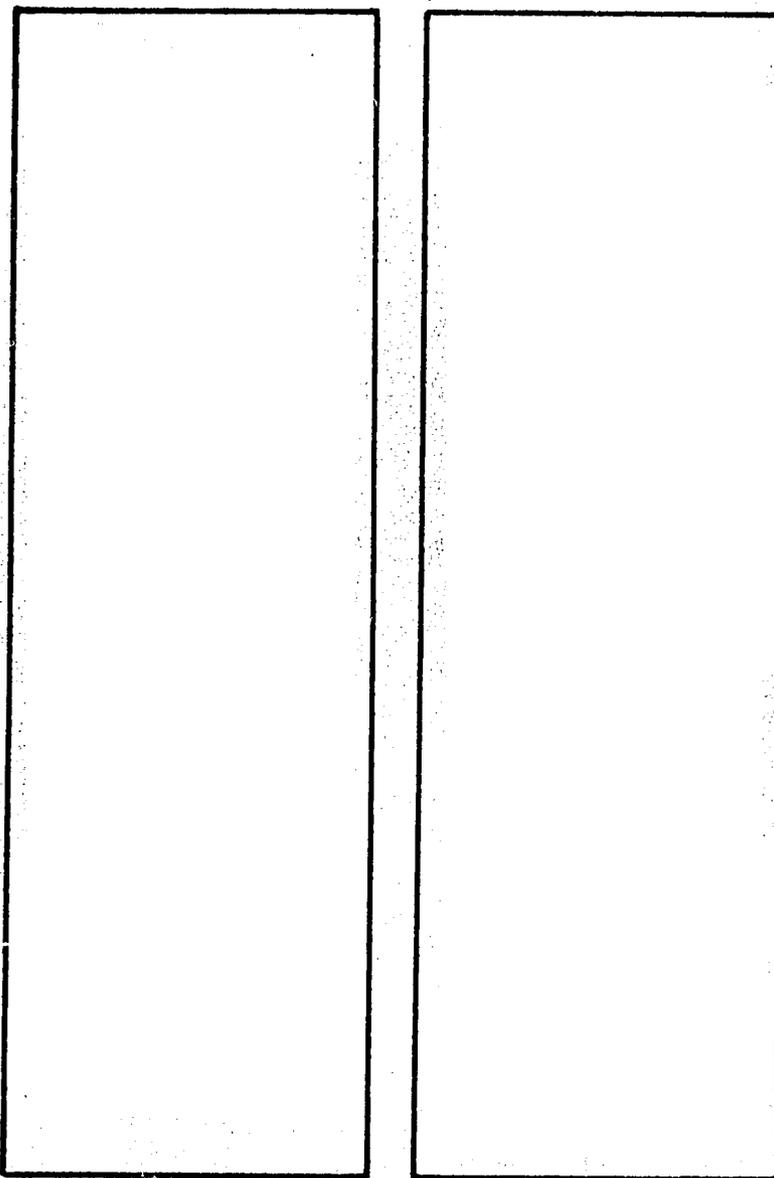
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**The Role of the  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
IN THE FIELD OF  
NATURAL RESOURCES PLANNING AND MANAGEMENT**

**Office of Science and Technology  
Agency for International Development  
Washington, D. C.**

**April 1972**



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THE ROLE OF THE AGENCY FOR INTERNATIONAL DEVELOPMENT  
IN THE FIELD OF NATURAL  
RESOURCES PLANNING AND MANAGEMENT

Summary Report on Workshop Held  
in Washington, D. C., January 21, 1972

Office of Science and Technology  
of the  
Agency for International Development

April 1972

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## I. INTRODUCTION

The Workshop on Natural Resource Planning and Management was one of a series of meetings and consultations held during the past year to examine the present and potential role of science and technology within the total framework of the development assistance program carried out by the Agency for International Development. The objective has been to progressively define and refine a program strategy and focus in the science and technology area in order to provide a basis for developing program options and priorities in the period FY 73-77.

This systematic examination of the application of U.S. science and technology to international development began last April with a workshop held at Columbia, Maryland, and was followed by consultations with developing country specialists from industry, academia, international organizations, and other donors. Later, a summer study, organized by the National Academy of Sciences, brought together eminent scientists and planners from the U.S. and a number of developing nations. In December, a second major workshop was convened at Airlie House to identify with more precision appropriate sectors within which AID's science and technology activities should be concentrated, and, beyond that, the specific subsectors which could serve as focal points for these activities. The analysis also benefited from the intensive period of project experimentation carried out by AID in this area over the past two years in more than twenty developing countries, as well as consultations with governmental officials and technical colleagues in twenty-five developing countries, and with officials of eighteen international agencies and eight other donor countries.

Based largely on the initial workshop at Columbia, natural resources planning and management was tentatively selected as one of three major sectors of science and technology deserving high priority in AID programming. The natural resources sector was singled out for attention since it appears to be relatively underdeveloped in the Agency's current program of work in relation to the breadth and high quality of U.S. capabilities in this area; and also to the potential of natural resource development for stimulating and supporting rapid national economic growth, particularly in the poorer countries of the world. Subsectors within this broad area were also defined and subsequently analyzed at the December 17-19 Airlie House Workshop which addressed the following task:

- (1) review the choice of subsectors within the three science and technology areas (i.e., natural resources, industrial technology, and science infrastructure);
- (2) develop criteria for project selection; and
- (3) identify some of the most promising types of project approaches.

The specific recommendations of the December Workshop in the natural resources area are set forth in Appendix C. One of these was a proposal that additional consideration be given to the natural resources sector to clarify, inter alia, the importance of natural resources to country development; special bilateral contributions the United States can make in this area; and the present level of emphasis that should be accorded natural resources by AID.

As a result, a workshop on Natural Resources Planning and Management was held in Washington on January 21. This report describes the key issues, significant observations, and major findings and conclusions which emerged from that session, as well as from documentation presented by U.S. technical agencies and multilateral institutions both in advance of, and subsequent to, the Workshop.<sup>1/</sup>

The term "natural resources" had been broadly defined for earlier meetings to include natural products (e.g., mineral, forests, fish, water) and amenities or situations (e.g., waterfalls, waterways, fertile soils, mountains) which are assigned value by man as the result of their potential economic or social benefits. The principal criterion is their potential usability.<sup>2/</sup> For purposes of the Workshop, as well as for subsequent consideration of the sector within the context of "science and technology," the focus was restricted to include only those aspects of agriculture, conventional electric power generation and capital project development (e.g., waterways engineering) which

<sup>1/</sup> Technical inputs for the Workshop are included as Appendix D.

<sup>2/</sup> Adapted from UN definition used in Natural Resources of Developing Countries: Investigation, Development and Rational Utilization, UN Department of Economic and Social Affairs, E/4608/Rev. 1-ST/ECA/122. pp. 3-9, 1970)

involve the effects and impacts of such activities on the character, use, and management of adjacent lands or other resources. Thus, a number of areas in which AID has historically been quite active -- and which are natural resources-oriented -- were excluded (e.g., irrigated agriculture). In addition, time limitations restricted the Workshop agenda (Appendix A) to minerals, energy, surface water, groundwater, forestry, land management, and surveying and mapping. Recreation and wildlife management, both components of the total sector, were not included on the agenda since they were judged to be of lower priority for AID programming purposes in the near term.

The title of the sector, "Natural Resources Planning and Management," emerged from lengthy discussions at the December Airlie House Workshop. "Planning and Management" is interpreted to include a spectrum of activities from surveying, mapping, resource appraisal, and establishing concession policies, to processing and marketing, conservation, environmental protection, and land use planning. The scope of this sector also includes resource "development" or "exploitation" in the usual sense which involves, among others, mining, harnessing of energy, and lumbering operations.

Limitations on time also prevented the Workshop from attempting to reach complete agreement on the many issues and suggestions that emerged during the discussions. However, it is believed that the body of the report accurately reflects the principal concerns and observations presented by the participants, as well as represents a general consensus with respect to present constraints on resource development in developing countries, several major impediments to a greater U.S. role, and areas in which the U.S. can make special contributions.

The results of this specialized natural resources workshop -- as well as the discussions of the natural resources sector during the Airlie House Workshop on Science and Technology last December -- are contributing to a further stream of work, including visits to the field. The intent is to produce by May an overall evaluation of the most promising areas for the application of U.S. scientific and technological skills within its bilateral development assistance program. Very shortly, an appropriate program framework for science and technology activities within the U.S. foreign assistance program during the next five years should be ready for consideration by AID management. This will provide guidance, at all levels of Agency

program and policy formulation, as to where the largest payoffs are likely to occur from matching U.S. capabilities to developing country needs. It will also support Agency efforts to mobilize the best possible U.S. capability to respond to developing country requests for assistance in a selected number of high yield activity areas.

## II. SIGNIFICANCE OF NATURAL RESOURCES TO ECONOMIC DEVELOPMENT

Natural resources constitute the principal economic asset of most of the world's developing nations. Indeed, a frequent Third World complaint is that the industrialized nations view it solely as a source for unprocessed natural resources, notably minerals, fuels, and lumber. On the other hand, some of the most significant economic breakthroughs made by developing countries over the past 50 years have been triggered by development of natural resources (e.g., oil in the Middle East, Venezuela, and Nigeria; copper in Zaire and Chile; lumber in Turkey and Malaysia; water in Pakistan and the UAR).

The identification, development, and wise utilization of land, water, forest, mineral, and energy resources is critical to sustained economic growth. They undergird industrial and agricultural development and are frequently a primary source -- if not the sole source -- of export earnings. For example, the growing Brazilian automobile industry relies almost exclusively on indigenous raw materials, particularly its vast iron ore deposits. Bolivia derives about 95 percent of its foreign exchange from the export of mineral products; Zaire, about 65 percent; Liberia about 75 percent. Impressive statistical information is available on the importance of mineral and forest products to export earnings and some of this data is presented in Appendix D. Probably of equal importance, but far more difficult to quantify, is the significance of resource development to employment opportunities, improved products for local consumption, and stimulation of rural development. The importance of water to a country's community development, agriculture, and industrial life is obvious. Similarly, without energy an economy cannot function; in most areas of the world the standard of living is closely linked to the availability of electricity and fuel.

It is also well to recognize that significant penalties are incurred by developing countries which fail to utilize indigenous raw materials. By relying on imports to fill the resource gaps, trade deficits are increased, scarce foreign exchange that could otherwise provide necessities unavailable within the country is forfeited, and opportunities to develop labor-intensive resource extraction and processing industries are foregone. Latin American countries, possessors of vast timber lands, collectively import \$407 million worth of forest products annually. Nigeria, which is heavily

forested, imports more wood and wood products than it exports. The same type of situation occurs in countries with unexplored coal, gas, and oil potential. In an attempt to reduce the loss of foreign exchange, countries poor in fossil fuels and hydro power are starting to seek new domestic alternatives to imports -- principally through development of geothermal and solar energy sources

The role of natural resources in the economies of the more industrialized countries -- though always important -- is relatively less critical, since such countries have at their disposal greater quantities of accumulated capital as well as established and innovative institutional and technological capabilities which collectively provide flexibility and resiliency in the face of changing market forces. Countries with high living standards are usually those which have been well-endowed with, or have access to, natural resources and have succeeded in putting them to good use. Beyond a certain stage, their economies become geared to providing consumer services and less so to producing natural raw materials. Where countries have achieved prosperity despite a relative paucity of natural resources, it is because they have been exceptionally successful either in combining their labor, skill, knowledge and enterprise with materials drawn, through trade, from the natural resources of other countries, or in selling specialized services to other nations.

The economic life of developing countries, on the other hand, revolves largely around the exploitation and use of their natural resources -- in agriculture, mining, industry, transport and other areas. While some countries with low living standards are held back by their poor endowment of natural resources, there are many developing countries where such low standards persist despite the existence of potentially valuable natural resources. It is therefore realistic and appropriate for wealthier nations and development institutions to seek ways of assisting poorer countries to develop their resource potential as an integral and major component of foreign assistance programs.

Several factors are now converging to stimulate an increased awareness and interest within developing countries in their indigenous natural resources. First, there is growing recognition that the development of minerals, fuels, forests, and water can bring with it major improvements in living standards. Indeed, it may be the only short-term possibility. Secondly, worldwide concern over environmental

degradation is focusing attention on the need for thorough knowledge of the resource base in order to develop it safely, and to adopt proper measures for sustaining and optimizing benefits from renewable resources. Added to this is the concern that the rapidly increasing demand for limited nonrenewable minerals will create shortages of critical raw materials within this decade. And finally, interest has been heightened by the development of new techniques and equipment for identifying resources and estimating their potential in areas which heretofore had been too difficult to explore. The application of remote sensing principles and instrumentation to resources previously hidden by perennial clouds, jungle vegetation, or rugged terrain has been the most dramatic new development.

Perceiving both new problems and opportunities, developing countries are now giving higher priority within their development strategies to the need to inventory and appraise their resource base, and to develop the infrastructure of laws, policies and institutions necessary to exercise an appropriate stewardship function. The rapidly evolving natural resources programs of the United Nations and the Organization of American States (Appendix D) are demonstrations of this fact. Even though countries have not in the past turned directly to AID in large numbers for assistance<sup>1/</sup> (undoubtedly because the Agency has not given this area high priority), a growing number of requests are now being received due to interest in remote sensing applications (e.g., Philippines, Mali, Lesotho, Malaysia) and a new environmental awareness leading to the desire for inventories and policy guidance (Colombia, Guatemala, Bolivia, Thailand, Philippines).

The creation in 1970 of a U.N. Committee on Natural Resources within ECOSOC is a significant illustration of the degree of developing country interest in the natural resources field. This Committee was established principally

<sup>1/</sup> Several Workshop participants from U.S. technical agencies felt that the fact that AID has not received significant numbers of requests for assistance in the resources sector is misleading. They noted that their agencies are often asked for help directly by counterparts in developing countries apparently because, with few exceptions, AID Missions have not been receptive to assistance in this sector and have discouraged formal requests through AID channels.

at the behest of Third World nations which have since been working actively within the new forum to create a "Revolving Fund for Natural Resources Exploration." The Fund, which would be financed initially from contributions by donor countries and later by a percentage of the mineral revenues received by the LDCs, was conceived as the best possible mechanism for promoting a rapid expansion of exploration programs for minerals and fuels. The rationale for the Fund, as stated by the developing nations in the U.N. Committee, is that resource exploration suffers in the country programming process because of the risk factor involved in prospecting; but that the potential payoff for their nations is so great that special means must be found to expand exploration activities. At its second session in Nairobi this February, the Natural Resources Committee voted to establish the Fund.

Finally, if one accepts the fact that the development of natural resources can trigger major breakthroughs in country economic development, then the intensification of effort in this sector is all the more attractive because the resource potential of large areas in Africa, Latin America, and Southeast Asia is virtually unknown. As concern grows over the depletion of the world's non-renewable minerals and fuels, the economic value of such resources should rise rapidly -- and along with it the potential payoff to the developing world.

From the geological viewpoint, mineral and energy deposits in vast areas of the world are hidden beneath covers of clouds, sand, thick soils, or jungle vegetation; and very little drilling exploration has been done away from known mineral areas. Large belts of folded sedimentary rocks -- often the site of oil and gas fields -- have never been tested. A strikingly disproportionate percentage of the known sulfide ore bodies and other types of metal deposits are found in the temperate and arid regions of the world. However, there is no geological reason why such ore bodies should not be present in the same relative abundance in tropical areas. The anomalous distribution undoubtedly is directly related to the amount of exploration which has been carried out. Twenty years ago it was commonly believed that there was no oil in the Sahara; and that there were soon to be serious shortages of iron ore due to the rapid exhaustion of known deposits. But vast discoveries of hitherto unsuspected mineral deposits have been made quite recently. The truth is that throughout most of the world, knowledge of the subsurface of the earth -- including the character of the rocks and mineral and water content -- is virtually non-existent.

It is estimated that 29 percent of the earth's land surface is covered by forests; and one-half of these are in tropical areas. However, little is known about the extent, properties, and potential uses of the hundreds of tree species that are found in the tropics. Even the extent of many of the primary species which have been exploited for many decades is not well known. Associated with this lack of knowledge of existing stands of timber is a very poor understanding of tropical silviculture and the impact of logging on wildlife, water supply, and watershed erosion. Another 46 percent of the world's land area is range land. Intensively managed range lands could become a source of increased protein while contributing to the maintaining or rebuilding of the moisture conserving properties of the soil (i.e., reduction of erosion and man-caused flooding). By integrating grazing habits with the characteristics of indigenous vegetation, livestock can become instruments of beneficial environmental change. This can be done without large capital outlays, without the undesirable effects of the chemical and physical methods sometimes used to induce environmental change, with less disruption of traditional modes of life among pastoral peoples, and at probably less cost than chemical or physical means. However, the application of principles of integrated range land management is impeded by lack of basic information about the biology and ecology of such areas, and the current and projected demand for grazing, and also by the absence of the requisite institutional and manpower capabilities.

Although the extent of surface waters, including river, marshes, ponds and lakes, is generally well known, their regime and flow are too often poorly understood, except in a few highly developed regions (the United States and Northern Europe, for example), and in certain limited tropical and subtropical areas in which accurate studies have been carried out. The state of investigation of underground water is even more unsatisfactory. Information on the extent and mechanics of groundwater systems, particularly those of large geographic areas, is deficient for most parts of the world; even through such knowledge is a prerequisite to the sound exploitation of underground water on a sustained basis. Information on the composition (e.g., salinity, silt content, biology) of both underground and surface waters and the

variations that occur during the course of the year is, for the most part, lacking.<sup>1/</sup> It should be noted that since surface water and groundwater regimes are inter-related, there is a need for integrated regional approaches to the analysis and management of water systems. As population pressures in developing countries increase the use of marginal and submarginal lands, knowledge of the carrying capacity of the land in terms of sustainable water yield will become critical.

1/ The following two reports, prepared by the U.S. Geological Survey at AID's request for the Development Assistance Committee of the OECD, present comprehensive information on the state-of-the-art and research needs in the fields of minerals and water resources exploration:

- (a) The Application of Geochemical, Botanical, Geophysical, and Remote Sensing Mineral Prospecting Techniques to Tropical Areas -- State of the Art and Needed Research; Dorr, et al; U.S. Geological Survey Open File Report, (IR) DC-20, December 1971.
- (b) Techniques for Assessing Water Resource Potential in the Developing Countries with Emphasis on Streamflow, Water Movement in Unsaturated Soils, Ground Water, and Remote Sensing in Hydrologic Applications; Taylor, George C., Jr.; U.S. Geological Survey Open File Report, December 1971.

### III. CONSTRAINTS ON NATURAL RESOURCES DEVELOPMENT

Several general observations about natural resources development in the Third World in the decade of the '70s deserve mention before focusing on specific limiting factors within this sector. First, developing countries are increasingly concerned with establishing the doctrine of "permanent sovereignty over natural resources." Their current preoccupation with promoting this doctrine in various international fora is derived from the desire to control all aspects of resource development from exploration through the processing and marketing stages and includes provisos which would essentially "legalize" the nationalization of foreign investment without recompense when a country feels that its sovereignty over resources is threatened or abused. Such total control, of course, requires developing nations to build their capabilities in all phases of resource development. Secondly, there is an emerging interest on the part of developing countries to avoid through proper planning and management a repetition of the waste, misuse, and general environmental degradation which has traditionally characterized natural resources development in all regions of the world.

As a result of these two factors, natural resource activities in developing countries no longer will be simply a matter of foreign entrepreneurs gathering the raw materials and shipping them abroad. The 1970's will find countries increasingly concerned with developing their own capabilities to explore, harness, process, and market the resources, as well as creating new policies, institutions and laws for ensuring that the exploitation is carried out in an orderly, well-planned fashion, with due regard to the relationship to and impact on other economic sectors and the environment.

The experiences of the United States and other industrialized nations demonstrate that a variety of factors must be present and interacting smoothly to ensure sound development of natural resources. These factors include an adequate base of information about the extent and potential of the resource base, the availability of capital, a skilled labor force, efficient management, realistic development planning, and well-conceived

economic programs and objectives. Weaknesses in any of these links can impede resource development even in countries possessing great natural wealth.

As previously mentioned, vast areas of the developing world remain essentially unexplored. For the most part, resource development has proceeded satisfactorily only in the more accessible areas of the developing world where the surface manifestations of the resource potential have been relatively obvious and large enough to attract foreign enterprise. Reconnaissance scale surveys and mapping designed to locate new resources have often proved too costly for the developing countries to finance, and not sufficiently attractive to foreign industry for the investment of risk capital.

In many regions, the perennial cloud cover and thick jungle canopy have prevented even the mapping of basic soils and rock types. However, with the rapid evolution of the state-of-the-art of remote sensing by aircraft, utilizing instruments which have the capability of penetrating cloud and vegetative cover, these previously hidden areas are now being revealed. Though the high cost of such exploration techniques will be prohibitive for most developing countries, some will find them cost-effective for certain purposes. Brazil, for instance, is financing on its own a radar mapping program of the Amazon Basin. It may well be that new data and data-gathering techniques will emerge from the forthcoming U.S. Earth Resources Satellite Program and trigger new break-throughs in resource exploration and appraisal. Not only will the satellite data be virtually free to developing countries, but the non-transitory nature of much of the essential resource information (i.e., rock types, forest species) should make one-time imagery from the satellite program valuable even if repetitive coverage of the same areas is not available. In addition, rapid advances being made in geodetic positioning, and ground-based geophysical and geochemical surveying are providing new tools for upgrading capabilities for carrying out traditional surveys, as well as for obtaining the necessary "ground-truth" data to support aircraft and satellite programs. One example is the Geociever, a relatively small, portable instrument which enables one to determine his location very precisely, even in deep jungle areas by monitoring the positions of Transit satellites during a series of passes.

Limitations in trained manpower at all levels -- resource planners, managers, scientists, technicians -- will continue to be a major constraint on resource development in the coming decade. As developing countries attempt to control all phases of the development of their natural resources, this limitation will loom ever larger. Resource surveys and inventories carried out in traditional modes usually require large numbers of trained scientists and technicians. If, however, a country decides to capitalize on the application of time and cost-saving advanced survey and mapping technologies, a new breed of trained expert is needed. Regardless of the approach used, the developing country will be severely constrained by manpower shortages in its attempt to undertake the preliminary work necessary to establish its resource base and lay the groundwork necessary to encourage further investment by the government or private industry. The Zaire Republic, with a long history of minerals production, has few nationals trained in the earth sciences and continues to rely on expatriates and foreign firms. The Philippines' Bureau of Mines has 55 unfilled positions in a 110-man staff due to the fact that private industry has been attracting the best employees with higher salaries, and the universities are not graduating geologists to fill the void. These are not unusual situations in the developing world.

Countries have traditionally filled the manpower breach by entering into contracts and agreements with private firms for resource surveys. These usually provide the firms with concessionary rights to certain resources which might be discovered. It is not uncommon in this situation for the country to end up with little or no access to the acquired data, and only a general idea of the value of the resources. The directors of the Forest Products Institutes in Ghana and Nigeria, for example, have recently decried the fact that foreign concessionaires are laying waste to timber lands for which the government has almost no knowledge of the types or volumes of species present. And the Government of the Philippines is preparing to finance geophysical surveys for several regions which were surveyed ten years ago by a foreign company which failed to make either the raw or interpreted data available. Sometimes the developing

country is no better off when working with donor governments. A recent AID-sponsored team which visited Mali to assist with preparation of an experiment for the forthcoming Earth Resources Satellite Program was told by Malian government scientists that aerial photography needed for planning purposes existed -- but was stored in Paris and was virtually inaccessible to them.

This suggests a second major deficiency in the manpower structure of developing countries -- the absence of trained resource planners and managers. Implementation of a sound program requires, among others, middle-level planners and managers skilled in such arts as assessing the true value of the resource base; designing methods for developing resources to ensure optimum production; establishing incentives and tax structures for stimulating private investment; and negotiating leasing and concessional arrangements. Developing countries feel that, historically, they have been on the wrong end of bad bargains, and are currently quite vocal on their intention to put an end to such "exploitation." This is reflected by the growing number of developing country requests for technical assistance in the areas of resource policies, laws, and concessional arrangements -- and also by the recent expropriations of foreign investments in the copper industry, and the demand by Middle East countries for renegotiation of petroleum import contracts.

The January workshop underscored, in particular, the benefits to be derived from comprehensive planning on a regional basis (i.e., river basins, urban areas). Such benefits include: (1) better assignment of values to the various components of the total resource base which will be affected; (2) determination of development alternatives and a truer accounting of their respective costs and benefits; (3) opportunities to channel financial and manpower resources into priority activities; (4) better chance of influencing population patterns; and (5) preservation of the renewing properties of the land.

Obviously, the shortage of financial resources to invest in the natural resources field adversely affects all of the aforementioned factors. There are insufficient

funds within developing countries with which to contract for surveys, develop curricula and obtain staff to train the scientists and managers, and to purchase and maintain technologies which can reduce the time and costs involved in resource development. Although the payoff from investments can be spectacular in certain areas such as minerals and fuels, the inherent risk factor and uncertainty tends to reduce the priority assigned to natural resources projects in competition with other developmental activities for the limited funds available from international assistance agencies. Because of this, the developing countries are seeking to establish within the United Nations new funding mechanisms exclusively for resource exploration purposes. It is also clear that the relatively long period of time required to complete a project (minimum of seven years), requires long-term commitments by development agencies, and tenacity by both donors and recipients.

Perhaps the attitude of many developing countries toward mineral and energy resources can be appropriately summed up in the following excerpt from the Nigerian Second National Development Plan, 1979-74.

"During the 1970-74 Plan period, Government will participate in the exploration and production of Nigeria's mineral resources. This direct involvement is necessary because of the crucial role which mining (and especially crude petroleum) is expected to play henceforth in the economy - providing fuel and energy for, and stimulating growth in other sectors of the economy, as well as providing the basis for future petro-chemical and fertilizer industries. Government's direct intervention, in addition to its purposeful regulatory role, will help to optimise these contributions to the national economy. Private companies have often in the past shown a reluctance to explore and prospect for new mineral deposits which do not present prospects of immediate financial returns. This timid approach, if left uncorrected, will result in a large part of Nigeria's hidden wealth remaining untapped for a long time to come.

"Government involvement in the mining sector will be in two main areas: the development of solid minerals and petroleum mining. With regard to the former, Government will explore the possibilities of new solid mineral deposits. In this connection, the Geological Surveys Division of the Ministry of Mines and Power has already, under its expanded geological surveys programme, drawn up a detailed plan aimed at taking an inventory of the country's mineral wealth. The country has been divided into seven zones to facilitate intensive geological surveys and prospecting in each zone. On the basis of these surveys, more thorough exploration of the areas for possible mineral deposits would be organized in order to determine their reserve potentialities. On the basis of these studies Government would decide whether to engage exclusively or in partnership with technical partners in the exploration and mining of such new solid mineral resources as may be discovered ....."

".....In summary, the specific policy objectives will be to:

"(i) promote the diversification of the country's primary mineral products through extensive geological explorations and mineral deposits appraisals;

"(ii) organize the development of mineral resources so as to contribute to the overall national development effort;

"(iii) control and regulate activities in the mining sector in order to optimise its effective contribution to the entire national economy;

"(iv) secure the conservation of the country's mineral resources; and

"(v) conduct research into efficient extractive methods and wider application and use of minerals."

#### IV. CURRENT ROLE OF GOVERNMENTS, DEVELOPMENT ASSISTANCE AGENCIES, AND PRIVATE INDUSTRY

Workshop participants were specifically requested to assess current and planned programs and capabilities of U.S. institutions and other donors in the field of natural resources planning and management in developing countries to serve as the basis for defining the scope and nature of an appropriate role for AID. Appendix D presents statements by representatives of the participating U.S. technical agencies and international development organizations which describe their relevant charters, programs, plans, and perspectives. Consultations had previously been held with representatives of several United Nations agencies -- FAO, UNESCO, and the UN Resources and Transport Division -- and information on the overall UN program has also been included. While it is not necessary to repeat or summarize the material presented in Appendix D, several major points that emerged during the discussions seem particularly relevant and therefore deserving of emphasis.

The U.S. technical agencies were unanimous in acknowledging that, with several isolated exceptions, the United States is essentially a "dropout" in providing bilateral development assistance in the natural resources field. On the other hand, France, Japan, Germany, and the Soviet Union are quite active bilaterally and do not disguise the fact that they seek reciprocal benefits from their development assistance in this field which provides an entree for expanding their industrial base and sources of raw materials. Meanwhile, the United States seems hamstrung as a result of its ambivalence over the proper rationale for U.S. development assistance in the natural resources sector, particularly with respect to minerals, fuels, and forest products.

Agency representatives expressed the view that a solid U.S. bilateral assistance effort in this sector is stymied by a persistent fear among development strategists that other nations will view this not as

development assistance, but rather as merely a veiled incentive for U.S. industry. Consequently the United States is apparently looking to the multilateral institutions as its instrument for providing assistance in the natural resources sector. However, it appears obvious that, although the United States has the scientific expertise, technology, and institutional capabilities to make special contributions to natural resources development programs, direct U.S. participation in multilateral activities is and probably will continue to be minimal.

A recent analysis of the United Nations' natural resources programs disclosed the following: The employment of U.S. nationals by the U.N. Resources and Transport Division (which administers the largest program in this field, approximately \$37 million annually) both on the professional staff and on field assignment on natural resources projects averages 11 percent, well below the norm of 18 percent for the U.N. system as a whole and far below the percentage level of U.S. voluntary and assessed contributions to U.N. programs. Of 72 professionals in the Division, only eight are U.S. nationals. The senior U.S. national is a relatively junior P-5 level officer in the Transport Section and there are no Americans among the five D-1 level employees. The chief of the Division employs about 500 experts on field projects funded from the technical assistance component of the U.N. regular budget, UNDP and funds-in-trust. However only 59 of these experts were U.S. nationals in 1970 -- well below what would seem to be the relative U.S. capability in this field.

The Workshop also revealed that, although AID policy has been to look to FAO to carry out forestry projects, U.S. experts are seldom called upon to participate in any capacity -- even though one-quarter of the world's professionals in this field reside in this country. Similarly, the representative from the Organization of American States noted that the OAS attempts to fill manpower requirements with Latin American expertise before looking to U.S. talent.

It was pointed out by several participants that the involvement of U.S. experts in multilateral programs is limited by their much higher salaries

relatively to those earned by professionals from other countries. The fact that other governments often underwrite the salaries of their experts to provide a competitive advantage was also noted.

The general conclusion was that the United States does not have its "fair share" of either professional or expert assignments associated with the natural resources programs of multilateral agencies to which the United States is the largest financial contributor. Given the dispersal of voting strength among the various member nations of these organizations, it is unlikely that the situation will change significantly for the better unless the United States takes special corrective measures. Suggestions of ways to stimulate a greater U.S. involvement in the multilateral programs included: more active participation by the U.S. Government in program development activities such as those carried out by the U.N. Natural Resource Committee; providing part of the U.S. contribution to the multilateral institutions in services rather than dollars; "topping off" salaries for U.S. experts involved in multilateral program assignments; and better and more persistent articulation of both the special talents U.S. personnel can bring to bear in multilateral natural resources activities, and also our desire to obtain a more equitable involvement.

With respect to the content of the natural resources programs carried out by multilateral institutions, the emphasis has been on assistance with resource surveys and appraisal. The Medium-Term programme of the United Nations -- which supports the greatest volume of work in this sector -- indicates that this emphasis will continue. However, increased attention will be paid to strengthening the training and institution-building components of these activities, as well as training managers and policy makers in the formulation and implementation of national resource policies, and concessional and leasing agreements. The Workshop took note, however, of the fact that less than five percent of UNDP funds for exploration projects goes for training and institution-building. Several representatives of the U.S. technical agencies also stated that the training and institution-building

components of U.N. projects suffer from the inherent deficiency of multi-national field teams, with a variety of backgrounds, philosophies, and experiences, which cannot provide the long-range continuity or follow-up with host agencies that bilateral donors can offer.

All donors, both bilateral and multilateral, acknowledge the need and their intent to build "comprehensive planning" and "integrated resource management" approaches into natural resources programs to ensure that principles of resource conservation, environmental protection, and optimization of benefits over the long-term are followed. However, to date there has been little more than lip service given to incorporating such integrated approaches into development assistance strategies in the natural resources sector. Workshop participants stressed that the United States is the world leader in this area and possesses the experience and expertise necessary to make a unique contribution to multiple-use resource management and environmental protection in developing nations.

On the other hand, representatives from multilateral agencies stressed that they seem better able (than bilateral donors) to work with countries at the initial program definition stage of resource development because of their "apparent objectivity."

An evaluation of the ongoing programs and plans of the multilateral development institutions discloses that they are quite comprehensive in terms of both the categories of resource types covered, and the nature of the developmental activities (i.e., surveys, training) being supported. However, a major gap exists in the development and application of new technologies to resource survey, appraisal, and management. While the multilateral institutions have been incorporating proven technological innovations (e.g., infra-red remote sensing in Ethiopia), none have a viable research component designed to develop or adapt technologies specifically for utilization and maintenance in and by the developing country -- technologies which the developing countries can understand, handle, and afford.

Recognition was given to the necessarily close relationship between data-gathering institutions (e.g. national technical agencies, UN, FAO, OAS) and the international and regional banks (e.g., IBRD, IDB, Asian Development Bank). One bank representative noted a growing time lag between the initiation of project studies and receipt of the requisite data by the lending institutions and suggested that ways be found to reduce the gap and thereby expedite the actuation of project funding.

The future role of private industry in the development of natural resources in developing countries was viewed as principally the economic exploitation of the resources based on contractual agreements with the host government. It is anticipated that the nature of the demand on, and response by, private industry will change during this decade as the result of several emerging considerations. With the advent of sophisticated and expensive new technologies for locating and appraising natural resources, developing countries will increasingly turn to foreign private industry to carry out preliminary reconnaissance surveys under contract, irrespective of their desire to assume self-sufficiency in all phases of resource development. Secondly, industry is being forced to incorporate broadly-based training programs for nationals into their overseas activities as part of the price of admission to the developing countries.

U.S. private industry will undoubtedly continue to play a significant role in resource development in developing countries, albeit operating under more stringent conditions with respect to profit-taking, requirements for training host country nationals, and possibly incorporating additional environmental safeguards. However, Japanese and other foreign industries are attracting an increasingly large share of the resource development markets in the Third World. Workshop opinions differed as to whether this is a proper concern of the U.S. development assistance strategists. While U.S. industry can be looked to for continued technological innovation in resource extraction and utilization, several Workshop participants noted that industry is not investing research funds on development of reconnaissance and large-scale mapping and surveying techniques for application in developing countries, and will rely on existing technology or government-financed breakthroughs for this purpose.

#### V. SPECIAL CAPABILITIES OF THE UNITED STATES

In an attempt to define a proper role for AID in the natural resources field, Workshop participants were asked to delineate areas in which the United States is prepared, technologically and institutionally, to make special and unique contributions. On the basis of presentations by the technical agencies and multi-lateral institutions, and their subsequent discussion, the following areas were identified:

- development and application of new techniques, equipment, and methodologies for resource surveys and management;
- demonstration and application of integrated resource planning and management principles to operational resource development programs;
- education and training in the field of resource management, particularly the application of integrated planning and multiple-use management principles for resource conservation, environmental protection, and optional utilization;
- research, training, demonstration and application with respect to the environmental aspects of resource development; and
- application of business management policies and practices to the contracting, marketing, and industrial development aspects of natural resources programs.

The first three items were cited by virtually every speaker as being (1) particularly significant to the developmental objectives of the developing nations; and (2) areas in which the United States has something unique to offer. It should also be noted that these areas are essentially identical to the natural resources subsectors considered during the December Workshop at Airlie House.

As the world leader in science and technology, the United States has over the years developed (with Federal research funds in most cases) the principal technological tools used in natural resource surveys, including the magnetometer, scintillometer, gravimeter, and computer modelling techniques. Based on recent demonstrable successes with radar mapping and multi-spectral imaging from aircraft, and the prospects for new advances with the forthcoming experimental Earth Resources Satellite Program, developing countries are looking to the application of remote sensing from aircraft and satellite to trigger major breakthroughs in their ability to locate, inventory, appraise, and monitor indigenous natural resources.

It is significant that the forthcoming Earth Resources Technology Satellite (ERTS-A) Experiment is stimulating countries such as the Philippines and Thailand to inventory and examine old aerial photos and resource data to reassess their utility in the light of new interpretation techniques and the opportunity to relate them to satellite-acquired data. Developing country involvement in the space program, even at the very modest current level, is also breathing a new vitality into languishing natural resource agencies and academic programs. This should have a positive impact on conventional exploration programs and also on manpower training and recruitment.

In addition to remote sensing techniques, new approaches to ground-based geochemical and geophysical prospecting, as well as physical and mathematical modelling, have great potential to upgrade traditional approaches to resource identification and evaluation. Because of differences in soil types, climates, and vegetation, much of this new knowledge and technology developed for application in temperate regions cannot be wholly applied to the developing regions of the world. Thus, research and development is needed to adapt the technologies and methodologies to new conditions, as well as to build instrumentation which can be utilized and maintained within the developing country by local experts. At present, neither the multilateral assistance agencies nor private industry is filling this void. On the basis of these considerations, the Workshop participants acknowledged that the development and

application of resource survey and monitoring techniques is an area in which the United States, through its bilateral technical assistance, can play an important and unique role.

Secondly, most participants cited the need for the expanded application of principles and technologies of integrated resource planning and management. This is the result of an increasing worldwide awareness of both the finite nature of the resource base and the large economic and environmental costs often incurred from single-purpose resource management which offsets total benefits over the long-term. Representatives from the technical agencies stated that their organizations have been implementing multiple-use approaches to forestry, mineral resources, and water resources for a number of years, and are strengthening their interdisciplinary capabilities in response to new national mandates and legislation (e.g., National Environmental Policy Act of 1969). As a result, there exists a growing cadre of scientists, technicians, and resource managers within the U.S. technical agencies who possess knowledge and operational experience in a wide variety of multiple-use techniques. However, several participants from development agencies questioned whether the U.S. agencies are actually in a position to fill an increased demand for experts for international projects.

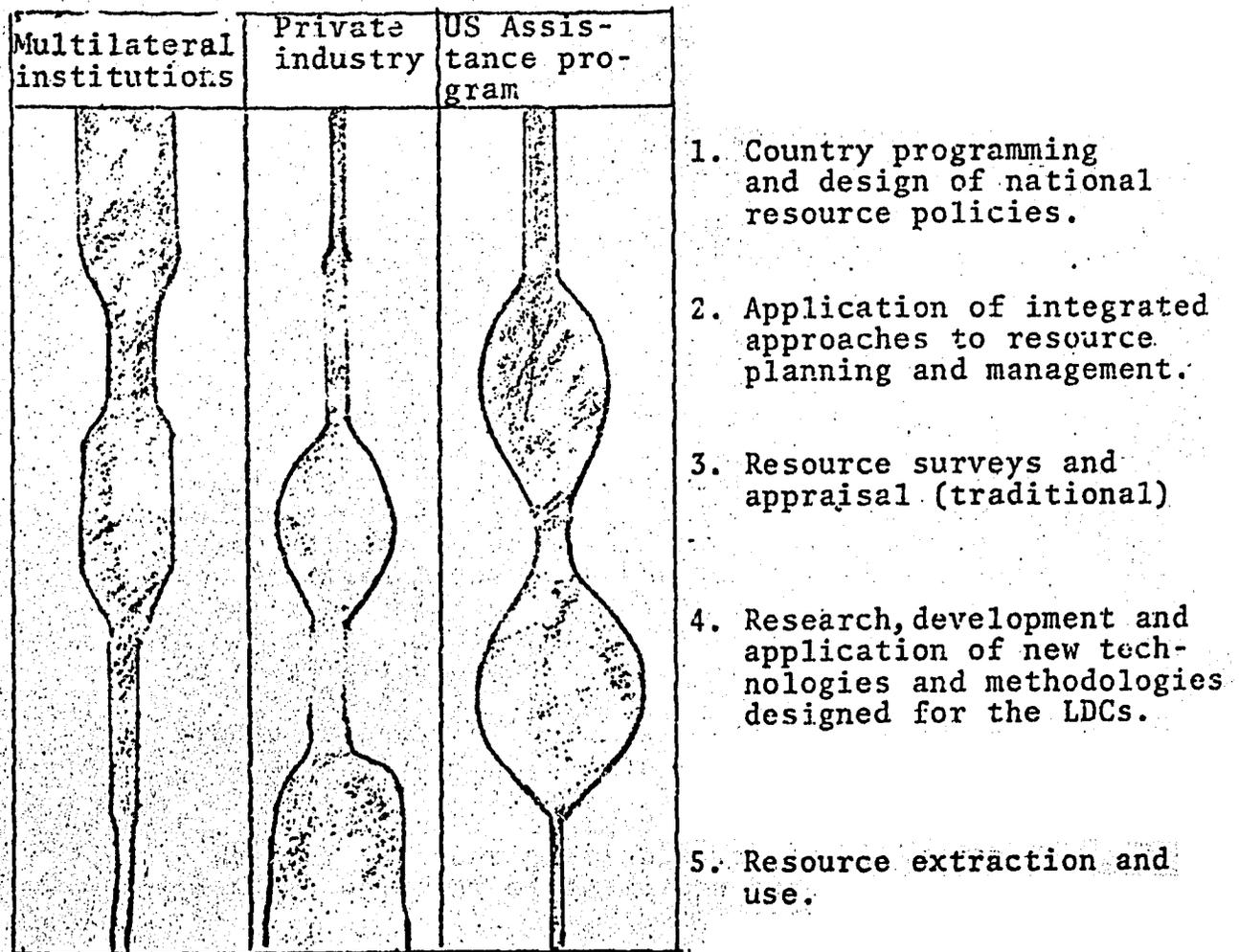
A growing number of U.S. universities (e.g., California, Michigan, Utah State) have introduced new courses and curricula designed to bring an interdisciplinary focus to bear on resource planning and management. The Workshop participants felt that the United States is in the best position among the donor nations and development institutions to provide this type of training and education for developing country planners and managers, and also for academicians who would return home to develop similar courses of study in their own countries. The OAS representative advocated special attention to this area, noting a large and growing demand within Latin America and also the fact that the OAS has initiated a pilot program at the University of Michigan.

The following diagram is an attempt to generalize the views which emerged at the Workshop on the appropriate roles of multilateral development institutions, private

industry, and the U.S. bilateral assistance program in the natural resources sector. Whereas roles depicted for the multilateral institutions and private industry reflect their ongoing program emphasis and short-term plans, the U.S. bilateral role is both selective (based on matching U.S. capabilities with significant gaps unfilled by other potential institutions) and hypothetical (given the virtual absence of a well-defined natural resources assistance program).

Institutional strengths

Resource development functions



## VI. CONCLUSIONS

The following conclusions emerged from the Workshop and were subsequently considered during a January 24 morning session involving only AID bureau and office representatives.

1. The United States possesses unique capabilities in a number of aspects of natural resource development, particularly in the following two areas: (a) the development and application of new technologies which can reduce costs and/or time for resource identification, appraisal and management; and (b) the application of broad-gauged, integrated approaches to land and resource management.
2. Institution-building should be featured in natural resource programs to ensure efficient utilization of both acquired data and scarce financial resources and trained manpower. Where opportunities for government reorganization are present, possibilities for combining independent, specialized resource agencies into a single, integrated organization should be thoroughly examined. Such an across-the-board institution is probably the best mechanism for effective implementation of comprehensive, multiple-use land and resource management concepts which are needed to optimize benefits to the countries over the long term. Creation of a "model" institution in one country would be a significant U.S. initiative. In other situations, existing resource agencies should be strengthened by attacking problems of inadequate manpower, underutilization of available data and equipment, and lack of capabilities for acquiring and applying new techniques and equipment to resource exploration and management.
3. Training at all levels (policy makers, resource managers, technicians) is needed. Emphasis should be on training on-site in the developing

countries whenever practical. This could involve traveling seminars by U.S. experts. In certain instances training in the United States is warranted -- focused on training counterparts to go home to train others. The relevancy of U.S. knowledge and experiences to the LDC setting should be continually examined, and university curricula and course development should be supported to correct deficiencies. Expanded summer training programs in resource management and environmental protection for LDC students going to school in this country should be explored.

4. Demonstration research programs conducted in the LDCs by U.S. and developing country experts may be particularly well-suited for the natural resources field. The U.S. experts would get the program moving and then turn it over to counterparts. This would not only provide training but would ensure that the research was applicable to the needs of the LDCs.
5. Research is required to adapt existing technologies and design new techniques and equipment expressly for application in developing countries. Where countries are seeking to build an indigenous capability, may require instrumentation which is simple to use and maintain, and is rugged enough to withstand severe tropical conditions. In other instances, the need is for new approaches to resource detection, monitoring, and management in areas covered by clouds, sand and thick vegetation, or otherwise inaccessible to traditional ground-based or aerial surveys as conducted in temperate regions of the world.
6. Support for new international or regional research and technology institutes -- such as regional forestry institutes -- should be examined. Patterned after the IRRI, such institutions would offer the same flexibility and acceptability by being disassociated from specific nations or donors.

7. Better linkages with multilateral agencies should be sought, although programs need not be carried out exclusively in cooperation with other donors. Direct linkages with LDC institutions are necessary. However, multilateral agencies should, in many instances, take the lead in country programming, and also in working with planning agencies on overall natural resource program design, particularly in situations where multilateral donors are more acceptable to governments.
8. The United States should take a stronger leadership role in identifying to countries opportunities, or program options, in the natural resources sector. Lack of knowledge of the natural resource base historically has meant that this sector has suffered in presentations to the LDCs of U.S. capabilities and interests within the overall development assistance framework.
9. Development of strong natural resources programs and institutions requires dedication and tenacity on the part of both the LDCs and donors due in large part to the long time lag between resource exploration and resource development, and the length of time required to perceive tangible new benefits from integrated resource management approaches. However, once a "critical mass" is present, potential economic contributions by the institutions and programs are often disproportionately higher than those possible in other developmental sectors.
10. A study should be made of the economic and political aspects of a diminishing U.S. role in the natural resources sector as a result of, among others, the high cost of U.S. expertise relative to other nations (such as Japan, Germany, Yugoslavia, and France).

APPENDIX A

Workshop On AID's Role In The Natural Resources Field  
January 21 and 24, 1972

Agenda

Friday, January 21 -- Room 2884, NS

Morning Topic: Programs and Perspectives of US  
Technical Agencies and Offices

- 9:00 - Welcome and Background -- Glenn Schweitzer,  
Director, AID Office of Science and Technology
- 9:10 - Chairman's Remarks -- Charles Johnson,  
AID Consultant
- 9:15 - Forestry - Clark E. Holscher, Director,  
Division of International Forestry, Forest Service, USDA
- 9:40 - Minerals - John Van N. Dorr, Office of  
International Geology, U.S. Geological Survey
- 10:05 - Subsurface Water Resources - George C. Taylor, Jr.,  
Chief, Office of International Activities,  
Water Resources Division, U.S. Geological Survey
- 10:30 - Surface Water Resources - E. Kent Bebb, Division of  
Foreign Activities, Bureau of Reclamation
- 11:00 - Desalination - Lucius M. Hale, Director,  
Office of Engineering, AID
- 11:15 - Energy - John Rixse, Power Division,  
Office of Engineering, AID
- 11:40 - Integrated Land Management - Jerry O'Callaghan, Chief,  
Division of Cooperative Relations, Bureau of  
Land Management
- 12:05 - Surveys, Mapping and Cartography - Robert L. Thomson,  
Chief, The Engineer Agency for Resources Inventories,  
Department of the Army
- 12:30 - Lunch

Afternoon Topic: Activities, Plans, and Perspectives of  
International Development Institutions

- 1:30 - Organization of American States - Kirk Rogers,  
Director, Office of Regional Development

- 2:15 - Inter-American Development Bank - Clarence M. Pierce.  
Senior Program Consultant
- 3:00 - World Bank - Wolfram Drewes, Special  
Projects Office
- 4:00 - General Discussion and Summary

Monday, January 24 -- Room 1406, NS

Topic: The Future Role of AID in the Natural Resources  
Field

9:00-11:00 - Discussion involving AID bureau and office  
representatives

APPENDIX B

Workshop On AID's Role In The Natural Resources Field  
January 21, 1972

Participants

Charles Holscher, Director, Division of International Forestry  
Forest Service USDA

John Van N. Doxr, Office of International Geology,  
U.S. Geological Survey

George C. Taylor, Jr., Chief, Office of International Activities,  
Water Resources Division, U.S. Geological Survey

Warren D. Fairchild, Ass't Commissioner, Resource Planning, Bureau of Reclamation

E. Kent Bebb, Division of Foreign Activities, Bureau of Reclamation

Jerry O'Callaghan, Chief, Division of Cooperative Relations, Bureau  
of Land Management

Robert L. Thomson, Chief, The Engineer Agency for Resources Inventories,  
Department of the Army

Kirk Rogers, Director, Office of Regional Development

Clarence M. Pierce, Senior Program Consultant

Wolfram Drewes, Special Projects Division, World Bank

Timothy Campbell, Office of Environmental Activities, World Bank

Lucius M. Hale, Director, Office of Engineering, AID

John Rixse, Power Division, Office of Engineering, AID

John Eriksson, AID-Bureau for Program and Policy Coordination,  
Policy Development and Analysis

Mel Schuweiler, AID-Bureau for Program and Policy Coordination,  
International Assistance Coordination

James Brown, AID-Bureau for Near East and South Asia, Office of  
Technical Support

William Romig, AID-Bureau for Near East and South Asia, Capital  
Development and Engineering (Water Resources)

Merten Vogel, AID-Bureau for Supporting Assistance, Office of Engineering

Edward Schiffman, AID-Bureau for Supporting Assistance, Office of  
Technical Services

Barbara Bowie, AID-Bureau for Latin America, Office of Development  
Resources

George W. Lawson, AID-Bureau for Technical Assistance, Office of  
Development Administration

Glenn Schweitzer, AID-Bureau of Technical Assistance, Office of  
Science and Tehcnology

Bill L. Long, AID-Bureau of Technical Assistance, Office of Science  
and Technology

Charles Johnson (Chairman) AID Consultant

David Adams, AID Consultant

APPENDIX C

WORKSHOP ON SCIENCE AND TECHNOLOGY PRIORITIES  
FOR INTERNATIONAL DEVELOPMENT

Airlie House  
Warrenton, Virginia

December 17-19, 1971

Sponsored by  
The Office of Science and Technology  
Agency for International Development

## NATURAL RESOURCES<sup>1/</sup> PLANNING AND MANAGEMENT

The principal thrust of AID-financed technical assistance in the natural resources sector should be to assist developing countries build their own capabilities to rationally plan and manage the development of indigenous mineral, water, forest, and land resources. Consequently, strengthening developing country institutions and infrastructure by providing training opportunities and high-quality U.S. consultants should be basic objectives of programming in this sector. Support of research designed to provide new resource management techniques also deserves high priority. In addition, the United States should be prepared to provide direct assistance in support of priority development projects in areas where it possesses special competence (e.g., water quality surveys), even though institution-building is not a major objective.

With respect to specific subsectors for concentration, the Workshop recommended clustering technical assistance activities in the natural resources sector into four areas. The recommendations were based on a review of suggested priorities which emerged from the Columbia Workshop of last April and their subsequent regrouping as presented in an issue paper prepared for this second workshop. The areas of concentration are:

1. Improved exploration and mapping techniques for upgrading the ability to identify and appraise resources while reducing the time and cost involved, such as the application of remote sensing.
2. Improved techniques for managing and conserving resources, including land use planning, technical bases for awarding concessions, and monitoring resource development.
3. Resource protection and rehabilitation, including pollution monitoring and abatement, natural disaster investigations, land reclamation, and water and waste management.

4. Technological approaches to increasing value added locally to resources, and economic development of underutilized resources.

As the result of discussions of the proper focus and scope of these four areas, it was concluded that the sector should be identified as "Natural Resources Planning and Management", which is broadly defined to include resource survey, appraisal, development and protection. Since "environmental planning" should be, and is, an integral part of A.I.D. developmental activities, no useful purpose would be served by according it separate mention in the sector title.

The proper institutional status and program priority for the natural resources sector within the overall A.I.D. framework was identified as an important and yet unresolved issue. It was therefore recommended that a study be undertaken to determine, among others, the importance of natural resources to country development; special bilateral contributions the United States can make in this area; the present level of emphasis accorded natural resources by A.I.D.; and recommendations on how to strengthen A.I.D. programming in this area if warranted.

A series of specific questions was addressed at the Workshop in an attempt to obtain reactions on the appropriate size and nature of an A.I.D. natural resources program:

1. How much emphasis should be accorded natural resources?

The natural resources sector currently appears not to be receiving the attention and funding by A.I.D. commensurate with the importance of natural resources to country economic growth. This assertion was based on the fact that natural resources undergird industrial and agricultural development, and are frequently a primary source of export earnings. In addition, growing worldwide environmental concerns, including the need for better stewardship of a finite natural resource base, has promoted this area in the priorities of developing countries as indicated by an increasing number of requests for assistance with the managerial aspects of resource development. Other donor countries and multilateral institutions are currently giving more attention to this area within their assistance programs than is the United States, which has a variety of

highly developed skills -- ranging from resource assessment and policymaking to professional and technician training -- with which to make a unique and significant contribution to country development. Consequently, the importance of U.S. technical assistance in this sector should be reflected by according it higher and more independent institutional status in the A.I.D. organization than it now has.

It was noted that the process of creating viable local institutions which can effectively conduct and manage resource development activities is very complex. The time involved to train resource managers and staff for the institutions is far longer than has generally been recognized in past assistance programs. Earlier A.I.D. assistance to natural resource agencies in developing countries has in most cases provided only a rudimentary framework for the institutions. The training was not continued far enough to develop fully mature, qualified leadership adequate to meet the needs of modern resource development and management. In fact, technologies and concepts in the natural resources field have advanced so rapidly in recent years that the resource institutions and technical experts in developing countries have actually fallen much further behind those in the developed world.

## 2. How can realistic and effective natural resource programs be designed to meet developing country needs?

Emphasis upon natural resources in country programs should be more closely related to the potential significance of the country's resource endowment. Requirements for natural resources assistance vary from country to country, depending upon the perceived resource potential, existing physical and institutional infrastructure for development and management of natural resources, and other factors. Existing capabilities within A.I.D. Missions for identifying opportunities and responding to country proposals in this field are very limited. In addition, there is no central focus in AID/Washington for development of integrated programming in the natural resources field, or to assume responsibility for reviewing and supporting many proposals and requests received through Missions or other Federal agencies. A systematic procedure should be developed for bringing U.S. technical expertise from State and Federal agencies, universities and industry into the review and

decision-making processes. Criteria for program development in the field of natural resources need first to be more explicitly defined and then an effort made to relate these criteria to each country's economic development program and infrastructure. In the design of natural resource programs, particular attention should be paid to legal, administrative, and socio/cultural factors which may constrain achievement of objectives.

3. How can funding arrangements for natural resource activities be improved?

The increasing sophistication of resource agencies in developing countries is resulting in more complex and diversified requests for assistance from A.I.D. Missions. To satisfy these requirements, there is a growing need for short-term services from highly specialized U.S. consultants who require relatively modest funding often at irregular intervals and on short notice. It is difficult to provide such services and also to pursue certain targets of opportunity with high payoff potential under existing A.I.D. administrative and funding procedures. A.I.D. needs to develop a quick response capability which will enable Federal agencies and universities to undertake such tasks with a minimum of red tape.

4. How can A.I.D. programs in the natural resources sector be more fully integrated with those financed by multilateral agencies, other bilateral donors and U.S. private industry?

The type of assistance A.I.D. can provide in support of natural resources objectives should supplement the types of help normally provided by multilateral agencies and other donor nations. For example, A.I.D. assistance in this sector traditionally has been oriented more toward institution development and training than assistance extended by the United Nations and other countries. Since resource development programs conducted by private industry rarely involve institution building, the absence of an A.I.D. involvement in this sector may create a serious gap in infrastructure development and training in some AID-supported countries. In addition, the United States has certain unique advanced technologies and expertise to apply to resource management that are unmatched elsewhere in the world, and consequently has a capacity for making unique and significant contributions even when other donors are providing assistance. It is therefore recommended that A.I.D. seek an expanded dialogue with other

donor countries and institutions to provide a better basis for clarifying joint interests and responsibilities, and identifying possible program opportunities, voids and redundancies.

A suggestion was made that A.I.D. explore possibilities for a closer relationship with multinational agencies and private industry in the conduct of natural resource training programs in the developing countries. While favorably disposed to this approach, the Workshop recognized that in establishing such a relationship with industry, care should be exercised to avoid creating the impression within recipient countries that A.I.D. assistance is a guise to expand the exploitative activities of these firms.

It was also noted that resource exploration and development activities by private industry in the developing countries are producing a vast amount of data pertinent to national resource appraisal and management programs which is largely unutilized or underutilized by host country agencies. A.I.D. should give high priority to development of local capabilities for acquiring and applying such data wherever possible.

1/ "Natural resources" includes natural products (e.g., minerals, forests, fish, water) and amenities or situations (e.g., waterfalls, waterways, fertile soils, mountains) which are assigned value by man as the result of their potential economic or social benefits. The principal criteria is their potential usability. For purposes of this paper and subsequent consideration of the sector, the only aspects of agriculture, electric power generation, and capital project development (e.g., waterways engineering) which will be included are the effects and impacts of these activities on the character, use, and management of adjacent lands or other resources. (See Natural Resources of Developing Countries: Investigation, Development and Rational Utilization, UN Dept. of Economic and Social Affairs, E/4608/Rev.1 - ST/ECA/122, pp. 3-9, 1970.)

APPENDIX D - 1

FOREST RESOURCES IN COUNTRY DEVELOPMENT

Statement by Clark E. Hols  
Forest Service - USDA

for

The Workshop on AID's Role  
in the Natural Resources Field

January 21, 1972

IMPORTANCE OF FOREST RESOURCES TO DEVELOPMENT

Even in these days of the greatest human population the world has ever seen, 29 percent of the earth's surface is still covered by forest. Approximately 5.2 billion acres of these forests are found in the developing countries, and 4.5 billion acres in the developed countries. About half of the world's forests are found in the tropical zone and make up most of the forests within the developing countries. This is the zone where economic and technical assistance is especially needed.

One of the critical problems in the developing countries is to generate sufficient foreign exchange to support a growing and stable economy which will permit them to make investments in their natural resources. Forest products are among the fastest growing exports of the developing countries as a whole and are the top export earner in a number of African and Asian countries. According to an FAO report, the developing countries exported US\$ 280 million of forest products in 1955, US\$ 770 million in 1965, and it is projected that they will export US\$ 1,500 million in 1975. Certain countries have done very well indeed, as is shown in table 1.

The Importance of Forest Products<sup>1/</sup> Trade  
for Selected Developing Countries  
in 1969

	Imports	Exports	Net Trade	Total Exports	Percentage Forest Products in Total Exports
	..... Thousand US\$ .....			Mill. US\$	Per cent
<u>ASIA</u>					
Sabah	850*	123 412	+122 562	170	72.6
Sarawak	438	68 273	+ 67 835	210	32.5
Philippines	1 000*	278 000*	+277 000	965	28.8
Burma	-	34 755	+ 34 755	129	26.9
Indonesia	1 654	118 800*	+117 146	742	16.0
W. Malaysia	1 880	78 259	+ 76 379	1 331	5.9
Thailand	2 585	12 330	+ 9 745	711	1.7
<u>AFRICA</u>					
Congo, Brazza.	120*	27 900	+ 27 780	44	63.4
Gabon	236	52 355	+ 52 119	142	36.9
Ivory Coast	994	136 186	+135 192	453	30.0
Ghana	214	41 045	+ 40 831	301	13.6
Cameroon	738	20 975	+ 20 237	226	9.3
C.A.R.	270	2 429	+ 2 159	36	6.7
Nigeria <sup>2/</sup>	1 436	14 454	+ 13 018	905	1.6
Liberia <sup>2/</sup>	476	1 463	+ 987	191	0.7
Congo, Kinshasa <sup>2/</sup>	189	3 887	+ 3 698	573	0.7
<u>LATIN AMERICA</u>					
Paraguay <sup>2/</sup>	699	11 364	+ 10 665	51	22.3
Honduras <sup>2/</sup>	653	14 891	+ 14 238	183	8.1
Brazil	1 967	129 421	+127 454	2 311	5.6
Nicaragua	564	2 936	+ 2 372	155	1.9
Surinam	217	4 710	+ 4 493	120*	3.9
Ecuador	-	4 230	+ 4 230	183	2.3
Colombia	3 095	7 906	+ 4 811	608	1.3
Guyana	446	1 177	+ 731	121	0.9
Guatemala <sup>2/</sup>	554	1 637 <sup>3/</sup>	+ 1 083	222	0.7
Chile	1 400	7 619 <sup>3/</sup>	+ 6 219	1 071	0.1

<sup>1/</sup> Including roundwood, sawnwood, veneer, plywood and other board products.

<sup>2/</sup> 1968

<sup>3/</sup> Pulp and paper exports: 27.7 million

\* Estimate

It is noteworthy that the statistics given in table 1, do not include pulp and paper. With the exception of a few countries such as Chile, pulp and paper exports are very minor in the developing countries and many would show a negative forest products trade balance overall because of their need to import these products. Latin America, for example, has 25 percent of the world's timber resources, yet in 1965, it had a negative trade balance of forest products, including pulp and paper, of US\$ 245 million. Pulp and paper imports accounted for mos. of that total.

Careful study of the table brings out that those countries having a high percentage of forest products in their total exports, are undergoing rapid exploitation of their forest resources, but with little or no provision for the management or regeneration of those resources. Forest resources are renewable and can be made to produce so long as man is willing to give them proper management. Without proper management, they can be used up and destroyed in the same way that a non-renewable resource can be used up. Furthermore, much of the export from those countries is in the form of basic raw material, that is logs, and the producing country is gaining no benefit from the manufacture of specific forest products from those logs. In some cases, countries may be better off, in the long run, to leave their forests unexploited until they can be properly managed, rather than harvest them rapidly and suffer the damages of floods, erosion and extensive decrease in productivity of the land.

The tropical hardwood forest is a complex mixture often containing hundreds or even thousands of species, only a few of which are well known and us

for commercial purposes. Commonly applied logging techniques select only high-value species and individual trees, making logging costs high and resulting in general degradation of the forest. There is a general lack of knowledge of species quality, other than those few already well known, and of silvicultural management. A great deal of research and study is required if tropical forests are to be managed on a sustained production basis.

#### EVALUATION OF FOREST RESOURCES IN DEVELOPING COUNTRY PRIORITIES

In the minds of some, particularly those concerned with agricultural development, forestry is a competitor for land and an obstacle rather than an aid to development. In their minds, forests should be destroyed as something undesirable, but this view is very narrow and has led to costly mistakes. In overall agricultural and industrial development, the presence of forests on watersheds can have a controlling influence on micro-climate and the conservation of soil and water as well as providing a source of supply of raw materials for agriculture and the economy in general. In many countries, the forest is a standing resource, already grown and waiting to be harvested. It can, therefore, become a quick earner of foreign exchange and contribute to the overall development of a nation.

Among the projects being supported by the United Nations Development Program (UNDP) and executed by the Food and Agriculture Organization (FAO), there are currently 325 projects operating in 94 countries. Of these, 47 projects (14 percent) are exclusively forestry, located in 43 countries; 45 percent of the countries involved are giving priority to forestry projects. This is particularly significant since only  $3\frac{1}{2}$  percent of the

Regular Program budget of FAO goes to forestry, indicating that member countries are giving a much higher priority to forestry in their field programs than is being given by the Organization in its Regular Program. Priorities, of course, vary from region to region and country to country, but in general it appears that Africa and Southeastern Asia are awakening to their forestry opportunities. With some exceptions, notably Chile and Brazil, forestry development in Latin America is lagging.

#### POTENTIAL CONTRIBUTIONS BY THE UNITED STATES

The United States has the greatest army of technically trained foresters in the world, approximately 25,000 or about one-fourth of the world's total. These foresters, scattered throughout government agencies, universities, industries, and as private consultants, represent a tremendous reservoir of technical knowledge. In the Forest Service, U.S. Department of Agriculture, there are approximately 6,500 professional foresters managing 187 million acres of land under the broad principles of multiple use. In addition, the Forest Service has a program manned by 1,100 scientists, covering all aspects of forestry research, including that at the world-renowned Forest Products Laboratory. Tropical forestry research is being done at the Institute for Tropical Forestry in Puerto Rico and the Institute for Pacific Islands Forestry in Hawaii. There are 52 professional forestry schools in the United States and nearly 60 two-year technician schools. Some universities have nearly one hundred professors and research fellows on their staff. Many of these foresters are available for technical assistance assignments to developing countries, and, if carefully selected for specific assignments, they can greatly benefit developing countries.

Forestry expertise in the United States is especially strong in the area of forest management, which is the weakest link in the chain of forestry development in the developing countries. The U.S. has great specialization in forest survey and inventory, forest watershed management, forest tree improvement, wood utilization, forest engineering, and forest pathology and entomology. The Forest Service, and probably other agencies of government as well, is willing to make its people available to assist in foreign forestry development.

#### SCOPE, FOCUS, AND MAGNITUDE OF AID'S ROLE

There are three principal areas where U.S. forestry can be of great assistance to developing countries: 1) identification and evaluation of secondary tree species so that more complete utilization of tropical forests is attainable in the tropical forest; 2) research in the fundamentals of silvicultural management of the indigenous tropical forest and plantation forests; and 3) the establishment and strengthening of forestry institutions within developing countries so that forest administrations are available to govern and control forestry programs, forestry education is available at both the professional and technician levels, and so that proper relationships and understandings are developed between the professional forester, the people and the industry using the resource. In addition, we continue to support training of bright young men in both academic and practical training in forestry in the United States, where it is not possible to get such training within given countries. United States approaches, techniques and policies toward forestry problems and opportunities are unique in the world and should continue to be available for forestry development.

Research is basic to the development of forestry in developing countries. Forest management begins with the harvesting of the trees from the forests; therefore, it is essential that techniques be sought for the complete utilization of the forest in order to make possible the regeneration of a new indigenous or plantation forest. Such research should start with the needs of industry and be built around the characteristics of the woods existing in the forests. It would appear that integrated industries would be best where lumber, pulp, particleboard, and plywood could all be produced from the forest mixture. This, in turn, would reduce the per-unit costs of the products and efficiently use the transportation systems and other infrastructure necessary for forest development. In addition, research will increase the body of knowledge of the ecology of tropical species.

A center for tropical forestry research located at an already existing institution, possibly in Southeastern Asia, is desperately needed. Such a center might be financed by a consortium of foundations or other institutions and be so organized as to utilize the special facilities and talents of other institutions around the world to perform specific items of research. This institute might have a similar structure to the Wheat and Rice Institutes located in Mexico and the Philippines. It would be extremely useful to enlist consultants to bring together already existing information on tropical forestry, into handbooks or guides to management. This would require little more than a fund to pay the salary

and travel expenses of the consultant plus the printing costs of his reports. Also, there is a great need for the translation of text material from English, French, German, Dutch and Swedish into languages of the developing countries so that the basic principles and research results of forestry can be more readily available to foresters and students in those countries.

All multilateral forestry projects should be reviewed, and the U.S. bilateral program seek opportunities to support them. U.S. bilateral programs could be instituted which would complement and supplement the projects of the UNDP/FAO, currently being carried on or planned for the developing countries.

Support could be given to the struggling forestry schools in developing countries, perhaps, by financing the attendance of American students for graduate work, with teaching and research responsibilities.

In conclusion, it would appear that the United States has greater capabilities and opportunities for assisting and supporting the development of forestry resources in the developing countries than most other countries of the world. There is a growing need for forest products and forecasts at the present time indicate that the demand will continue to grow. Forestry offers many opportunities for strengthening the economy of developing countries as evidenced by the fact that each developed country has a sound forest industry based on sound forest practices and sustained production. The same potential exists in developing countries.

ROLE OF MINERAL RESOURCES IN COUNTRY DEVELOPMENT <sup>1/</sup>

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## Importance of Mineral Resources to Developed Countries

Industry, agriculture, and social development are all closely related to mineral resources. The course of civilization from the earliest days has been conditioned by the development of those resources. Note the use of the terms "stone age", "bronze age", "iron age", terms given by archeologists to the development of early cultures. Mineral commodities have been articles of trade from the beginning; copper originating from the Michigan deposits has been found in Indian remains over much of the United States; flint was traded widely in Europe from the earliest days. The Phoenicians got their tin from Cornwall. Spanish and Greek mines were foundations of the Roman Empire. It is unnecessary to belabor this point except to emphasize that international trade in mineral commodities is even more important for our world civilization today than it was in the past.

A steady supply of mineral commodities is essential to the developed nations; the USSR is perhaps the only developed country which has the potential of supplying most of the raw materials needed for its industry from within its own borders. Our own country is for all practical purposes totally dependent on imports for a number of essential mineral commodities without which much of our industry and manufacturing would cease. Most other developed countries are in a worse position than we.

<sup>1/</sup> Statement presented at AID Workshop on Natural Resources, Jan. 21, 1972

Because of unpredictably unstable political conditions, it is to the interest of all developed countries to have available alternative sources of supply and most countries, notably Japan, have made considerable efforts to this end. Alternative sources of supply need not imply financial or political control, merely that alternative sources be known and available so that the loss of one source does not become disastrous. Some developed countries aggressively try to secure some political as well as financial control; this is generally not present U. S. practice.

This statement as to the importance of mineral resources to the developed countries may seem out of context in this meeting, but it is intended to show that our own self-interest is deeply involved in the more altruistic approach of the rest of this presentation and that emphasis on aiding mineral development in less developed countries is no giveaway program and can never be reasonably attacked on that basis. As will be shown, mineral development is even more to the benefit of the Developing Countries.

#### Importance of Mineral Resources to Developing Countries

Although mineral commodities produced in the Developing Countries are often looked at by them and by others primarily as a source of foreign exchange and governmental revenues, these are not the only benefits resulting from their development and exploitation. In the long view, they are not necessarily the most important. The minerals industry brings ancillary benefits that may be of even more importance in Developing

Countries. I shall try to emphasize both aspects.

Data are readily available in various publications as to the part minerals play in the trade balance of many countries. Bolivia derives about 95 percent of its foreign exchange from the export of mineral products, Zaire, about 65 percent, Liberia about 75 percent. The table attached to the text of this statement lists the part that minerals play in the foreign trade of many countries. Some with considerable undeveloped potential are included in this list for contrast; in a decade their figures might well be quite different. As startling a change in export income from minerals as that experienced by Liberia over the last two decades may well take place for Ecuador. Argentina may become more comparable to Brazil, assuming that a rational political climate for development exists. Many other countries not now deriving much economic sustenance from minerals will probably show very significant increases over the next few decades.

Statistics on the importance of the minerals industries in the GNP of many countries are deceptive in that they include under categories other than minerals production such items as steel production and products made therefrom, as well as much transportation, etc., even though in many cases the railroads and the steel plants would not exist were there not a base in minerals production to support them. Such categorization is essential from the economist's viewpoint, but it radically downplays the importance of the minerals industry in terms of GNP and employment. The automobile industry of Brazil, 95 percent based on national materials, produces about 500,000 units a year; it would not exist were it not for the steel industry, which in turn would not exist without the great iron ore deposits.

Mining is essentially a pioneer industry; the mines are where the ore deposits are, not where the population centers are. In many cases these are located in the less accessible parts of a country and, to successfully develop the ore deposits, not only means of transportation must be built but schools, hospitals, housing, and whole communities must be provided for the people who develop the ore. Such communities and transportation facilities in turn attract satellite industry and commerce and agriculture, which in the course of years become able in many cases to stand on their own feet and may long outlive the ore deposit that was the reason for starting the development. The development of the Amapa Manganese deposits in the rainforest of Brazil is an excellent example; this was carefully planned to achieve these ends. Not all are as carefully planned, unfortunately, but the trend is up.

It should perhaps be emphasized that in many Developing Countries the capital costs of developing a mine or oil field routinely include provision of housing and community development. In few of the newer mines I have visited in Africa and South America are the savage conditions of many of our own older eastern and western mining communities duplicated. These communities are instead centers of local education as to modern concepts of living.

In 1967 I had the opportunity to visit 23 African countries on a UN mission to study needs for and progress in providing education and training in the minerals industry. The training programs and policies of many mining companies were seen firsthand. Three things were impressive; the first was the amount of effort and funds devoted to training Africans

with little or no previous experience in handling modern equipment and mechanical devices in their proper use and maintenance; the company programs were usually more elaborate and better conceived and executed than the Governmental programs. A classic example from South America is that provided by the Toquepala mine in Peru, which staffed itself with illiterate Indians from the Altiplano, trained them in the use of machinery, educated their children, and moved 10,000 Peruvians into the money economy. The second was the effort and funds devoted to training and using indigenous managerial and professional talent. I know that in many cases the same is true in a number of South American countries. A third impressive thing was that a large number of the persons trained, after a period of work at the mines, left for other jobs, either self-employed, in the Government, or with other firms in urban areas. Thus mines train a much larger number of persons than their roster implies and are very significant factors in upgrading the human skills in the countries in which they operate.

Managerial skills are particularly important in Developing Countries and a developing mining industry fosters them over a wide range of activities. The drive toward employment of nationals in industry so prominent in many countries has produced much progress indeed; the Vitoria á Minas railroad in Brazil, now staffed entirely by Brazilians and a fine ore railroad, is an example in progressive management that most U. S. railroads should strive to emulate. Engineers and technicians from all over the world visit the large iron mines at Itabira, now staffed entirely by Brazilians, to observe the innovations made there.

Contrary to some published opinion, I personally look for little if any diminution of copper production from Chile after nationalization once the break-in problems have been solved, which will probably take a couple of years.

An important feature of mineral development activity in Developing Countries is the base it gives for introduction of other industries. The industries that process the raw materials into intermediate or finished products, such as smelters, refineries, petrochemical plants, and steel plants, are the first to come into being. Then machines or raw materials needed in the developing industry, such as barite mines and processing plants, cement plants, the manufacturing of trucks, railroad cars, machinery, drills of various sorts, etc. come into being because they have certain assured markets and assured raw materials. Most African countries are too small and undeveloped to have this phase important as yet; political adjustments and economic realism must come first. However, in some of the larger South American countries this process is well advanced and will continue; it is an essential part of the take-off process and the further advanced it is, the less closely related to mineral development the process seems. Nonmetallic minerals, such as limestone, salt, ornamental stone, gems, gypsum, and others, are particularly important in building up local industry.

Finally, I would like to emphasize how closely mineral development should be related to agricultural development. Characteristic of most Developing Countries is the low agricultural productivity, linked to low consumption of fertilizer materials and in many cases to the thoroughly

leached nature of tropical soils. The highly publicized "green revolution" depends for success not only on special types of food plants developed in recent years, but also on a much increased input of fertilizers. Many of the fertilizers are, of course, based on mineral products, petroleum, phosphates, potassium salts, and limestone. Many of these commodities are in ample world supply, but local sources are needed if the green revolution is to be effective everywhere, for they cannot economically be transported great distances and local sources save foreign exchange for other pressing developmental needs.

#### Mineral industry development and the Developing Countries

Most Developing Countries are in the tropical or subtropical zones of the world, probably because in the humid tropics human subsistence in the ecological balance was not difficult and stimulus for development caused by uncomfortable environment was not acute, or, in the case of arid zones, little surplus for takeoff existed. With the explosion of wants and population during the past two centuries, the ring of subsistence and custom has been broken and the tropical world is on the move or would like to be. I have in my home an axe which I saw made in India, starting with the iron ore being fed into a tiny primitive blast furnace operated by a goatskin bellows pulled by a boy, through the stage of beating the slag out of the 10 pounds of metal produced, to the stage of shaping and hafting the axe. It is a good axe but I doubt that many more will be made by this 4000 year old process, which produced two axes and several arrowheads in one day.

The tropical zones, both arid and humid, present many problems in development, as I do not need to emphasize to you gentlemen. I shall not discuss the political and cultural problems which, although very important to development, are not my province, but will attempt to sketch the physical problems, different from those encountered in our temperate climate, that affect mineral development.

The most important factors in the humid tropics are those of high average annual temperature, coupled with high and often seasonal rainfall. The result of these two environmental circumstances is rapid and deep destruction of bedrock by weathering with accelerated solution and removal of the more soluble constituents such as calcium, magnesium, potassium, sulfide minerals and a host of minor elements, and the concentration of the resistates such as oxides of aluminum and iron, and of the clay minerals. As a result of this process, tropical soils commonly are not very fertile. They need many additives to produce bountifully and have poor structure for cultivation. From the minerals viewpoint, certain types of ore deposits form preferentially in this environment, particularly iron ores of some types, manganese ores, certain types of nickel ores, and aluminum ore. These are surficial deposits, easily found, and in fact are major sources of most of those metals.

On the other hand, many of the useful elements occur preferentially as sulfide deposits in the earth's crust. Obvious surface manifestations of such sulfide deposits are easily and rapidly destroyed under humid tropical conditions and many methods of prospecting that are effective in temperate zones are much less effective or ineffective in tropical

zones. Furthermore, the deep weathering and formation of clay minerals in humid tropical environments changes electrical properties of the surficial materials and enough research to fully evaluate the effects has not yet been done. The Geological Survey prepared last month for the Office of Science and Technology of AID a position paper on the state of the art and needed research in prospecting in tropical zones and those who are interested in pursuing this matter further can find much more detail in that paper. It is sufficient to emphasize here that much basic research is needed to make more effective known and still-to-be-developed prospecting techniques in the tropical areas. It should also be emphasized that deposits of industrial and fertilizer minerals are also difficult to find in the tropical environment and even such simple construction materials as sand and gravel or rock suitable for crushing to make concrete are not easily found in many large areas. The streets of Belem, Brazil, were paved with rock imported from Europe. Crushed rock in Manaus is brought in from quarries 400 km away. I should remind you that the total value of the industrial, fertilizer, and construction minerals and material produced in the world is considerably more than that of the metals produced.

Although the arid tropics in many places do not have these problems, they are most difficult of access and in many places are covered by windblown sand, obscuring rock outcrops and making human subsistence precarious.

The primary tool in search for mineral raw materials is the geologic map, for the occurrence of useful mineral materials is governed by geologic laws. In most tropical areas, because of difficulty of access

and particularly because of the deep soil cover, most such maps, if they exist at all, are very generalized and often inaccurate. As discussed in the paper cited above, new modes of arriving at usable maps have been and are being developed; progress in the science and particularly in the tools available to it is now explosive. Geologic maps are useful not only in prospecting but in civil engineering, agriculture, and many other arts based on use and manipulation of the natural environment. However, to make use of these tools and to interpret the results they give demands considerable scientific and practical sophistication and experience.

In order to make use of the newer modes of geologic appraisal in the search for deposits of useful materials, Developing Countries need strong geological organizations with highly trained scientists and technicians. Many of the smaller countries obviously cannot afford to create and maintain such organizations. Because geology and mineral resources are regional and have little relation to national boundaries, a regional rather than national approach to mineral development is the most logical if political problems could be solved. Thus Guinea, Liberia, and the Ivory Coast all share parts of the same iron ore province, which should be explored and developed as a unit rather than piecemeal. Many other countries, however, are large enough and are making efforts, some notably successful, to create such organizations. Among these are Brazil, Argentina, Mexico, Bolivia, Peru, Colombia, Venezuela, Guyana, Chile, Nigeria, the East African republics, Malagasy, Zambia, Pakistan, India, Indonesia, and others. The smaller countries usually have

skeleton or poorly organized geological services or contract most of their geological work to expatriates or foreign or international organizations. This is particularly prevalent in former French colonies.

Furthermore, there is a natural distrust in many Developing Countries of the intentions of foreign companies anxious to develop their mineral resources, a distrust rooted both in ignorance of prospecting hazards, techniques, and needs and also, let us face it, in some rather unscrupulous historic deals and lack of political wisdom on the part of some foreign companies. If indigenous expertise can be developed in these countries, the countries will be in the position of negotiating from knowledge rather than from ignorance and suspicion will be greatly allayed.

The needed research and the needed basic information-gathering to make productive the difficult search for mineral resources in the Developing Countries must to a large extent be carried on within the Developing Countries. For this reason the Geological Survey, financed in large part by AID, has placed prime emphasis in its bilateral programs on developing indigenous institutions and indigenous expertise. This has ranged over the whole gamut from assistance in organizing scientific libraries, through topographic mapping, cartographic techniques, analytical laboratories, geochemical and geophysical exploration, geologic mapping, computerization of geological data, engineering geology, disaster studies in cooperation with engineers and construction specialists, volcano studies, mineral deposit evaluation, and management problems. In early years, emphasis was placed on the more immediately urgent aspects, such as geologic mapping and mineral deposit appraisal; with the continually

increasing capacity of many of our counterparts, emphasis has been shifting toward less execution ourselves and more consulting and advising on specific problems. Training programs, both in-country and in the United States, have been basic to the whole program and have paid off handsomely, both in improving host-country capacity and in insuring a continuing exchange of information between our country and the others, as well as a continuing orientation toward our country.

The Developing Countries are aware of the importance of mineral production to varying degree and of the importance of developing their own expertise and institutions to an even more widely varying degree. Here again size and history are of overriding importance, for small countries, particularly many of those in West Africa, have had little opportunity to develop sophistication in this field. I shall not soon forget the French mine I visited in the Ivory Coast, the manager of which, when asked about their training program, answered that indeed they did have a training program, young French student geologists were brought in for practical training during their vacations in France. Perhaps because of this attitude, the Geological Survey was visited recently by the Minister of Mines of that country, who expressed interest in training Ivoirians in American universities and securing help from the USGS.

Many of the smaller countries, particularly in Africa, have turned to the institutions, both universities and governmental, in the original colonial powers to plan and execute the geological investigations basic to minerals development and also to such institutions and others of the

European community for the actual prospecting work. United Nations organizations, whose costs have been defrayed to such a large extent by this country and whose technical personnel is largely European, are also widely used by these countries. Because of the predominately European operative personnel, most business and development spinoffs go to European companies.

Little effort is apparently made by such organizations to build up indigenous institutional expertise, for in most cases their work is oriented toward other objectives. The average UNDP project in minerals devotes 5 percent or so of total expenditures (or less) to training of indigenous personnel. Africans are usually the titular heads of local institutions; rarely did I see or hear of any West African earth scientists in the field or actively engaged in scientific work. USGS experience in Liberia gives us keen insight into the difficulties involved in developing such expertise; it also shows that it is possible.

Many of the larger countries, on the other hand, seem determined to develop their mineral industry to the extent possible and at the same time to develop their institutions. Turkey, Colombia, and Brazil have borrowed considerable sums from AID to defray the expenses of working with the USGS to develop their capacity; Saudi Arabia is bearing all the cost of making a wide-ranging investigation of that country, the Philippines is negotiating a loan for further mineral resource investigations using both the new and more conventional techniques. A cooperative program with Indonesia has been reactivated. Bolivia recently requested reactivation of the cooperative program with the USGS in geological mapping and minerals exploration. A long-term, broad-scale geological and geophysical program with Liberia is being

wound up this fiscal year. Beside the countries mentioned above, responsible officials in Afghanistan, Iran, Pakistan, Libya, Korea, Thailand, Yugoslavia, Greece, Zambia, Mali, Ghana, Ivory Coast, Ethiopia, Nigeria, Mexico, Costa Rica, Guyana, Argentina, and Peru have requested bilateral assistance from the U. S. Geological Survey within the last two years; because of problems of financing and political problems, few of these requests could be met. Undoubtedly, were funding available and were the availability of funds for such help widely known, many more requests for assistance in minerals and institutional development would be received. In every case that the requesting country was an AID country, the USGS has been careful to route such requests to AID channel. Moreover, the USGS has received a number of requests from UN agencies for assistance in our fields of competence and, whenever possible, has cooperated with these agencies in such fields as geothermal power, geochemical prospecting, cartographic work, etc. I have not mentioned the many countries in which work on water resources has been requested and carried on.

The USGS has been severely handicapped by two factors; the first is the lack of flexibility in financing, as our organization has no authority to work overseas on its appropriated funds. Among the myriad demands on AID funds, that for mineral resource development is often lost in the shuffle despite the fundamental importance of this activity. Secondly, because a number of countries are no longer on the AID list, requests for assistance cannot be funded easily although the need for geological surveys and mineral development may be acute in order that

such countries can diversify their economy. Although Iran, for example, derives a notable income from petroleum, the critical professional mass needed for diversified mineral development does not yet exist within that country, nor is it likely to be developed without specific effort from outside

In the course of its thirty years of experience in work in 70 different developing countries, the Geological Survey has identified a number of fundamental geological problems common to many of these countries which demand broad-scale research for solution. Solutions to these problems would benefit many countries, not just one or two. At the request of the Office of Science and Technology, AID, research projects on a number of these problems have been drawn up and submitted. The USGS has invested a considerable amount of high level scientific time in the preparation of these projects. So far, nothing concrete has come out of this and no funding has been made available. We would suggest that research of this type is an excellent investment for the U. S. Government to make, for results can be applied in many countries and solid economic benefits may be expected. Such benefits will be both economic and social in the Developing Countries and the work will also assist the supply problems of the more developed countries such as our own. A list of these projects is appended to the text of this paper.

To summarize, the minerals industry has much greater potential of assisting the development of the Developing Countries than a simple glance at the production statistics would suggest; the multiplier effect of this pioneering industry can be great, reaching into foreign

exchange balances, transportation, industry, agriculture, and education, as well as being very effective in improving the ultimate resource of any country, the skills of the people in it.

Developing Countries vary widely in their present capacity to develop their minerals industry and particularly in their realization of the potential contribution that the minerals industry can make to their progress. Although many have no concept of the importance to them of creating the knowledgeable and effective institutions which are the foundation of progress in minerals development, many others are striving to create the laboratories, field teams, geochemical and geophysical prospecting know-how, mapping and cartographic abilities, and scientific knowledge that are the sine qua non of intelligent and effective minerals development.

The U. S. Geological Survey has worked in 70 different countries during the past 31 years, and has trained or arranged training for well over a thousand men and women from these countries. It has made notable contributions to developing the minerals industry of many of these. It feels that it could have been more effective if funding had been more regular, flexible, and had not been given on the basis of short-term objectives rather than the long-term effort that is needed in many specialized but interrelated fields.

The Geological Survey, which is specifically charged with responsibility for knowledge of domestic mineral resources, is keenly aware of the present and impending shortages in certain key mineral commodity resources and of the absolute necessity of having alternative foreign resources on which our country can draw for future needs. Present

civilization depends on exchange of commodities and these raw materials are as necessary to us and other developed countries as many of our products are to the Developing Countries.

Percentage of total exports of a country represented by Mineral exports

(Data from USBM Minerals Yearbook except underlined figures,  
from K. P. Wang, Minerals and Metals in International Trade, 1970)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Argentina			1.94		2.6				3.5	
Australia				10						<u>25</u>
Bolivia	88			96	95					<u>95</u>
Brazil			9.4							9.4
Canada	(1/3 of total exports)				26			30	28	26
Chile			89	83	83					<u>90</u>
Colombia			16							
Ecuador			1.0		1.0					
Gabon				44+	50-					
Indonesia										<u>50</u>
Iran								(oil)	<u>90</u>	
Jamaica										<u>55</u>
Liberia		50-						76		<u>75</u>
Libya								(oil)	<u>95</u>	
Malaysia										<u>20</u>
Mexico				28	26.5					
New Caledonia				95	90					<u>95+</u>
Nigeria			15.5					25		70 (large increase due to increase in crude oil exports)
Peru										<u>50+</u>
Philippines										<u>20</u>

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
South Africa			65	66 (41% if gold excluded)						45 (gold excluded)
Surinam										85+
Sweden										20
Thailand										20
Turkey										10
Venezuela		95			97			95	95	90
Zaire				49	72					65
Zambia									70	95



Ground Water Resources in Country Development <sup>1/</sup>

by

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U.S. Geological Survey

Importance of Ground-Water Resources

1. Ground water or the water in the saturated rocks of the Earth's crust that supplies wells and springs is perhaps the most reliable source of available fresh water for man's use.
2. Although widely available ground water is more abundant and of better quality in some areas than in others owing to the regional geologic and hydrologic framework in which it occurs.
3. Ground water assumes special importance in the arid and semi-arid regions of the developing world where surface-water sources may be absent or at best unreliable. In such regions regularly-spaced wells make possible systematic utilization and management of range lands for livestock production and permanently established pastoral administrative and marketing centers.
4. Also in arid regions ground-water development from wells or infiltration galleries may provide the only permanent source of water for sustained irrigated agriculture as well as the base for the entire local economy.
5. Because ground water is not readily contaminated by disease vectors, modern drilled wells with adequate sanitary protective

<sup>1/</sup> Statement at AID Workshop on Natural Resources January 21, 1972

design are favored sources of clean water for villages and small communities throughout the developing world.

6. Even in large irrigation projects in developing countries traditionally sustained by diversions from streams, ground-water development has taken on major importance for water-logging and salinity control as well as for provision of supplemental irrigation supply.

#### Ground-water resources in developing country priorities

1. Virtually, all the advanced and most of the middle-level developing countries have given high priority during the past two decades to systematic improvement and expansion of community water supplies drawn very largely from ground-water sources. This emphasis, of course, stems from efforts to control disease vectors; to improve health, sanitation and living conditions in the rural environment; and to check in some measure migration to the cities. I would say that community water supply has been of first priority among the demands on ground-water resources in most developing countries.

2. Irrigation from ground-water sources, I would say has generally been of somewhat lower priority than community water supply. Ground water, however, is not everywhere available in sufficient quantity for large-scale irrigation requirements. Where conditions are favorable, however, a number of developing countries have

given strong emphasis to ground-water development for irrigation and increased agricultural production. Among many notable examples that might be cited are the Indus Plains of West Pakistan, the Ganges Plains of India, the coastal plain of Taiwan, and the New Valley in the Western Desert of Egypt

3. A considerable number of developing countries with semi-arid climates but limited surface-water resources have given important emphasis to ground-water development for improved rangeland management and livestock production and collaterally for stabilization of nomadic populations. Ethiopia, Kenya, Somalia, Sudan, Nigeria and Niger, all in the savannah belt of Africa are notable examples of countries which are currently emphasizing ground-water development for rangeland management.

4. Ground-water development for industrial and municipal water supply has received perhaps the lowest level of priority attention in recent decades. With progressive urbanization, however, there will doubtless be increasing emphasis given to ground-water development in coming years to supplement limited or polluted surface-water resources.

#### Contributions U.S. can make to Ground-Water Resources Development

1. The U.S. through its own bilateral program as well as through the multilateral agencies has already contributed during the past 25 years large inputs of capital development aid for community

water supplies, irrigation projects, rangeland management, and municipal water systems based wholly or in part on ground-water development. At the same time substantial U.S. technical assistance inputs have been provided to improve capabilities for operation and management of such projects.

2. As one small measure of this effort, the Geological Survey has provided technical direction and/or support to ground-water investigations and related institutional development in 43 countries under the U.S. bilateral program during the past 25 years. About half these investigations were oriented toward irrigation development, a third toward community water supply, and the remainder toward more effective rangeland utilization. The Geological Survey has also provided technical support or consultation on ground-water projects of United Nations agencies in 51 countries during the same period. Currently, there are active ground-water projects in some 60 countries under the aegis of UN agencies.

3. In many of the advanced developing countries talents for successful operation of existing ground-water development projects have reached the "take-off" level. In middle and lower-level countries, however, there is still a considerable distance to travel on the road to viability. Nevertheless, I think the time is now ripe for U.S. aid programs to shift emphasis away from piecemeal ground-water development for single-purpose objectives toward integrated development for multiple uses taking into

account natural limits of ground-water reservoirs and aquifer systems. Much, of course, has been and is being done along these lines in the water-resources planning of advanced developing countries. I think also there is need to shift the emphasis back more toward the resource itself, namely the physical limits of development, and away from the resource utilization and economic benefits. If this shift does not occur there will be an increasing generation of problems such as declining water levels, aquifer depletion, and water-quality deterioration--all measures of over-development or misuse.

4. There is also a marked need for bringing into being high-level competence in the management of entire ground-water reservoirs and aquifer systems rather than just of smaller projects within such systems. Also, ultimately, ground-water development has to be integrated with river basin development to insure optimum utilization of the total water resource.
5. Renewed attention needs to be given to institution building and advanced training of ground-water management personnel. This phase of the whole development process has been somewhat neglected in recent years. It needs to be revitalized.
6. The developing countries need to be made more aware of the environmental costs of ground-water development for economic growth. Protection of water quality in fresh-water aquifer systems against pollution by pesticides, herbicides and

fertilizers and against recycling irrigation return and contamination from adjacent natural brackish or saline ground water is now becoming increasingly important in many advanced developing countries. Measures need to be taken to insure aquifer viability and even restoration of depleted aquifers through artificial recharge techniques appropriate to local geologic controls. Optimum use of aquifers and ground-water reservoirs needs to be stressed using more advanced techniques of systems analysis, including analog, digital, mathematical, modelling of relevant geologic, hydrologic and socio-economic parameters.

7. Increasing emphasis needs to be given to development of aquifers of marginal yield and water quality as for example in the crystalline rock terrains of peninsular India, the savannah region of Africa and northeast Brazil.
8. Increasing emphasis should be given, where possible, to the use of subsurface potential for regulation and storage of surplus surface runoff and to full utilization of water resources through conjunctive development, use and management of both surface and ground water in hydrologic basins or regions.
7. Much has been done but a great deal more remains to be done, if the developing countries are to reap the benefits of economic growth without at the same time suffering the costs of environmental deterioration.

APPENDIX D -4

OUTLINE OF REMARKS, JERRY A. O'CALLAGHAN, CHIEF, DIVISION OF COOPERATIVE RELATIONS, BUREAU OF LAND MANAGEMENT AT AID WORKSHOP ON: "AID'S ROLE IN THE NATURAL RESOURCE FIELD," JANUARY 21, 1972.

INTEGRATED LAND MANAGEMENT AND LESSER DEVELOPED WORLD

I. Introduction

1. Starting assumption: natural resource<sup>1/</sup> development has a lower place in technical assistance to lesser developed countries than its intrinsic importance warrants.

2. Reasons.

- a. natural resource development viewed as an adjunct to rural development, generally agricultural development.
- b. natural resource development viewed resource by resource, generally extractively.
- c. lack of institutional base for integrated natural resource development.
- d. lack of awareness of the relevance of the evolution of American land use experience.
  - (1) land settlement
  - (2) public administration of land use
    - (i) on Federal land
    - (ii) on private land
- e. overly technical background of AID missions.
- f. rapid turnover in AID missions and attendant disruptions of program continuity.
- g. summation: lack of a well defined conceptual focus for natural resource development.

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<sup>1/</sup> In these remarks I use the description of natural resource in the so-called Arlie House Report, "Workshop on Science and Technology Priorities in International Development." It reads in part: "Natural resources include natural products (emphasis in original) and amenities or situations (emphasis in original) . . . which are assigned values by man as a result of their potential economic or social benefits." Integrated land management is essentially the use of public authority in identifying, assigning values to products and amenities of natural resource situations, and then organizing the funds and manpower to realize them.

## II. New Conceptual Approach.

1. Nature is integrated.
2. Approaches should reflect this.
3. Institutions should reflect this.
4. Using Arlie House definition/see footnote.
5. Integrated land management.
  - a. under public authority identifies and assigns values to delineated areas of land and implements courses to achieve the optimum realization of the totality of the values over time.
8. Various means.
  - a. government ownership and administration of land.
    - (1) national forest in the U.S.
    - (2) public lands in the U.S.
  - b. public authority to regulate land use.
    - (1) zoning.
    - (2) land use planning.
    - (3) regional planning.
    - (4) emergence in U.S. of national land use planning.

## III. Results from the Integrated Approach.

1. Early and orderly identification of values.
2. Early and orderly assignment of values.
3. Opportunity to enhance values by foresight and planning.
4. Possibility of avoiding or minimizing conflict over assignment of values and uses.
5. Truer accounting of economic and social costs of alternative ventures.

6. Channeling human effort where greater possibilities of economic and social benefit can be realized.
7. Possibilities of a better urban, non-urban balanced.
8. Possibilities for labor intensive natural resource development in countries where unemployment is endemic.
9. Preservation of the renewing capabilities of the land.

#### IV. Conditions for Success.

1. Political will to end trial and error methodology.
2. Willingness to invest capital, owned or borrowed, in long term integrated natural resource development often as educated manpower.
3. Patience to develop the institutions.
4. Wise use of capital liquidated during some forms of resource development.
  - a. not used for consumption
  - b. not squandered in ill conceived endeavors.
  - c. possible plowback in form of educated manpower (land grant college idea)

#### V. Some requisites.

1. Need to meld technology and management on delineated areas of land.
2. Need to create institutions to do this.
3. Careful adaptation to conditions of each lesser developed country.
4. Real requisite.
  - a. indigeneous leaders with technical, administrative, and political skills.
  - b. Gifford Pinchot as a case in point.
5. Pinchot's strategic contributions.
  - a. dismissal of idea that technical forestry could only be introduced at a higher stage of development.

- o. application of a rudimentary degree of technical forestry to actual forest lands of what was a lesser developed nation.

## VI. Outline of Early Action<sup>2/</sup>

1. Reservation of large areas for ultimate integrated land management.
2. Creation of demonstration areas.
  - a. applying science and technology to a specific area of land.
  - b. providing training arena for technical - administrative leaders.
  - c. acting as a matrix for reinvestment of capital liquidated in extractive use of natural resources.
  - d. furnishing cadres for the further extension of integrated land management as more intensive management is called for in the reserved lands.
3. Integrated land management Education Centers in U.S.
  - a. Emphasis on training natural resource managers i.e., those who would integrate work of technical specialists.

## VII. Later Actions.

1. As supply of professional specialists and managers grow!
  - a. identification and assignment of values (per AID'S Arlie House definition) i.e., land use planning.
  - b. determination of best ownership or administrative jurisdiction.
  - c. transfer to appropriate ownership or jurisdiction e.g. agricultural land turned over to an agricultural settlement administration for ultimate transfer to farm settlers.
  - d. interim management with appropriate degree of integrated land management.
2. Full scale integrated land management.
  - a. as conditions warranted.
  - b. as the institutions available.

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<sup>2/</sup> Although these actions could be adapted to extending land use planning and management using public authority over all kinds of ownership of lands, these actions are predicated upon large blocs of government owned land subject to its management in a proprietary capacity.

c. as the professional talent available to man the institutions

VIII. American Bi-lateral involvement.

1. 200 years of experience in land settlement and land use.
2. Federal government an excellent, almost sole, source of expertise in integrated land management on a national scale because integrated land use management has developed pragmatically among Federal land management agencies.
3. prospective experience under the emerging National Land Policy Act.



APPENDIX D - 5

SURFACE WATER RESOURCES <sup>1/</sup>

E. Kent Bebb  
Division of Foreign Activities  
Bureau of Reclamation

Aside from the air we breathe, water is the resource most essential to man's survival. Water is necessary to sustain our lives, to grow our crops, to water our livestock, to move our freight and to dispose of waste. It is also used for generating electric power, for manufacturing, for air conditioning, and for many recreational activities. Civilizations have emerged and prospered where water was available and declined and disappeared where water was not available or was misused. Water is a vital ingredient of a sound economy.

Rivers and other surface streams or water bodies are the principal sources of water supplies. History shows that the earliest human settlement grew in the proximity of streams and lakes. However, because of population pressure and other circumstances, man is penetrating into previously uninhabited areas. As many of these areas are arid or semi-arid, especially careful development and husbandary of water resources is essential to transform them into habitable environments. Water is not evenly distributed over the globe in a manner to serve man's needs, at the right place and at the right time. For these reasons manmade facilities are required to alleviate the imbalances.

Throughout time, the harnessing of freshwater has been a prerequisite for socioeconomic advancement and long-term stability. Man, in the thrust for advancement, has turned to and depended upon many of the great rivers of the world as a workable natural resource to satisfy many of his growing needs. And for ages man has sought the means and technology to control many vast rivers for development of arid land resources to meet a continually growing demand for electric energy.

Today, many rivers have been almost completely controlled by man -- some partially -- and some not at all. The people living along the banks and bottom lands and deltas have learned the natural ways of the streams. To them, the reality of a river is immediate and inevitable. During the wet season, the bottom land and delta areas are flooded.

After the rainy season has passed, another picture presents itself. Water fast becomes as scarce as it was plentiful. In many years not enough water can be impounded to assure the production of crops. During these years the fields are dry and barely enough crops are harvested to provide food for the people, the grass dries up and livestock becomes thin from lack of food. But, even in the driest years,

<sup>1/</sup> Statement at AID Workshop on Natural Resources , January 1972.

many rivers and their tributaries flow past and through parched lands carrying sufficient water to relieve, in large measure, the searing drought. Without manmade development, none of the water can be used to quench the thirst of the land except for small patches along the banks where water can be carried by hand or diverted with small river pumps.

#### LDC Problems re the Planning, Development, and Management of Surface Water Resources

LDC's know the results of uncontrolled surface water. However, they frequently think of uncontrolled surface water as a threat rather than as a potentially beneficial resource. Thus, only part of the problem of impressing the LDC's of the importance of developing surface water resources has been accomplished. Educational and public information programs are needed to apprise their leaders as to the development possibilities of their country with controlled water versus the known hazards and their uncertainty without such control (flood, food shortage, loss of life, property damage, etc.).

LDC's must be convinced of the importance of strong leadership, organization, and training of technical and managerial personnel to ensure uniformly high standards of basic data collection, multi-objective as well as multipurpose planning for whole river basins, and effective consideration of environmental factors. They must be convinced of the requirement for good and continuing surface water inventory and eventual control if economic development is to take place.

Often, LDC's are not aware of means for obtaining assistance for necessary water resources data collection, manpower training, development planning, construction, and the eventual project operation, maintenance, and management. There needs to be much clearer understanding of the opportunities for loans, technical assistance, and management assistance under the AID program.

All too often the long-term benefits of well planned water resource development are not recognized. The necessity for the consideration of national, regional and local needs in water use planning, the time of negotiation for monies with which to plan and construct feasible projects, the actual time of construction, and the manpower training time involved to develop counterpart planners and management specialists who will carry on the work, must be taken into account.

Frequently, LDC's need to be made aware of the possibility for, and the advantages to be derived from, cooperative development of international streams. The concept of joint development and responsibility for efficient utilization of the water resources may radically alter existing relationships with adjoining countries, and may require negotiation of international treaties and agreements.

The need for training "middle management" technical and subprofessional personnel, concurrently with more advanced professional and academic training is often overlooked. Too frequently exaggerated emphasis is placed by LDC's on "degree oriented" programs when what is really needed is nondegree practical training which will provide the manpower that can execute the development plans of the professionals.

#### AID's Potential to Assist LDC's

Under its basic legislation, AID has the authority to call upon and integrate the expertise of all government agencies on a reimbursable basis. Under the mantle of the Department of State, it can and has established missions in the LDC's which work directly with counterpart government officials and which can observe and evaluate country needs, firsthand. Staffing of these missions could and frequently does include specialists familiar with the surface water resource problems of the country. It is essential that not only diplomatic and administratively trained personnel be involved in plans for technical assistance but that technical personnel experienced in the problems of the collection and evaluation of data and comprehensive water resource planning be included in any negotiations. This is particularly true in the matter of training LDC personnel who will eventually take over the responsibility for their country's water resource development.

AID has access to and could utilize, to a great degree, informational teams from the USIA who could assist in the preparation of pictorial information which can transcend any language barrier and can spark the curiosity and interest of responsible officials in the LDC's in the potential of their surface water resources.

Any development plan, whether it be for surface water or minerals, should be based on a master plan with established time frames and clearly established goals to be accomplished. Preparation of such a plan for water resource development in LDC's could be assembled in a relatively short period by qualified and experienced planners. Such expertise is available within our government and should be utilized in the very early stages of mission operation.

Along with the pictorial information presented, there is an acute need for high level LDC government officials to witness, firsthand, the actual accomplishments of good water resource planning, on an appropriate scale which will be challenging but not overwhelming. This would involve physical visits to projects in the United States and in other developed countries wherein they could relate to their own country's problems.

#### Reclamation's Potential Assistance to AID in Water Resource Development in the LDC's

As part of its original mission, the Bureau of Reclamation has worked closely with the Geological Survey in the collection and interpretation of basic data on available surface water; we have conducted field investigations to determine suitability of lands for irrigation; made surveys to locate engineeringly feasible storage sites; prepared engineering and economic feasibility studies to provide the Congress with information on which it could make reliable judgments as to the need for, and potential of, the water resource development; developed farm budgets for each potential project to provide reliable information on the cost of producing crops, anticipated yields, market value of crops produced, and the gross and net income which the project water user can expect to receive while paying his share of the project costs; designed and constructed engineering features associated with the projects; and ensured that the constructed projects were operated and maintained so as to protect the Federal investment in the project and that the water users or project beneficiaries inherited economically sound, efficiently operated projects.

Over the years, a staff of trained specialists in all fields related to water resource development has been established at our Engineering and Research Center and at other locations in the West. Our operations within the United States are limited to the 17 contiguous western states which have a problem of unreliable and inadequate water supply during the crop producing season. This area is divided into 7 regions, based on river basin drainage, each region being administered by a regional office and such planning and construction offices as are required for current work. At the present time there are about 8,800 specialists employed by the Bureau from whom AID could draw needed expertise. The area in which we believe we could particularly contribute is that of multiobjective, multipurpose river basin planning, wherein all available water resources are considered for development utilizing economic and engineering feasibility studies, weighted by environmental considerations, to evolve projects which will best meet the LDC's short and long term needs. Reclamation's experience, enhanced by improved and streamlined planning procedures, put us in a position to perform this work quickly and at minimum cost.

Our work in the undeveloped and sparsely settled western states has counterpart in AID's work with LDC's. Projects which we propose must have the support and backing of the water users and we must, therefore, assemble appropriate data and information which will convince local, state and Federal authorities of the necessity for and the desirability of the project.

In the past, we have worked closely with AID in providing technical teams to perform water resource planning studies in some 50 LDC's. Also, we have made specialists from other related fields available upon request for short-term overseas assignments.

An equally important area of past and potential assistance to AID lies in our training of foreign personnel in this country in the various technical fields related to water resource development by means of practical, on-the-job training, tailored to meet individual requirements. Periods of training may vary from a few months to a year. While the majority of programs have been conducted for professional personnel (i.e. graduate engineers, economists, agronomists, etc.), we have conducted training for many subprofessionals. We have a few selected courses of formal instruction for our own personnel, which may be attended by trainees; however, most of our training is accomplished by having the trainee work directly with men experienced in the technical fields in which he is to acquire skills.

In summary, the Bureau of Reclamation looks forward to continuing to lend valuable, prompt, and efficient support to AID and the LDC's, particularly, in the early stages of water resource planning and development, up to and including the preparation of engineering and economic feasibility studies. We also believe that our type of practical, in-service training is peculiarly suited to meet the needs of many LDC's which must develop or increase the expertise of their own technical, professional and subprofessional personnel to effectively carry on the resource development work financed under AID or other sponsorship.



ENERGY<sup>1/</sup>

Mr. John Rixse  
Power Division  
AED Office of Engineering

We are interested in energy because it is essential to a nation's growth.

BUT, we must delve further because there are two major types of energy - raw and processed. How we look at the development of these two types of energy and how we look at the role of these two in a country's development can be, and I feel are, quite different. I would suggest that energy as a natural resource development and energy as a tool of economic, social, cultural and political development are quite different.

Let's each of us weigh these matters from scratch and then ask ourselves some questions, the answers to which will lead us, not our predictions.

Raw Energy

solar  
fossil-coal, lignite  
Petroleum, gas  
nuclear - uranium, thorium, etc.  
animal wastes  
vegetable wastes  
wood  
water  
human  
geothermal

Processed Energy

steam, hot air (gas)  
charcoal, coke  
refined oils, gasoline, kerosene  
hot metals (fluid)  
electricity (electrical)  
mechanical  
Briquets

First I would submit that raw energy is a "natural resource," and that, processed energy is a "resource" and that they must be treated separately, yet, can be studied or evaluated simultaneously in conjunction with a country's over-all development needs, potential and plans. Hence we try to stress "Energy Studies."

On the other hand, since this workshop deals with natural resources, let's look at raw energy. Here we find several groupings.

First is that of low cost, readily available energy, e.g., human, wood, animal wastes, vegetable wastes and to some limited degree water.

Second is that requiring major capital investment and not readily available; and which

<sup>1/</sup> Statement at AID Workshop on Natural Resources, January 1972

(a) must be economic locally, e.g., water, lignite

(b) may be used locally, but owing to the high world value and high capital requirement is most usually exported, e.g., coal, petroleum and gas.

Third is that requiring continuing research and technological development, and substantial capital, with high world value, hence is most usually exported, e.g., nuclear material.

Fourth is that requiring continuing research and extensive capital, yet must be used locally, e.g., solar and geothermal.

Of these it is to be noted that the most dominant are the raw energy natural resources in the second and third groupings. These are the ones which the LDC's must be dependent upon for the next several decades. These are the same resources which are involved in the so-called exploitation of a developing country for which it receives capital and which may or may not be beneficial to the country's development.

Concerning solar and geothermal energy there are active programs underway, with geothermal being attractive enough that it attracts private risk capital

Now as to the questions which must be asked.

- (1) What is the energy potential (by types) of an LDC?
- (2) What is the energy need of the LDC?
- (3) How well do these match - Energy Evaluation
- (4) Will development of the raw energy (natural resource) benefit mostly the LDC or the developed country?
- (5) What are the economic, cultural, social and political needs of the LDC and how would development of its raw energy resources meet those needs?

There are ways at getting at these questions in the context of a country, a region, the world, but they must take into account a substantial number of conflicting factors. This is a stimuli of the World Energy Conference and might lend itself to more intensive consideration under its auspices or to a more limited degree by A.I.D.-financed Energy Studies, as we have done.

In closing, most if not all LDCs are able to meet their energy requirements without new or major innovations or exploitation of their present raw energy resources, primarily because processed energy is economically available, requiring, primarily, capital for utilization.

ACTIVITIES OF THE INTER-AMERICAN DEVELOPMENT BANK  
RELATED TO NATURAL RESOURCES

Mr. Clarence M. Pierce  
 Office of the Program Advisor

The amount of time assigned to the remarks concerning the Inter-American Development Bank has been very generous. I seriously doubt whether I can usefully provide information which would require 45 minutes to express.

From the title of the work group in the communication from Mr. Long, I assume that the information you would like to have involves two parts:

1. Activities of the Inter-American Development Bank (to which I will refer hereinafter as "IDB" or "Bank") in development and exploitation of natural resources by lending and technical assistance;
2. Bank policies and programs for the conservation of natural resources of member countries.

As a financial institution, IDB is concerned with development loans designed to improve the economy and social development of member countries. Nearly all of the loans may depend upon use of natural resources in one form or another. A recent survey of loan projects in the Bank's pipeline as of September 1971 estimates that 31% have a high impact potential in resource development or use, and 56% have an indirect or modest impact. Only 13% of the loans are estimated to have no direct or indirect natural resources involvement.

IDB classifies its loans by sectors which, for the most part, are not identified directly to any particular resource component. For example, the sector of Agriculture involves a number of resources including land, water (irrigation), forestry and fisheries. The

1/ Statement at the AID Workshop on Natural Resources January 21, 1972

sector of Industry and Mining involves a complex of natural resources as does Electric Power. Water supply and sewerage systems are not limited exclusively to water and use of water but are related as well to the whole problem of urban development and pollution control. I am sure that these classifications of sectors are well known to you and that it is unnecessary to elaborate further. However, the use of broad sectors as a means of classification makes it difficult to present any accurate statistics on the specific natural resources involved and the impact of the loans concerned on the use of such resources.

With the above qualifications, the lending of the Bank in calendar 1971, by sectors, was as follows:

- 1/  
LENDING IN CALENDAR 1971

<u>Sector</u>	<u>Millions of US\$</u>
Agriculture	93.22
Transportation and Communication	170.20
Industry and Mining	53.65
Electric Power	146.20
Water Supply and Sewage Systems	57.00
Urban Development and Housing	7.50
Education	62.50
Tourism	23.90
Preinvestment	15.40
Export Financing	23.64
Technical Assistance	6.00
<u>Total:</u>	<u>659.21</u>

Accumulated total 1960 through 1971: \$4.745 (approx.)

As previously indicated, the impact of these loans on specific natural resources involved with respect to their use and effect, is very difficult to present accurately without a detailed analysis of

1/ The figures are provisional, subject to adjustment. Final figures will be reported in the official Report of the Bank for fiscal 1971 (The Bank uses a calendar year as its fiscal year.)

each loan. The accuracy of such an analysis might be also questionable.

The answer to the second question is very simple to express. As of yet the Bank has no formal policy or policies with respect to overall concern about conservation of natural resources and environmental protection. This is not to say that the Bank does not have a concern in this field. The Bank has acted to take into account conservation of specific natural resources within particular loan projects which have included the additional cost as a social expense for proper protection of the natural resources involved or of the environment.

Recently the Bank contracted a consultant to try to organize information about this problem in the Bank so that some constructive steps could be taken to develop standards and guidelines which would assure more effective protection of use of natural resources and of the environment. The consultant is Mr. John Camp who is at present a consultant of the Rockefeller Brothers. He has prepared a draft report on which I have drawn heavily for these remarks:

"From a rather cursory review of the Bank's operations with economists and technical specialists, it was found that there is a general awareness and concern for the environmental aspects of their speciality areas. There seems to be little question that pollution control devices are considered a part of sound planning for a particular industry, that highway design and location takes into account measures to control erosion and provide adequate drainage, and that the most appropriate treatment methods are used in establishing sewerage systems. There is

also recognition that perhaps present guidelines or criteria used to plan and analyze the feasibility of loan projects could be expanded to include environmental considerations. The conclusion is reached that while directly related environmental aspects of loan projects may be given adequate attention, there is still a need for taking into account broader environmental considerations such as ecological factors in opening up new land areas with roads, industrial location in relation to population centers which involves urban planning, and in the case of sewerage systems, for example, the projected use of waterways into which treated effluent will be discharged. This is a reflection of the need to evaluate the social costs and benefits of projects, including their favorable and unfavorable impact on the environment."<sup>1/</sup>

Within the Bank at present there is no formal analysis of proposed projects to assess their impact on the environment. This type of review has depended upon the particular project analyst in the specialized fields for action. Mr. Camp has recommended that there be a staff review of all projects designed to evaluate their environmental impact prior to submission for formal approval. I understand that this recommendation is similar to the process presently in effect at the IBRD.

Project appraisal does not supply the entire answer to the problem presented by the impact of lending in developing countries. It is not possible to impose arbitrarily standards which are not understood or accepted in developing countries. It is clear that those working in the inter-American field know that there is a wide range of opinion regarding the need for control of natural resources and protection of

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<sup>1/</sup> The Inter-American Development Bank and the Environment - Suggested Policy and Strategy, John Camp. Draft of December 2, 1971.

the environment. In addition to this there is the question about whether the social cost of protection of natural resources and the environment should be borne entirely by the developing countries. This situation indicates the need for the development of or agreement on, a development strategy which hopefully will emerge from the U.N. Conference scheduled for Stockholm for this year. The remaining task will be then to try to relate the national development programs and the projects as proposed by the developing countries to such a strategy. The methods by which the additional cost of the protection devices incorporated in such programs and projects may be financed will be the concern of the governments of both the developed and developing countries and the financing organizations considering the projects involved.

As in any institution, there are a variety of viewpoints within the Bank on this subject. The report of Mr. Camp will be useful in attempting to develop a consensus on major points and hopefully result in the administrative changes which will permit the IDB to cope in a more effective manner. As a personal opinion, I would expect that IDB will continue to improve the standards and guidelines for specific projects involving natural resources and environmental protection such as: Forestry, Fisheries, Irrigation, Hydraulic projects with particular reference to dams and reservoirs, Urban Development projects including water and sewerage, Mining and Industrial projects, and Colonization and Agrarian Reform projects. The objective of these continued efforts will be to improve the standards for projects for these types of activities so as to build in safeguards for use of natural resources and protection of environment.

The Bank has made loans which contain provisions for research as part of those loans. Also a considerable proportion of the technical assistance funds of the Bank have been expended for making the results of research available to member countries through training and distribution of information. It is anticipated that the Bank will become even more active in support of research as a means of developing a consciousness of the need for conservation of natural resources and protection of the human environment.

The list of such activities is too long to detail here. Also, support of research has been applied to different aspects. For example, in the field of agriculture, it has covered the following types of activities:

1. Loans which included research components for agricultural research institutions involving training of staff (vocational as well as fellowships for graduate training), equipment for research, technical libraries, etc.
2. Support of international research centers.
3. Survey of national research centers as to their fields of specialization and requirements and capabilities.
4. Support of research in basic food crops needed for better nutrition in member countries.
5. Support of research in technological packages which will permit application of modern agricultural technology by marginal farmers.

**Program**  
**of the**  
**Office of Regional Development**

**General Secretariat**  
**Organization of American States**





The Office of Regional Development (ORD) of the Executive Secretariat for Economic and Social Affairs of the Organization of American States was established in November 1969 as an expansion and restructuring of the former Natural Resources Unit of the Department of Economic Affairs. The responsibility of the Office includes supervision of two major training centers: the Inter-American Center for the Formulation and Evaluation of Development Projects (CETREDE) and the Inter-American Center for the Integral Development of Land and Water Resources (CIDIAT).

Between field and headquarters personnel, the ORD has a staff of 95 persons comprised of specialists in soils, geology, forestry, hydrology and hydrogeology, civil and hydraulic engineering, geography, economics (agricultural, industrial and regional), and regional planning, as well as technical support personnel. More than half of these experts are stationed in Latin American countries; nonetheless, a technical nucleus of experts representing the various disciplines of the ORD operates out of the headquarters office in Washington, D.C. The ORD's staff functions on a budget of approximately \$ 2 000 000 per year; in addition, some \$ 750 000 is provided annually by national counterpart financing to field activities and training centers.

## OBJECTIVES

The basic objective of the Office of Regional Development is to collaborate with the member states in their efforts to accelerate the economic and social development of particular zones or regions. These regions may be wholly contained within one country or may include areas of several countries that have agreed to cooperate and coordinate their efforts for the purpose of mutual development.

More specifically, the Office is dedicated to providing assistance in:

- survey and evaluation of physical resources
- formulation and evaluation of development projects
- regional development planning
- rational integrated management of natural resources

Upon request from a member state, the Office provides technical assistance, advisory services, and training to help national and local agencies to:

- design and execute studies in these fields
- develop the institutional capability to conduct the studies themselves

The balance between these task-oriented and institution-building activities depends in part on the needs and capabilities of the counterpart agency and the urgency of the project.

## STRUCTURE

The General Secretariat of the Organization of American States is divided into two executive secretariats - the Executive Secretariat for Economic and Social Affairs and the Executive Secretariat for Educational, Scientific, and Cultural Affairs - and two assistant secretariats - the Secretariat for Technical Cooperation and the Secretariat for Management. The Office of Regional Development is a division of the Executive Secretariat for Economic and Social Affairs; other major units of the Executive Secretariat are the Departments of Economic Affairs, Social Affairs, and Statistics.

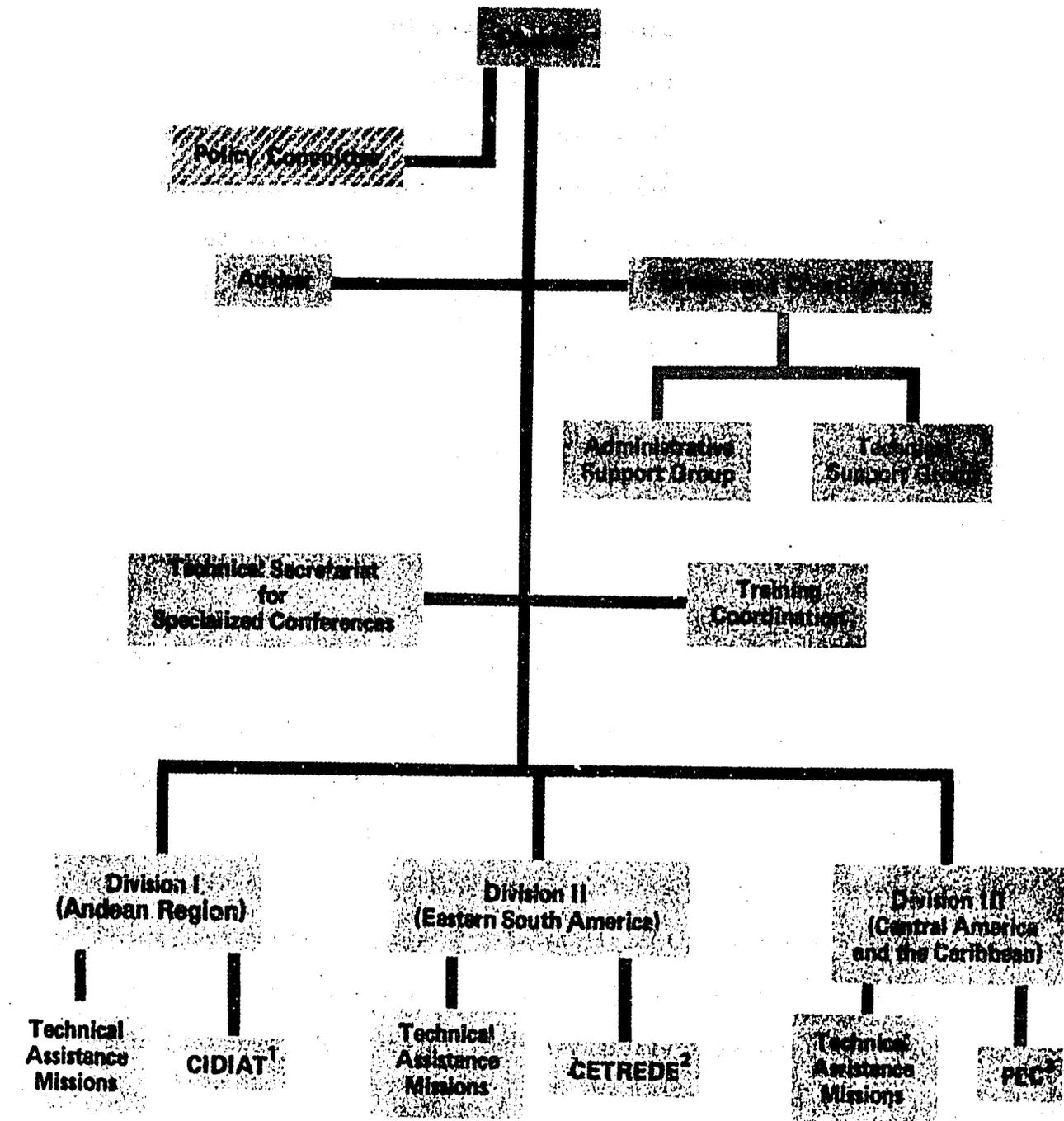
The program of the Office of Regional Development is executed by three geographical divisions that are responsible for guiding the program's technical assistance activities in the member states: Division I - South America, Andean Region; Division II - South America, Atlantic Region; and Division III - Central America and the Caribbean (See Figure I).

The geographical division system assumes that a sufficiently large group of high level professionals is maintained at headquarters to provide a permanent interdisciplinary team competent in the major disciplines involved in the work of the Office. This team participates in planning and management of the wide-ranging activities of the regional development program. Headquarters personnel are administratively assigned to individual divisions, but in practice frequently work together as field teams carrying out specific technical missions.

The inter-American centers under the jurisdiction of the Office are supervised by the Division in which they are located geographically, CIDIAT in Division I and CETREDE in Division II.

The three divisions are assisted at headquarters by a technical support

# ORGANIZATIONAL CHART OFFICE OF REGIONAL DEVELOPMENT



(1) Inter-American Center for the Integral Development of Land and Water Resources

(2) Inter-American Center for Formulation and Evaluation of Development Projects

(3) Special Training Program

Figure 1

group which provides cartographic and publication services and by an administrative support group, both under the supervision of a Special Assistant for Management. A Special Assistant for Training Coordination advises the Director in matters of training policy, develops new training programs, and provides liaison with training facilities outside of the ORD. A Technical Secretariat for Specialized Conferences provides support to the Inter-American Committee on the Alliance for Progress (CIAP) and to Pan American congresses dealing with highways, ports, and telecommunications.

A special feature of the ORD is the Policy Committee, consisting of the Director, his Adviser, the Division Directors, and the Special Assistants for Management and Training. The Committee advises in the formulation of office policy, assists the Director in the preparation of the program-budget, evaluates requests for assistance from the member states, approves the work plans of technical assistance missions and the training centers CIDIAT and CETREDE, and generally maintains coordination of office activities. In its activities, the Policy Committee strongly reinforces the horizontal interactions within the program of regional development which are required to maintain its integrated inter-disciplinary focus.

## PROGRAM AND ACTIVITIES

Virtually every large technical assistance project involves some aspect of the four major thrusts of the Office: resource survey, project formulation, regional planning, and resource management. In the following descriptions of the activities of the ORD, a given project may be indicated under several categories but is described under the one that was the most important component of the project.

Figure 2 is a tabular summary of the nature of activities of the ORD (and the former Natural Resources Unit), past and present, indicating the relationships of technical assistance to training and citing examples of technical assistance missions in each field of endeavor. Representative examples of completed technical assistance missions are described below and summarized graphically in Figure 3, while current technical assistance is described in the next section. The related training activities are described in detail in a subsequent section.

### SURVEY AND EVALUATION OF PHYSICAL RESOURCES

#### Fields of activity

1. Planning, execution and supervision of surveys of physical resources including infrastructural factors such as transport, telecommunications, energy, etc.
2. Identification of specific development projects
3. Preparation and execution of cadastral surveys
4. Establishment of modern documentation practices for: utilization and dissemination of existing data; systematization of data forthcoming from remote sensing

#### B. Examples of completed technical assistance in these fields

1. & 2. Survey execution and project identification

##### a. At the Multinational Level

## SUMMARY OF PROGRAM AND ACTIVITIES OF THE OFFICE OF REGIONAL DEVELOPMENT

FIELDS IN WHICH THE ORD PROVIDES TECHNICAL ASSISTANCE AND ADVISORY SERVICES	EXAMPLES OF MISSIONS OF TECHNICAL ASSISTANCE OR ADVISORY SERVICES	RELATED TRAINING FACILITIES
<p><u>I. Survey and Evaluation of Physical Resources</u>                      Planning, execution, and supervision of surveys                      Identification of development projects</p> <p>Establishment of modern information systems,                      Systematization of remote sensing data</p> <p>Advice and support to strengthen local institutions</p>	<p>Multinational: Plata Basin Phase II*                      National: Dominican Republic*, Haiti+                      Regional: Guayas River, Ecuador*; Pedraza-Paez, Venezuela*</p> <p>Country Indices*, Plata Basin Phase I*,                      El Salvador Agricultural Planning+</p> <p>INHERI, Ecuador*; SUDENE, Brazil*; IDESP,                      Marajó Island, Brazil*</p>	<p>PEC courses in:                      photointerpretation                      soils                      geologic exploration and mining                      use of forest products                      reforestation                      underground water exploration                      applied hydrology                      administration of natural resource surveys                      transportation economics</p>
<p><u>II. Formulation and Evaluation of Development Projects</u>                      Planning and execution of prefeasibility studies;                      Preparation of scope of work of feasibility studies</p> <p>Preparation of loan applications</p> <p>Comparative evaluation of alternative projects;                      Coordination of projects in regional plans</p>	<p>Guayas Basin, Ecuador*; Pedraza-Paez                      Region, Venezuela*; Santa Lucía Basin,                      Uruguay*</p>	<p>Training Centers offering inter-American and national courses:                      CETREDE - preparation of industrial, agro-industrial and infrastructural projects                      CIDIAT - formulation of land and water development projects; operation and maintenance of irrigation districts</p>
<p><u>III. Regional Development Planning</u>                      Integrated regional development planning</p> <p>Studies to define development regions;                      Preparation of comprehensive regional plans</p>	<p>Department of Meta, Colombia+                      El Salvador+; Northwest Paraná, Brazil*</p>	<p>PRA course in:                      Regional Planning, Universidad Nacional del Nordeste, Resistencia, Argentina</p>
<p><u>IV. Conservation and Management of Natural Resources</u>                      Advice on resource management policy and legislation</p> <p>Erosion control, reforestation, land reclamation studies</p> <p>Identification of national park sites</p>	<p>Conservation policy for Peru*                      Northwest Paraná*; Land Reclamation, Barbados*                      Cutibireni Park, Peru*</p>	<p>PEC course in:                      National Park Management</p> <p>PRA course in:                      National Resource Economics and Management, University of Michigan, Ann Arbor, Michigan</p>
	<p>* Described in text on completed technical assistance</p> <p>+ Described in text on current technical assistance</p>	

100

Figure 2

## La Plata Basin Program

This major project, involving five member states, was designed to: produce the information necessary for design and execution of development projects, and for planning in the fields of water resources development, transport, minerals, agriculture, and forest resources, as well as the preparation of integrated national and regional projects.

support local, national, and regional agencies responsible for the design and execution of development projects in the basin, and aid in the coordination between local agencies and the national and international committees operating in the basin.

identify development projects and design and execute studies of these projects through the prefeasibility stage.

The program has been conducted in three phases. Phase I consisted of an Inventory of Hydrologic and Climatologic Data. The study collected and analyzed all existing data in these disciplines (including preparation of a series of maps at 1:3,000,000 scale), evaluated the data collection institutions and their methodology, and made recommendations for improving the data networks, exchanging information among the countries, and undertaking specific hydrological studies related to development projects.

Phase II, the Evaluation of Natural Resources, consisted of three parts:

an analytic inventory, preparation of map catalogue and compilation of maps at a scale of 1:3,000,000 of existing data not covered in Phase I; topics included were aerial photographic coverage, mapping of topography, geology, soils, land capability, ecology, land use, and forest inventories.

selected thematic studies and mapping at 1:3,000,000 scale of natural resources and related factors pertinent to development. Subjects selected were geology, soils, vegetation, hydrogeology, present and potential land use, energy, transport, and population distribution.

based on the data collected, areas were identified that justified more intensive study for the identification of development projects.

The Plata countries have requested more intensive investigations in certain of the areas identified in the Phase II report. These studies, constituting Phase III of the Plata Basin Program, are reported under Current Technical Assistance Activities.

### b. At the National Level

#### Integrated Evaluation of the Natural Resources of the Dominican Republic

This 16-month project included the preparation of 1:250,000 scale

## SELECTED TECHNICAL ASSISTANCE ACTIVITIES 1960-1971

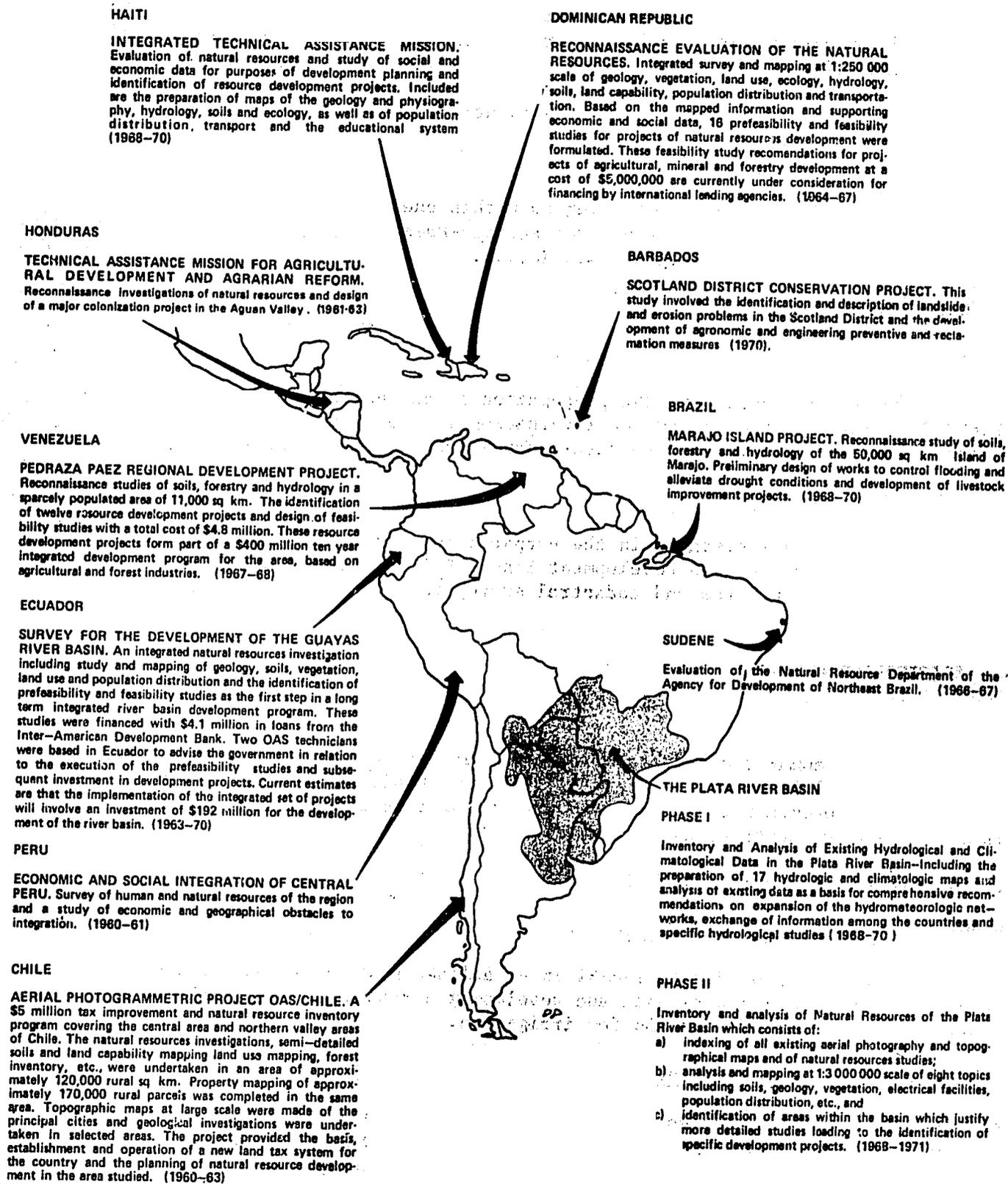


Figure 3

maps of natural resources used in the identification of development projects and which also serve as the point of departure for selected detailed mapping now being conducted by the Dominican Government. Specific pre-investment studies and comprehensive development programs were recommended in the fields of agriculture (including irrigation and drainage projects, crop diversification and intensification, research and extension), surface and underground water, forest resources, minerals and resource conservation. Several of these projects were subsequently funded.

c. At the Regional Level

Projects involving surveys of a region within one country, such as the Guayas River Basin in Ecuador and the Pedraza-Paez in Venezuela, are described in the section on Project Formulation.

3. Cadastral Surveys

Honduras

Assistance was provided in the preparation of an application for a \$ 2,600,000 loan from the Agency for International Development (AID) to finance a national cadaster and resource survey program for Honduras.

Sierra Region of Ecuador

The ORD provided assistance in the preparation of a \$ 4,000,000 loan request to the Inter-American Development Bank (IDB) to finance an agricultural development program and cadastral survey in the Ecuadorian Sierra Region.

4. Information systems

Country Indices

A series of annotated indices of each member OAS country were prepared during the years 1964-66 which cover the following topics in map catalogue form: aerial photographic coverage and mapping of topography, geology, soils, forests, vegetation, and land use.

5. Strengthening local institutions

INHERI Soil Testing Laboratory, Ecuador

Assistance was provided to INHERI in establishing in-house soil testing facilities, training personnel and developing a systematic approach to survey and evaluation of soils for irrigation.

Evaluation of the Department of Natural Resources of SUDENE

In 1967 Natural Resources Unit personnel studied the operations and interrelationships of the 10 divisions of SUDENE's Natural Resources Department and made recommendations for improving its efficacy.

INSTITUTIONAL DEVELOPMENT IDESP, STATE OF PARA, BRAZIL

For a period of three and a half years, the Natural Resources Department of IDESP was strengthened by means of technical assistance and related training with particular focus on the program for economic and social development of Marajó Island.

I. FORMULATION AND EVALUATION OF DEVELOPMENT PROJECTS

A. Fields of activity

1. Planning and execution of prefeasibility studies; preparation of the scopes of work for feasibility studies
2. Assistance in the preparation of loan applications for such studies
3. Comparative evaluation of possible projects and integration of projects in order to combine them into a comprehensive regional development plan

B. Examples of completed technical assistance in these fields

Development of the Guayas River Basin, Ecuador

Reconnaissance studies undertaken by the OAS resulted in identification of areas with development potential and the design of a \$ 1,300,000 program of pre-investment studies which was executed with a loan from IDB. Positive conclusions from these studies led to an additional \$ 2,500,000 IDB loan for feasibility and financial design studies; these in turn resulted in a proposed 40-year program of development of the river basin including flood control, drainage and irrigation projects with an estimated total construction cost of \$ 193,000,000. After completion of the initial basic studies, the OAS provided high level advisory services during the subsequent pre-investment stage.

Integrated Development of the Pedraza-Paez, Venezuela

Preliminary design of integrated projects for production and industrialization of agricultural and forest products as well as for rural agricultural settlements in an area of 11,000 sq. km. Estimated cost of proposed feasibility studies was about \$ 4,000,000. These formed a part of a ten-year program of integrated development of the region.

Integrated Development of the Water Resources of the Santa Lucía River Basin, Uruguay

This prefeasibility level investigation of the Santa Lucía River Basin resulted in the identification and formulation of a series of water resource development projects for water supply, irrigation, and ground water development, including preparation of scopes of work for feasibility studies of each project. The total plan of water resource development in the basin until the year 2000 will involve an investment of approximately some \$ 25,000,000. Follow-up actions related to the water supply project were initiated coincident with the presentation of the final report.

## II. REGIONAL DEVELOPMENT PLANNING

### A. Fields of activity

1. Studies for planning the integrated development of river basins
2. Studies to define development regions and assistance in the preparation of comprehensive regional development plans

### B. Examples of technical assistance

1. Examples of completed technical assistance activities in this field are limited because it represents a relatively new component of the ORD program. Assistance in regional planning has so far been provided to the Brazilian Superintendencia de Desenvolvimento de Regiao Sul (SUDESUL), and is planned for the Instituto de Desenvolvimento Economico e Social de Par  (IDESP), also in Brazil. Additional projects are discussed under Current Activities.

## IV. CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES

### A. Fields of activity

1. Studies to aid in the establishment of sound resource management policy and legislation
2. Studies on erosion control, reforestation, land reclamation, etc
3. Studies for the identification of national parks as part of comprehensive resource development programs

### B. Reports of completed studies in this field include:

1. "Conservation of Resources and the Establishment of National Reserves in Latin America - Cutibireni Park: A Pilot Project in the Peruvian Jungle" (1965)
2. "Conservation of Renewable Natural Resources and Reforestation in the Department of Meta, Colombia" (1970-71); includes the identification of site for national park.
3. "Erosion Control Study in the Northwest of the State of Parana, Brazil" (1970-71)
4. "Development of Conservation Policy for Renewable Natural Resources in Peru" (1970-71)
5. "Land Reclamation Study of the Scotland District of Barbados" (1970-71)

## **CURRENT TECHNICAL ASSISTANCE ACTIVITIES**

A review of current technical assistance indicates an evolution of the program in accordance with requests from the member states and augmented capabilities of the Office of Regional Development. A sampling of current activities is outlined below under the divisions which are responsible for their execution.

### **ACTIVITIES OF DIVISION I**

#### **Bolivia - Preparation of Ecological Map of Bolivia**

This project involves the design of a program for the preparation of an ecological map of Bolivia and the training of Bolivian personnel to execute the work. The map will be used in conjunction with other pertinent data to help identify areas with economic potential for development particularly in the agro-economic field.

#### **Colombia - Study of Conservation of Renewable Natural Resources and Regional Development of the Department of Meta**

This study, covering 85 000 sq. km. of piedmont and plains lands of the Department of Meta, includes formulation of plans for erosion control, reforestation, and other conservation measures; development of a scheme for optimum land utilization based on soils investigations; a linear programming study for determination of goals for agricultural and livestock production for 1981; and identification and elaboration of a group of specific development projects.

#### **Ecuador - Puyango-Tumbes River Basin Development**

The purpose of this project is to promote the physical integration of the frontier regions between Ecuador and Peru by means of developing the natural resources of the Puyango - Tumbes and the Catamayo - Chira River Basins. Among the topics to be included in this binational development program are: design of irrigation systems, use and management of soils, and development of hydraulic resources. The project will involve a series of studies on the soil and ground water conditions, a preliminary study of the sites chosen, and preliminary designs of structures necessary for the development of the region's irrigation and hydroelectric potential.

#### **Paraguay - Pilot Project for the Implementation of the National Rural Cadaster**

This mission provides technical assistance in the design of a national cadaster program which will involve property mapping and land evaluation for purposes of taxation. Mission activities also include the training of

**CURRENT TECHNICAL ASSISTANCE ACTIVITIES IN SOUTH AMERICA**

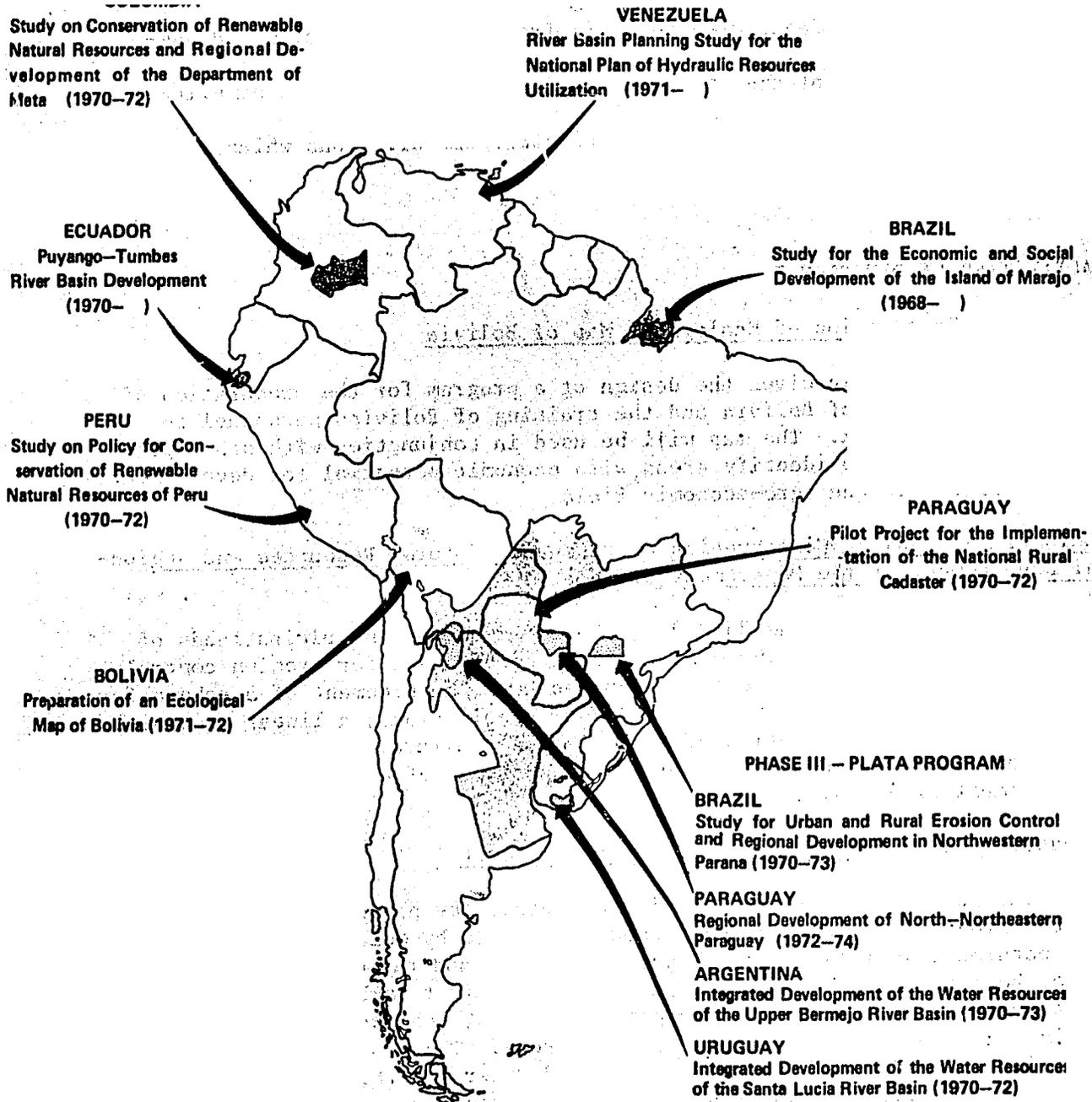


Figure 4

personnel for implementation of the program and the execution of a pilot cadaster in the Carmen del Paraná area. A by-product of the project will be information that will be utilized in the formulation of agricultural and livestock projects, regional and national development policies, and marketing decisions.

#### Peru - Study of Policy for Conservation of Renewable Natural Resources

This study consists of a nationwide investigation to identify, describe, classify, and locate geographically the principal problems involved in conservation of lands, forests, waters, and wildlife. In addition, it includes the proposal of preventive and corrective measures for existing problems, and the recommendation of a national conservation policy involving the legal, organizational, and administrative changes necessary for its implementation.

#### Venezuela - River Basin Planning Study for the National Plan of Hydraulic Resources Utilization

Previous studies have established water requirements for agricultural, industrial, and potable usage for the years 1970, 1980, 1990, and 2000 in each of the eleven hydrographic regions of the country. The current study involves the design in preliminary form of the system of works necessary to meet these various water use requirements, with construction programmed over the 30-year period.

### ACTIVITIES OF DIVISION II

#### 1. The Plata River Basin Project, Phase III

##### Argentina - Integrated Development of the Water Resources of the Upper Bermejo River Basin

This reconnaissance-prefeasibility study of the hydrologic development potential of an area of 38 000 sq. km. of the Upper Bermejo River Basin includes the identification of specific multiple use and single purpose water resource development projects. Prefeasibility studies and preliminary designs of specific projects and general recommendations will be made as to the sequence of execution and selection between specific alternatives so that a rational development plan may be set up for the region.

##### Brazil - Erosion Control and Regional Development, Northwest Paraná

This urban and rural erosion study is being carried out by an interdisciplinary group of experts in an area of approximately 30 000 sq. km. The objectives of the project are: to make a comprehensive study of the technical problems involved in controlling erosion; to determine its causes and effects in order to determine measures for rehabilitating those areas that are already badly affected; and to recommend preventive measures for other areas identified as potentially susceptible to erosion. The next stage will involve a pilot project for regional and urban development planning of southern Brazil. The new focus of the mission will take into consideration the recommendations made in the previous phase while putting

emphasis on technical assistance in the fields of physical and urban planning.

#### Paraguay - Regional Development of Northeast Paraguay

An area of 33 000 sq. km. is being studied with respect to its development potential in the following fields: generation of energy, mineral resources, irrigation, drainage, soils, agriculture, and forestry. This reconnaissance-prefeasibility study is being carried out by an interdisciplinary group of experts that will collect basic data on the indicated fields as the basis for a rational evaluation of the development possibilities of the region.

#### Uruguay - Integrated Development of the Water Resources of the Santa Lucía River Basin (follow-up mission)

The present activities of this project, which was initiated in 1969, involve advisory services to the Ministry of Public Works of Uruguay on the implementation of the OAS Study recommendations and technical support to the recently created Santa Lucía River Basin Development Commission.

#### 2. Other

##### Brazil - Marajó Island Project

Marajó Island, located at the mouth of the Amazon River, State of Pará, covers an area of about 50 000 sq. km. An evaluation of its development potential is currently under-way, based on hydrologic, drainage engineering, topographical, and soil mechanics studies, as well as on the technical and economic feasibility of flood control, drainage, and water management projects. The period 1968-70 was devoted to basic hydrological, soils, and forestry studies, while current studies are focused on planning the social and economic development potential of Marajó.

#### ACTIVITIES OF DIVISION III

##### Haiti - Integrated Evaluation of the Natural Resources

study of natural resources and population distribution in Haiti as part of an integrated investigation which included sectorial and institutional development aspects. The resulting report includes eight topical maps of the country. The second phase of this program, initiated in 1971, is aimed at providing assistance in the implementation of recommendations resulting from the earlier study and the formulation of specific projects with the purpose of raising the productivity of the agricultural sector, elevating the nation's capacity to feed itself by improving subsistence agriculture and the existing road network, and developing an export program. Included in the present program is technical assistance to three agricultural cooperatives established through OAS initiatives.

# CURRENT TECHNICAL ASSISTANCE ACTIVITIES IN CENTRAL AMERICA AND THE CARIBBEAN

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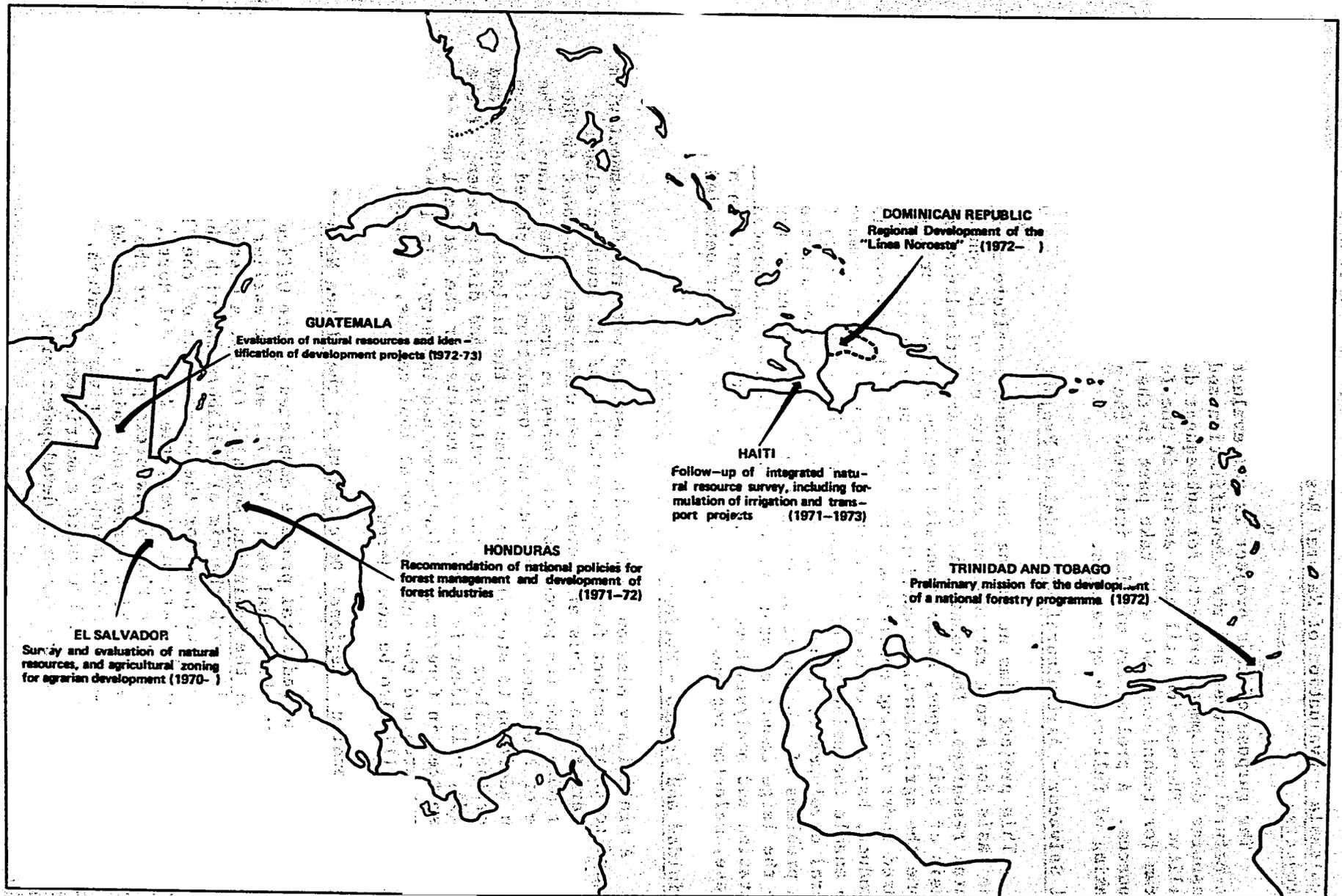


Figure 5

### Guatemala - Evaluation of Natural Resources and Formulation of Development Projects

The purpose of this project is the evaluation of existing information on natural resources and the identification and formulation of potential resource development projects for subsequent detailed study of their feasibility. The mission will also assist in the formulation of a training program for technicians who will take part in the management of natural resources. A preliminary mission initiated the program prior to the undertaking of full-scale operations.

### El Salvador - Agricultural Zonification Project

This project aims at giving the planning institute of the Government the basis for a more rational and extensive use of the country's agricultural resources. The country is divided into agricultural zones on the basis of soil types, socio-economic factors and other criteria. In each zone the agricultural productivity, based on production functions, is compared under varying conditions with the value of the potential agricultural product, based on costs of production, transport, and commercialization, to enable the selection of optimum land utilization schemes for agricultural development. Simultaneously, a study on regionalization is focused on problems of unbalanced development and unemployment in rural areas. Due to the large amount of statistical data collected, the procedures of computation and analysis have been programmed for a computer. In a subsequent phase, selected regions will be studied intensively for detailed planning.

### Trinidad and Tobago - National Forestry Program

A preliminary mission to Trinidad consulted with the Government with regard to their project for the reforestation of the southern slopes of the Northern Range. This area embraces ten watersheds and about 60 000 acres, or more than ten percent of the forested area of the Island. The objective of the mission is the eventual formulation of a phased program which, in addition to stopping the erosion of the hillsides, flooding and silting of the valleys, the decline of wildlife, and disfigurement of the countryside, will identify a series of projects for the rational use of these resources in forestry, agriculture, and industry. In light of the size of the area and the inter-sectorial implications, a regional plan of development will also be considered.

### Dominican Republic - Regional Development of the "Línea Noroeste"

Following the cadastral project completed by the Office of Regional Development during the fiscal year 1970-71, and the earlier Survey of the Natural Resources of the Dominican Republic (1969), a mission was sent to the Dominican Republic with the aim of collaborating with the Government in the formulation of a program for the development of the "Línea Noroeste". The Dominican Republic's largest river, the Yaque del Norte, crosses through this dry region, located in the northwestern portion of the country. The development of the area, which borders on Haiti for about 40 kilometers, will depend on the total utilization of the river's waters. It is anticipated that this program will require a multi-sectorial effort in which the integrated approach to the region's development will be linked to national development plans.

### Honduras - Forestry Project

During the fiscal year 1971-72, technical assistance is being provided to the Government of Honduras on a package of forestry projects among which are the following: exploitation of several forestry areas; the selection of one of these areas for integral, inter-sectorial development; consultation with respect to the feasibility of a sawmill project in the area of Agua Fría; and collaboration for the formulation of a National Plan of Forestry Development.

## CURRENT TRAINING ACTIVITIES

The training program of the Office of Regional Development is designed to complement the main thrusts of the technical assistance activities of the Office. In terms of mechanisms, the program consists largely of two centers and two fellowship programs which collectively offer training in fields of survey, development, and management of natural resources; natural resource economics; project formulation and evaluation; regional planning and development and allied subjects. An additional program is designed to help strengthen local training institutions and operational agencies.

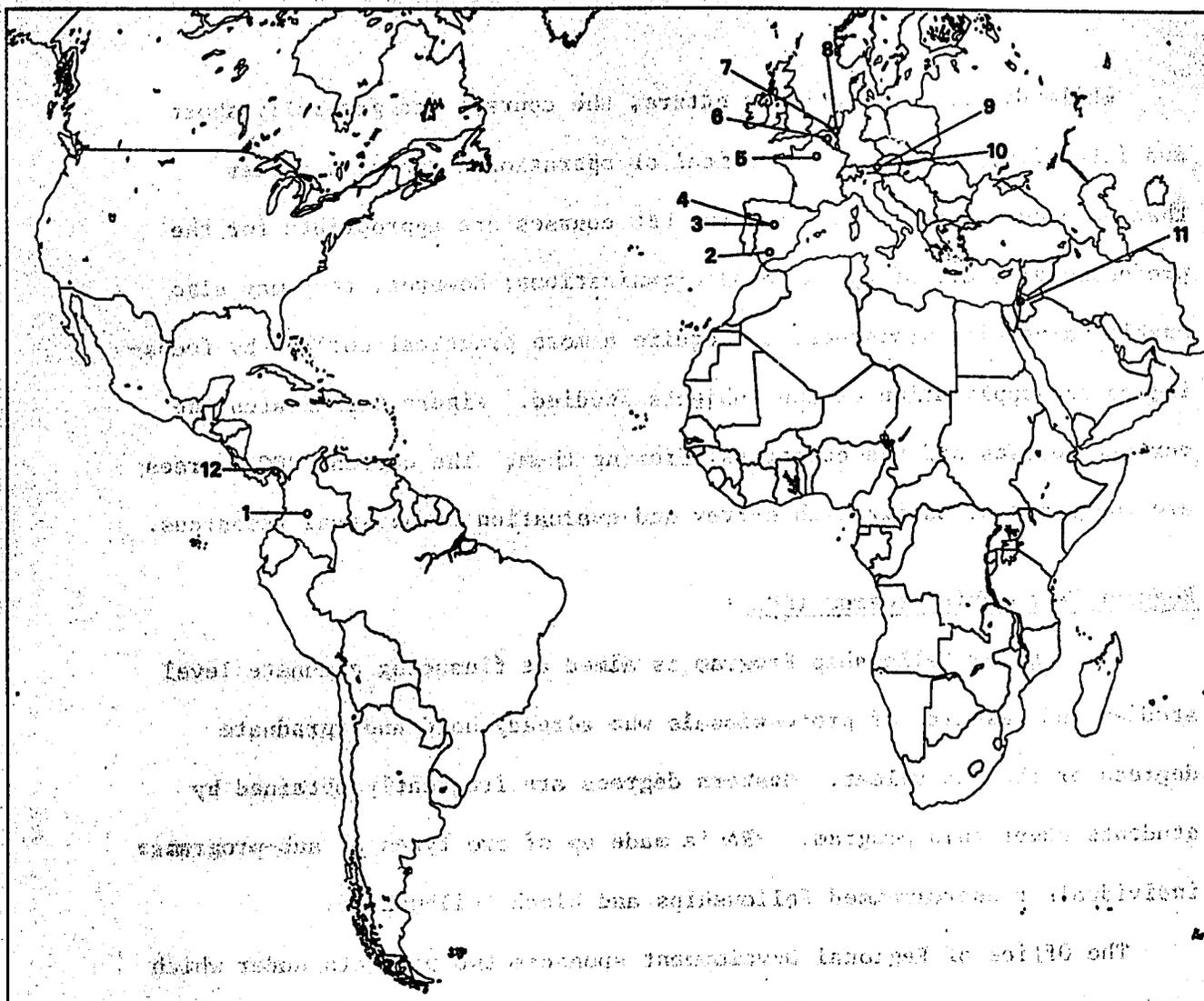
The training facilities under the jurisdiction of the ORD form a part of three OAS programs:

Special Training Program  
Regular Fellowship Program  
Inter-American Centers

In addition, the Regional Program of Assistance for Institutional Development (PRADI) is operated by the ORD.

### Special Training Program (PEC)

The Special Training Program is a cooperative undertaking in which the OAS works together with the governments of several European, Mideastern, and Asian countries to enable participants from the member states to attend certain courses offered by universities and study centers in these countries. Round-trip travel expenses of fellowship students are financed by the OAS, while the host country is responsible for the expenses of each course as well as the fellowship students' subsistence. Selection of candidates for PEC courses is conducted by the OAS, and the results confirmed or modified by the host country.



### CURRENT TRAINING ACTIVITIES - SPECIAL TRAINING PROGRAM COURSES

- |   |  |
|---|--|
| <p>1. Photointerpretation PEC 1.005-B Inter-American Photointerpretation Center (CIAF), Bogotá</p> <p>2. Edaphology and Plant Biology PEC 1.023 Universities of Sevilla and Granada</p> <p>3. Forestry with Emphasis on Reforestation PEC 1.029 Technical School for Forest Engineers, Madrid</p> <p>4. General and Applied Hydrology PEC 1.167 Hydrology Institute of the Superior Council for Scientific Investigation, Madrid</p> <p>5. Transport Economics PEC 1.258. Agency for Technical, Industrial and Economic Cooperation, Paris</p> <p>6. International Course for Graduate Pedologists PEC 1.214. The State University of Ghent, Belgium.</p> | <p>7. Photointerpretation PEC 1.005-A International Institute for Aerial Survey and Earth Sciences (ITC), Enschede, Netherlands</p> <p>8. Seminar for Administrators of Integrated Natural Resource Programs PEC 1.108 International Institute for Aerial Survey and Earth Science (ITC), Enschede, Netherlands</p> <p>9. Forest Products Utilization PEC 1.266, Austria</p> <p>10. Exploration, Prospecting and Mining PEC 1.269 Mining and Metallurgic University, Loeben, Austria</p> <p>11. Underground Water Exploration PEC 1.169 Hebrew University of Jerusalem</p> <p>12. Remote Sensing - Individual Fellowships Inter-American Geodetic Survey, Canal Zone</p> |
|---|--|

Figure 6

While differing greatly in nature, the courses are generally short and intensive, and offer a practical or operational approach rather than an academic one. Usually, the PEC courses are appropriate for the professional staff of operational organizations; however, they may also enable university professors to acquire a more practical outlook by focusing on the application of the subjects studied. Figure 6 indicates the current courses and the countries offering them. The current PEC courses are concerned primarily with survey and evaluation of physical resources.

#### Regular Fellowship Program (PRA)

The Regular Fellowship Program is aimed at financing graduate level studies and research of professionals who already hold undergraduate degrees or the equivalent. Masters degrees are frequently obtained by students under this program. PRA is made up of two types of sub-program: individual or unprogrammed fellowships and block fellowships.

The Office of Regional Development sponsors two projects under which fellowships are awarded in a "block" to several participants who will follow a common course of studies at the same university or center.

1. Natural Resource Economics and Management, conducted at the University of Michigan, Ann Arbor, Michigan. Five fellowships of one year's duration are awarded annually. The course, given in English, is recommended for experienced professionals or university professors in engineering, forestry, hydrology, fisheries, geology, soils, and agriculture, as well as for economists, geographers, and lawyers with special interest in natural resource development and management.
2. Regional Planning, conducted in Spanish at the Universidad Nacional

del nordeste, Resistencia, Chaco, Argentina. Three fellowships of eleven months' duration are awarded annually. The program is aimed at candidates with an academic background and some experience in law, architecture, geography, engineering, agronomy, sociology, or a related field.

#### Inter-American Centers (CETREDE and CIDIAT)

The ORD operates two of the OAS' Inter-American Training Centers: the Inter-American Center for the Formulation and Evaluation of Development Projects (CETREDE) located in Fortaleza, Ceará, Brazil, and the Inter-American Center for the Integral Development of Land and Water Resources (CIDIAT), in Mérida, Venezuela. Both offer one or more inter-American courses each year, and national courses for OAS member states upon request. Figure 7 indicates the courses being given during the current fiscal year.

#### 1. Inter-American Center for the Formulation and Evaluation of Development Projects

CETREDE provides training in the formulation and evaluation of investment projects, primarily small industrial, agro-industrial, and physical infrastructure projects. The inter-American and national courses are very similar in character, although the latter occasionally limit their evaluation to projects already prepared. The projects selected for study are always actual development projects; frequently, implementation of these projects is later financed by credit organizations. The inter-American courses are given at the Center's headquarters in cooperation with the Banco do Nordeste and the Universidade Federal de Ceará. National courses are held in the interested member state in collaboration with the operative, financing, or planning agencies.

# CURRENT TRAINING FACILITIES IN THE MEMBER STATES

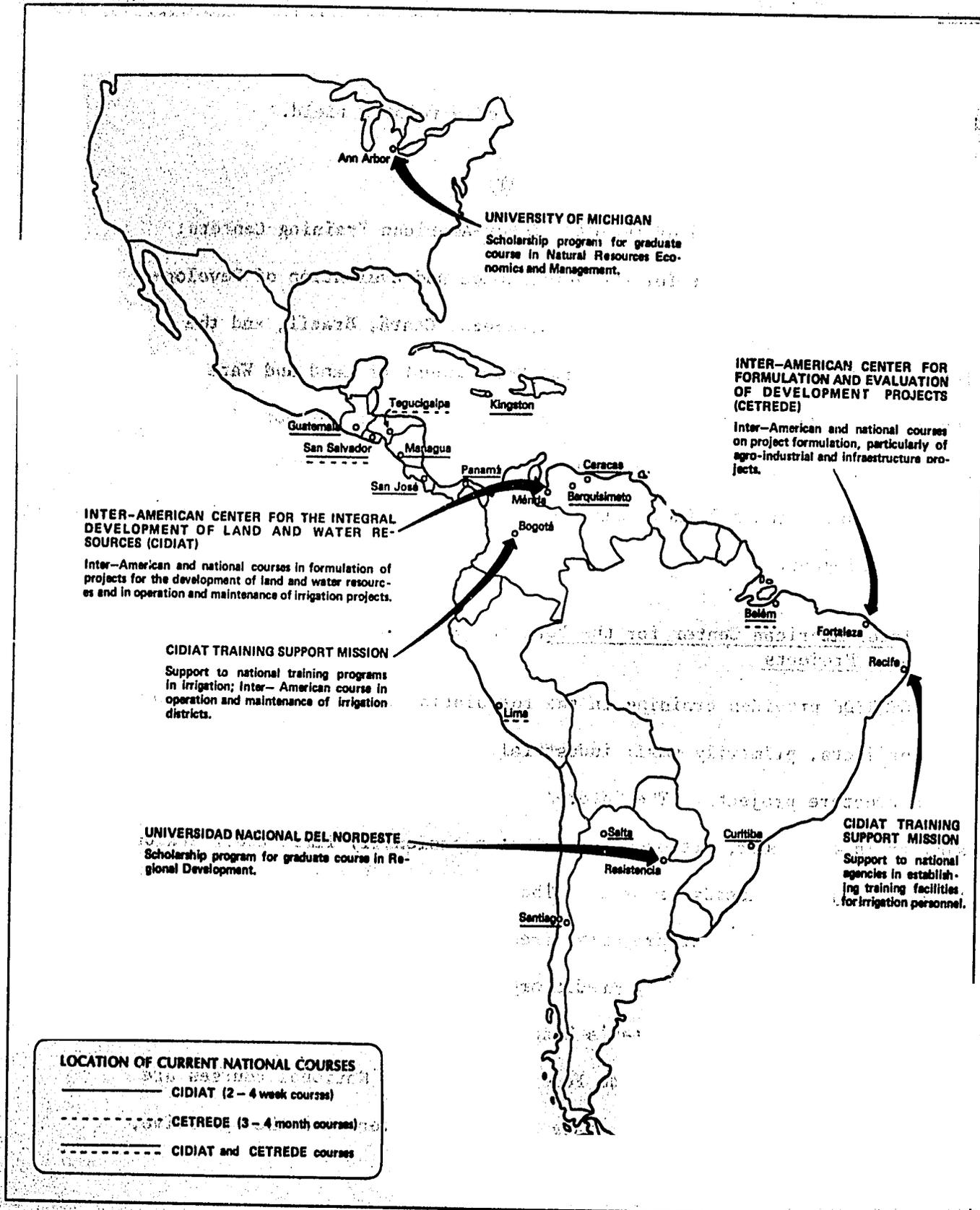


Figure 7

2. Inter-American Center for the Integral Development of Land and Water Resources

The training offered by CIDIAT is aimed chiefly at instructing students in technical methods and procedures for the planning, formulation, and execution of projects for development of land and water resources, with particular emphasis on irrigation. The inter-American courses given at Mérida, Venezuela, are designed for high level executives and include general principles and policies for the planning, formulation, and evaluation of such programs and projects. The inter-American courses given at Bogotá, Colombia, are primarily aimed at training technical personnel in the operation and maintenance of irrigation systems.

The national courses may cover any of the topics mentioned, depending on the request of the interested country. They are usually of less than two months' duration, and can be adjusted in terms of level and approach to fit the needs of the requesting country.

The Center is also operating training support missions in Colombia and Northeast Brazil designed to strengthen local facilities that provide training for irrigation personnel.

Regional Program for Assistance to Institutional Development (PRADI)

This new program uses a variety of mechanisms to strengthen human resources of operational and training institutions involved in the evaluation, development, and management of natural resources and in regional planning and development. The program offers assistance to help operational agencies determine their training needs, analyze management problems and prepare long-term personnel development plans; it also provides information on suitable training facilities available from the OAS and other

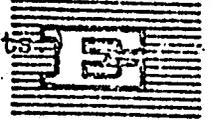
organizations. PRADI can provide a national course upon request, normally in conjunction with a technical assistance mission of the ORD. The program offers support to training institutions by providing advice on the development of programs, courses, and curricula, and by offering scholarships and short-term professors. Finally, the program attempts to increase the efficiency of existing training facilities by evaluating relevant courses, disseminating information on available training facilities, and serving as a clearing house of information on financial assistance for training.

Appendix D - 9

UNITED NATION'S PROGRAMS

Extracts of U.N. Documents E/C.7/19 and E/C.7/16  
which describe the natural resources programs  
of the U.N. Resources and Transport Division,  
Regional Organizations, and Specialized Agencies.





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REVIEW OF ACTIVITIES OF THE ORGANIZATIONS OF THE UNITED NATIONS SYSTEM  
AND WORK PROGRAMME OF THE COMMITTEE ON NATURAL RESOURCES

PROGRESS OF WORK IN 1971 OF THE RESOURCES AND TRANSPORT  
DIVISION IN NATURAL RESOURCES DEVELOPMENT

Report of the Secretary-General

## INTRODUCTION

The present report reviews progress in 1971 in the relevant work in natural resources development of the Resources and Transport Division of the Department of Economic and Social Affairs. For a longer perspective, reference should be made to the progress report submitted to the first session of the Committee (E/C.7/8 (Parts I and II) and Add.1-4). It is also a companion to the draft work programme presented in document E/C.7/20.

The bulk of activities during the year continued to consist of field assistance activities, which are governed by requests by individual Governments or groups of governments. The growth in the activities of the United Nations reflects the role that natural resources play in the economic development of the developing countries. It is now being recognized that the activities which result in the discovery of new resources or in the discovery of better ways of utilizing known resources are basic to economic growth and development.

Recent growth experience has also revealed that in a number of instances countries which have discovered and developed important natural resources have been among the fastest growing developing countries. Particularly in the case of several newly independent countries, the development of natural resources offers the prospect of rapid growth in production for domestic use and exports, national income and government revenues within a comparatively short period. During 1969, for example, the export value of minerals, base metals and fuels alone of developing countries was \$22.4 billion, equivalent to 44.7 per cent of the total value of all exports of developing countries.

The Division's activities may be broadly divided into operational or field project activities and non-operational activities, which complement each other and are closely interwoven in practice. Both are largely geared to meet the needs and challenges of developing countries in the field of natural resources, through the closely integrated work of resources economists and specialists from various technical disciplines. The operational activities include substantive support

to field operations and their execution, while non-operational activities draw on that experience for research and provide expertise for backstopping operational activities; non-operational activities include studies, seminars and conferences on matters concerned with policy, planning and technical and management aspects of the development of natural resources. During the period under review, the activities of the Division have continued to be essentially directed towards the promotion of development efforts in respect of the following aspects: (a) exploring, evaluating and developing natural resources in the fields of minerals, energy and water, along with surveying and mapping such resources; (b) stimulating and facilitating the transfer of new technology and scientific knowledge in the development and utilization of natural resources; (c) strengthening administrative and technical services in the Governments through practical field programmes incorporating training elements; (d) conducting and organizing applied technical and economic research and disseminating the results through publications, seminars and conferences; and (e) the provision of substantive services to the Economic and Social Council, the Committee on Natural Resources, and other organs in this field

I. PROGRESS IN OPERATIONAL ACTIVITIES

The United Nations provided guidance and services to technical assistance and pre-investment projects, as well as to interagency programmes, including the World Food Programme and the Fund of the United Nations for the Development of West Irian.

During the period under review the Resources and Transport Division was providing substantive supporting services for 101 UNDP (Special Fund) projects in various fields of natural resources development, including surveying and mapping, geology and mining, water resources, energy and electricity. The total cost of these 101 projects, stretching over several years, was budgeted at \$87.3 million in Special Fund allocation and \$87.1 million equivalent in government contributions. The field expenditure by the United Nations for Special Fund projects under the Division's responsibility was \$19.6 million in 1970 and is estimated at \$21.5 million for 1971. It may be worth while to note from table I-4 that Special Fund field expenditure for natural resources exceeded that for projects in all fields executed by the United Nations. During the period January - October 1971, the number of United Nations natural resources experts in the field amounted to 529 excluding subcontractors' personnel.

A. Interdisciplinary programmes

An interdisciplinary approach and integrated natural resources development have been applied in several field projects, such as in an investigation of the feasibility of obtaining not only power but also minerals and desalinated water in a geothermal project in Chile or in combined development of water resources, power and transport in river projects. The approach is further characterized by emphasis on the application of new technology not only in narrow fields but through adaptation and cross-fertilization in related fields so that the best possible results and resource development are obtained. In this manner, scarce technical personnel is more effectively used in the field and at Headquarters, where, for example, two technical advisers on drilling and one on laboratories cut across the fields of minerals, energy and water.

B. Cartography

During the period under review the United Nations provided technical assistance to 13 countries in the fields of cartography, geodetic surveying, hydrography, land registration and land surveying, map reproduction, photogrammetry and topographical surveying.

Larger-scale projects in surveying and mapping are being undertaken in Ceylon, Colombia, India, Indonesia (in association with FAO), the Ivory Coast, Jamaica and the Sudan. The Ceylon project successfully completed its initial objectives in the establishment of the institute for surveying and mapping for the training of survey technicians. Additional supplementary assistance to strengthen further the institute through the introduction of advanced courses in survey engineering for supervising officers and other senior personnel of the Ceylonese Survey Department has been approved by the Governing Council of UNDP. The Colombia project was initiated during the period to provide the aerial photography needed by the national mapping organization in Colombia to support the development of the Choco Valley. The India project is now in its second phase, continuing the work on the strengthening of the pilot production centre for pre-investment surveying and mapping and particularly with the expansion of the training institute, to meet the development needs of the Survey of India. The project in Jamaica has largely been completed, and consultant services will be continued for an additional year as requested by that Government. Two other projects, in Ivory Coast and Sudan, aimed at strengthening the efficiency in national surveying and mapping activities of these countries, are continuing as scheduled.

The work of the Resources and Transport Division in the field of energy is aimed at providing assistance in the development of both conventional and new sources of energy in developing countries. The United Nations assistance is mainly through the provision of substantive support in the formulation and execution of technical co-operation projects in Member countries. Projects for the exploration, development and utilization of primary energy resources, such as coal and lignite, petroleum and natural gas, as well as for the development of non-conventional sources, such as geothermal power, solar energy and oil shale, form a considerable part of this programme. In addition, the work programme included operational as well as non-operational projects in electric power development.

#### Petroleum and natural gas

It is apparent from government requests from developing countries that assistance is required on an increasing scale in highly specialized fields in petroleum technology such as particular methods and techniques of secondary recovery, offshore exploration, drilling and production. In addition, developing countries lack experienced personnel in the fields of petroleum legislation and management.

During 1971, 12 developing countries (Bolivia, Burma, Chile, Ecuador, Ghana, India, Malta, Panama, Saudi Arabia, Syrian Arab Republic, Trinidad and Tobago, Turkey) were assisted by experts in petroleum exploration, secondary recovery methods, petroleum refining, petroleum economics and legislation.

In Bolivia, assistance continued to be provided to the Centre for Petroleum Development which was established in 1966 to increase production of oil and natural gas through the application of modern techniques in exploration, drilling and production. The project has included the construction and equipping of service laboratories, assistance in exploration and production operations and training of counterpart personnel of the Bolivian national oil company - Yacimientos Petroliferos Fiscales Bolivianos (YPFB), both in field and laboratory techniques. Subsurface studies have been carried out by a group of geologists using an IBM-1130 computer. Studies relating to production, reduction of drilling costs, improved use of mud and cement techniques have been prepared and issued as a series of handbooks.

In Chile assistance has been provided since 1969 in marine exploration for petroleum on the continental shelf of Chile. An airborne magnetometer survey of the Pacific coastal area and a geological study of a marine area in the Straits of Magellan have been completed; the results have been encouraging and further work including marine seismic surveys to define and locate possible hydrocarbon-bearing structures is under way. In addition to the training of counterpart personnel, appropriate equipment has also been provided.

### Coal

During 1971, Turkey and Yugoslavia were assisted by experts in coal development. In the Philippines the project which became operational in 1965 has the objective of evaluating the mineable coal resources of the Malangas Mining Reserve with special reference to coking coal, and to open up a demonstration mine. By the end of the project in 1968 adequate reserves for production were identified, but lack of secure markets hampered follow-up activity. Assistance is currently being provided in connexion with mining operations and an expert has been assigned to advise the counterpart agency on the organizational and financial aspects of their operations in Mindanao, on evaluation of new plant investments, on the development of markets for Malangas coal and on training of counterpart personnel.

### Geothermal resources

Technical advisory missions by the staff of the Resources and Transport Division to advise on geothermal resources development were undertaken in Argentina, Greece, Guatemala, India, Nicaragua and Peru during 1971, in addition to supervisory technical missions to Chile, El Salvador, Ethiopia, Kenya and Turkey.

The United Nations assistance in this field covers several large-scale projects which include geological, geophysical and geochemical surveys, as well as exploratory drilling. These are under way in Chile, Ethiopia, Kenya and Turkey.

## Electric power

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In the field of electric power, the United Nations provided technical assistance in such matters as electrical power systems planning and design in Afghanistan (electrical power expert), Equatorial Guinea (electrical power expert and power plant supervisor), Ghana (design engineer and electrical engineering expert), Haiti (electrification programming expert), Iraq (power engineer), Togo (adviser in electrical power development) and Zambia (electrical engineering adviser).

In some countries the state of the existing distribution systems has been particularly poor and inadequate to meet basic safety and security of supply requirements. The United Nations is providing expert service on the request of some of these countries in order to remedy the situation through modernization and reinforcement of the existing supply systems. In Haiti, for example, the United Nations has engaged the services of experts in hydroelectric plant operation, in transmission and distribution system planning and design and in the operation of an interconnected system.

The success of an electrical utility body in a developing country will depend, to a large extent, on the type of organization and management, both financial and administrative. The United Nations has provided experts in these fields in Ghana (chief accountant and commercial engineer), Peru (organization and management expert) and Somalia (for the drafting of an appropriate legislation for establishing such a body).

Technical assistance advisory missions were sent to Bolivia to advise on energy programming projects; to Dahomey, Ghana and Sierra Leone to review the project on the strengthening of the Sierra Leone Electricity Corporation and to West Irian for annual review of the rehabilitation of diesel power plants.

In Madagascar, assistance is being provided in the preparation of a power development programme. The aim is to assist in the development of electrification of the east-central region, but attention is also being given to the erection of small power plants supplying other parts of the island. The project became operational in 1968 and was completed at the end of 1971.

#### D. Mineral resources, including ocean minerals

The activities of the Resources and Transport Division in the field of mineral resources are designed to assist the developing countries in establishing a framework within which they can work towards attaining the fullest benefit from their resources, particularly in the search for and development of minerals. The mineral survey projects for which the Division has substantive responsibility for example, combine the direct search for ore deposits of development importance with the establishment or strengthening of national mineral resources departments and the training of local staff to undertake continuation programmes at the end of project operations. Because projects are undertaken only at the request of Governments, and the need as expressed by these requests has thus far been for mineral resource surveys, the programme has been oriented in that direction. At the same time, there has been a trend towards expansion into new fields, such as offshore mineral exploration.

##### Mineral surveys

In the exploration projects undertaken, copper was again the metal that provided the highlights of the year under review. The project in Chile was completed after its work on the porphyry copper mineralization discovered at Las Pelambres demonstrated the potential importance of this deposit. The project reported drill-indicated tonnage of 270 million of 0.77 per cent copper and 0.02 per cent molybdenum to a depth of 215 metres, with drill-inferred tonnage of similar grade between 215 and 435 metres estimated at 90 million. Despite Chile's known riches in this mineral, there is consensus that other copper deposits of major importance await discovery in the country.

The Las Pelambres porphyry copper discovery, of which the ultimate size will only be determined by later extension drilling and may well prove to be one of the most important porphyry copper deposits ever found was carried out by an international team headed by a Canadian project manager and including experts from Canada, Italy and the United Kingdom.

The phase II mineral survey completed in Panama has led to the discovery of a new mineral belt in the Cordillera along the San Blas coast adjacent to the Colombian border, which contains copper as main mineral with indications of molybdenum, zinc and gold associated with granodioritic intrusive and andesitic volcanic rocks. Further detailed exploration is to be undertaken, as in the case of the previous Cerro Petaquilla discovery which resulted from the phase I survey.

The mineral project in Turkey has also identified porphyry copper type mineralization in the Merzifon-Ispir sector of its project area and detailed investigations are proceeding to determine economic potential. Here again, identification of this type of mineralization, which has major development importance in view of the large tonnages involved and scale of operations necessary for their economic exploitation, upgrades the exploration potential of the region, which in turn attracts investment for mineral development activities. Systematic exploration surveys in progress by the project in the Menderes Massif are also indicating good hopes of locating new mercury deposits.

On the African continent, most interesting exploration results have come from the mineral project in Somalia, where uranium deposits at Mudugh have been discovered in sedimentary formations. Their economic potential is considered to be more attractive than the Bur deposits located in an early phase and which are now under investigation by private interests. A third phase project was requested for implementation, beginning in March 1972.

Less spectacular but nevertheless important are the location of the phosphate deposits in the Bas Congo, which could have considerable economic significance for that country, and which were investigated by the mineral project in Zaire.

In the Republic of Guinea, mapping and drilling at Mt. Nimba outlined 300 million tons of high-grade ore (over 65 per cent Fe). The results of the UNDP study will enable the Government of Guinea to offer the deposit to an international consortium for development. In the non-metallic mineral sector, a project in the Central African Republic is making progress in drilling and evaluating limestone deposits.

Always seeking to introduce new methods in the United Nations mineral exploration programmes, the mineral project just started in Lesotho is testing out the application of airborne multispectral photographic and infra-red thermal sensing surveys for locating kimberlite intrusives, which could have importance for the diamond industry in that country. Such methods are expected to find greater application in future mineral exploration programmes and will usefully complement the longer-established ground and airborne exploration techniques.

### Offshore mining

Although still at a relatively early stage, operational activities in the nearshore and offshore environment were under way with a project in Indonesia, where counterpart organization offshore exploration and mineral dressing practices are being upgraded through the introduction of new and improved methodology. Advisory services were provided in 1971 to the Government of Burma to help prepare a project intended to resuscitate the country's tin mining industry from placer deposits along the Tenasserim coast, which is to start operations in 1972. Advisory services were also provided to Israel as a first step in implementing a project designed to assist in the exploration and evaluation of offshore sand and gravel deposits which are needed to replace depleted onshore reserves.

### Institution building

The many facets involved in building up administrative and technical services required for the implementation of a country's natural resources development policies receive varying degrees of attention depending on the type of project being implemented. Some elements such as training of counterpart personnel, establishing or strengthening the over-all national capability of mineral resources departments, as well as existing national chemical laboratories to ensure acceptable standards of reliability, are included in varying degrees as a matter of course in mineral resource survey projects, as mentioned above. Some are designed specifically to establish or strengthen an existing institution or department. The Guinea National Mineral and Geological Centre, Conakry, is concentrated on organization and training as well as on co-ordinating bilateral aid programmes in this sector. The project in Iran to assist in establishing the Geological Survey Institute, which was initiated in 1962 and completed in 1971, saw the creation of a permanent institution providing for all the specialized technologies needed to foster mineral development and serving both the private and the public sectors. Detailed mineral surveys were carried out, and hitherto unknown but significant deposits of phosphate, bauxite and refractory clays were found. An outstanding success of the Institute has been in identifying the nature of the mineralization at Sar-Cheshmeh, where a large porphyry copper deposit now has proved reserves of 320 million tons of 1.2 per cent grade.

Assistance has also been rendered in negotiations on mineral development agreements and in mining legislation, in general to up-date mining codes and strengthen the ability of Governments to achieve their objectives in deriving the greatest benefit from their mineral resources. Such assistance was provided to Morocco and Somalia in mining policy and legislation. In connexion with the discovery of porphyry copper in Panama, advice was also given to the Government in negotiations for an agreement to develop the deposit. Similar advice was given to the British Solomon Islands Protectorate with respect to a bauxite deposit which was located by the United Nations mineral survey completed in 1968. New minerals policy was established for Swaziland by the Minerals Committee of the country with the assistance of an adviser. Some countries lacking expertise have found assistance through the United Nations in this category particularly valuable and necessary to safeguard national interests.

#### E. Water resources

The activities of the Resources and Transport Division in connexion with water resources are concerned with water resources planning and development, including the social, institutional, legal, administrative and economic aspects. Possibilities for utilization of non-conventional sources of water supply (such as desalinated water, geothermal steam and water from cloud seeding) are also considered when and where applicable. An advantage is derived from an interdisciplinary orientation, leading to a more integrated approach to the water development problem. An example is the relationship which exists between geological survey work and ground-water exploration and development.

Within this context, field activities in surface water continue to place emphasis on integrated planning for multipurpose development of water resources, and water projects on the other hand are concerned specifically with survey, hydrology, drilling, test pumping and related operations such as air reconnaissance, hydrogeology, water analysis and ground geophysics.

Finally, on the institutional side, attention is paid not only to training and formulation in the fields of legislation and administration but also to pragmatic research activities.

### Surface water

In the field of surface water, technical assistance activities were expanded in 1971 through the assignment of specialists to various countries. In this connexion assistance was provided in the design and preparation of construction drawings for dams and hydraulic structures for water works in Burma; investigations for dams, reservoirs and causeways in Mauritius; construction methods in the execution of Moby dam project also in Burma; advice to the Water Resources Development Board of Ceylon in formulating plans for multipurpose development of water resources; river training to control scouring of bed and erosion of banks of the River Nile consequent on the construction of the New Aswan Dam in Egypt.

The importance attached in the rational development of international water resources is best illustrated by the recently initiated Axios-Vardar River development project involving Yugoslavia and Greece; and by the Senegal River regulation project involving four countries, Guinea, Mali, Mauritania and Senegal, which have formed a joint organization for the development of the basin.

A United Nations interregional project has been started for multipurpose development of the Kagera River basin serving the United Republic of Tanzania, Rwanda and Burundi in East Africa, so as to identify projects for irrigation, hydroelectric development, fisheries, swamp reclamation and related fields which will be most beneficial to all the countries in the region.

The stress laid by the Natural Resources Committee on institution building is reflected in a project recently started in Argentina with the Institute of Water Resources Administration Management and Law. In Afghanistan, a Water Management Department was started for ensuring co-ordination and orderly development of the country's scarce water resources, preparing legislation for water control and use having regard to existing rights and customs.

Finally, integrated use of surface and ground waters is being achieved through a United Nations project in the Cauvery Delta in India.

### Ground water

In the ground-water field, technical assistance was provided in the organization of a ground-water branch (Uganda); study of special problems; sea water intrusion and analogue in model studies (Lebanon); water resources survey

(Fiji); engineering geology studies (Singapore); and computer studies (Argentina). The ground-water resources planning mission in Chad wound up in 1970, while the team for management and training for water well drilling in Sudan pursued its activities and was complemented by the recruitment of a third expert.

Technical assistance missions of an advisory nature were provided to Sudan within the framework of the "Freedom from Thirst" campaign, and in the Turks and Caicos Islands and in the Dominican Republic to make an over-all assessment of the country's ground-water development problems.

Four projects in Upper Volta, Somalia, Togo and India were completed in 1971. In Upper Volta, the survey of ground-water resources related to mineral prospecting, and railway studies in a very arid area led to the drilling of some productive boreholes but the yield was not enough to cover the projected needs. In Somalia, preliminary reconnaissance of the water points and hydrogeological units of the whole country was completed and a hydrogeological map was prepared. A follow-up of this project involving borehole drilling and geophysical prospecting is also envisaged. In Togo, the exploration of ground-water resources of the sedimentary coastal basin was also initiated. New aquifer formations were discovered in the vicinity of the city of Lome and are likely to contribute substantially in the future to its water supply system. In India, the Rajasthan project for the assessment of the ground-water resources in five areas for multiple-use community water supply, cattle and irrigation was completed in 1971.

Projects for the organization and strengthening of ground-water resources in Mali and Mauritania were undertaken and reconnaissance surveys, geophysical investigations and drilling work in desert areas were carried out. Producing boreholes were drilled and the training of local personnel was undertaken.

#### New sources of water supply

In the field of new sources of water supply, work was continued satisfactorily on the water desalination projects in Kuwait and Israel. Information being gathered in Israel on the electrolysis pilot plant operations will facilitate serious consideration of marginal desalination.

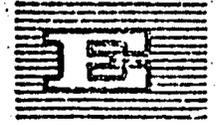
The Resources and Transport Division has co-operated in its field of competence with other specialized agencies in the execution of some Special Fund projects. In Jamaica, for example, the United Nations supplied the water resources planning engineer in a Special Fund project for the development of water resources which the United Nations had helped to prepare and which was allocated to FAO for execution.

## II. PROGRESS IN NON-OPERATIONAL ACTIVITIES

The non-operational activities of the resources and transport Division included substantive servicing of the Economic and Social Council, the Committee on Natural Resources and other organs with regard to natural resources questions, and conferences, seminars and expert meetings, as well as research and studies, on particular aspects of natural resources development.

Much work and time was necessarily expended in servicing and attending meetings at various levels. First and foremost in this category were obviously, as far as the Division was concerned, the preparation of documents and other servicing of the Committee on Natural Resources, for its first session in early 1971 and for its second session. Other intergovernmental bodies serviced or attended included, on a more limited scale or for particular topics, the General Assembly, the Economic and Social Council, the Committee for Programme and Co-ordination, the Sea-bed Committee, the Committee on the Peaceful Uses of Outer Space, and its Scientific and Technical Sub-Committee, the Preparatory Committee for the United Nations Conference on the Human Environment and various bodies connected therewith, the Advisory Committee on the Application of Science and Technology to Development etc. At the interagency level, it included meetings on water resources, marine and other science and technology, space applications, environmental questions etc., and generally for improved co-ordination and co-operation.

The more specific non-operational activities in 1971 are presented briefly below by subject areas. By and large, they correspond to the structural organization of the Division, which includes the Cartography Section, the Energy Section, the Geology and Mining Section, the Ocean Economics and Technology Branch and the Water Resources Section (Water Resources Development Centre). The presentation is in turn subdivided into two groups: conferences, seminars and expert meetings; and research and studies, respectively. In the cases of ocean economics and technology, and water resources, a third group deals with interagency co-operation, in view of its particular importance in those cases, while of course close attention is given to co-operation and practised also in the other areas.



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COMMITTEE ON NATURAL RESOURCES

Activities of the organizations of the  
United Nations system related to  
natural resources

## II. Economic Commission for Asia and the Far East

### Introduction

The operational activities of the Economic Commission for Asia and the Far East (ECAFE) secretariat in the field of natural resources development are undertaken in accordance with the directives of the Commission through the secretariat's Division of Industry and Natural Resources (Mineral Resources Development Section and Electric Power Section) and its Division of Water Resources Development.

### Mineral resources

The primary role of the secretariat in this field is to stimulate the development of mineral resources and to advance basic geological knowledge and the means of undertaking exploration for new mineral resources in the region. To that end, the main activities are directed towards:

- (a) The creation of an international forum for the development of mineral resources, at which the problems of developing countries concerning the investigation and extraction of minerals are discussed in relation to possible methods and techniques for resolving those problems;
- (b) The initiation of a systematic inventory of mineral deposits of the ECAFE region, on standard data sheets amenable to computerization and capable of serving as a pattern for a world-wide inventory;
- (c) The maintenance of contact with international non-governmental organizations in an endeavour to establish standards for use on a world-wide scale in certain specialized fields of mineral resources development;
- (d) The promotion of regional and multinational projects for groups of countries having common interests, including co-ordination in the compilation of regional geological and related specialized maps on a scale of 1:5,000,000; the organization of a Working Group on Stratigraphic Correlation between the Sedimentary Basins of the ECAFE region under the aegis of the Commission on Stratigraphy of the International Union of Geological Sciences (IUGS); and the establishment of a regional mineral resources development centre;
- (e) The promotion of the organization of regional and subregional bodies for joint action in the exploration and production of mineral resources through the medium of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP), established in 1966, and the establishment of a tin research and development centre for south-eastern Asia;

(f) The introduction and promotion of modern methods and techniques in the field of geological survey and mineral resources development; and

(g) The rendering of technical advisory services to agencies through regional advisers and specialists contributed by donor countries.

### III. Economic Commission for Latin America

#### Orientation of work

The work of the ECLA secretariat in the field of natural resources is directed according to the nature of the responsibilities entrusted to the Commission, which, very briefly, may be summarized as to search for and present appropriate solutions to the main economic and social problems of the Latin American countries. It is essential for ECLA to identify the natural resources available to each country and the prospects for their economic exploitation, both for analytical purposes and to help Governments in the formulation of development programmes.

#### Available means and priority fields of action

In accordance with the Commission's first resolution on natural resources (99 (VI)) a joint working group was set up, which is currently made up of officials from ECLA, the Office of Technical Co-operation, the World Meteorological Organization and the Pan American Sanitary Bureau (ECLA/OTC/WMO/WHO(PASB)).

Despite joint action by the above organizations, the ECLA secretariat has only been able to obtain the services of a small group of professionals concerned directly with the examination and promotion of natural resources development (on average, seven at headquarters in Santiago and three at the Mexico Office). Because of the scarce means available, priority attention has been devoted to the study of water and energy. Only sporadically in the past five years has it been possible to have the services of an expert to study mineral resources, and it is hoped to add another expert in this field in the near future.

It should be emphasized that most of the professionals mentioned above have normally been "regional experts", that is they have been concerned principally with operational tasks.

ECLA's work is divided into the following spheres: (a) studies and research on topics of general interest; (b) short-term technical assistance missions at the request of interested Governments; (c) seminars; and (d) collaboration with United Nations agencies and regional organizations. As these activities are concerned principally with economic and social aspects, technical aspects are examined only in so far as they are essentially bound up with the latter.

Studies and research and a good many of the technical assistance missions cover, among other things, the compilation of available data on the respective fields, the examination of current demand, its evolution and future prospects, a critical analysis of work carried out by national and international organizations, project evaluation, needs of financing and current legislation and administrative organization, with a view to obtaining information on those fields that might more urgently require in-depth study. Possible guidelines for international aid are explored, especially as regards matters that fall within the competence of the United Nations Development Programme (UNDP).

### Results

So much has been achieved up to now that a detailed account of results would be impossible. Briefly, it may be said that ECLA has collaborated with most of the Latin American countries in carrying out economic studies on energy and water utilization, in the light of national plans and economic and social development strategies. Numerous fields have been covered in operational activities and research including the following: meteorology, hydrology, agrometeorology, water projects for multiple purposes, urban water supply, industrial water supply, irrigation, water disposal (urban and industrial), flood control and drainage, water resources legislation, institutional organization for the exploration and development of natural resources, water planning and management, the development and planning of electricity systems, electricity interconnexion, financial aspects, electrical energy and water supply rates, statistics and terminology, estimates of hydroelectric potential, rural electrification, hydrocarbon reserves, structure of the consumption of hydrocarbons and its evolution, prospects for consumption, foreign trade in petroleum and petroleum products, the prices of petroleum products, the financing needs of the petroleum industry, mineral reserves and resources, importance of mining as a source of employment, production and export of mineral ores, international prices of selected mineral ores, investment, mining development policies, legislation and administrative organization etc.

#### IV. Economic Commission for Africa

Within the limits of its terms of reference, the Economic Commission for Africa (ECA) has carried out several operational activities in the field of natural resources:

##### Hydroelectric energy

(a) Involvement in studies and negotiations for the multinational utilization of hydroelectric energy in groups of countries such as Dahomey-Togo-Ghana, Ghana-Upper Volta, Nigeria-Niger, Ivory Coast-Ghana, Togo-Dahomey, Nigeria-Cameroon-Chad, Ivory Coast-Liberia, Zaire-Rwanda-Burundi, Kenya-Uganda-United Republic of Tanzania, Morocco-Algeria-Tunisia.

(b) Publication of an African map on "Primary Energy" and one on "Electrical Energy" (in press).

(c) ECA has been engaged in preparing studies on electrical energy in various subregions of the continent and encouraging groups of countries to collaborate. It has been shown that between 1965 and 1969, production and consumption of electric energy has increased from 23.38 per cent of the total in 1965 to 26.70 per cent in 1969.

The Economic Commission for Africa has carried out similar studies for the West African subregion, the East African subregion and the North African subregion.

##### Petroleum

In the field of petroleum, ECA has been engaged in the following:

(a) Preparation of a "Summary of information on resources and development of the petroleum industry in Africa" showing the present status, and forecasting the evolution of the reserves, and oil production for each African country up to 1980;

(b) Production of a paper entitled "Comparison between the cost of petroleum works in the off-shore and on-shore areas";

(c) Compilation of a comprehensive review of petroleum development in Niger and Libyan Arab Republic from the start of explorations to May 1971;

(d) Similar studies are being made for Senegal, Gabon, Mali, Egypt, Ethiopia, Somalia, Mauritania, Algeria, Morocco and Tunisia.

### Development of water resources

The importance of water in irrigation and production of power in Africa has been to the forefront in the operational and on-going activities of the Economic Commission for Africa, which have included the following:

- Evaluation of present and foreseeable water needs of African countries;
- Encouragement of co-ordinated development of river basins by the Chad Basin Commission, the Niger Basin Commission and the Senegal River Basin Commission;
- Study of major deficiencies of hydrological data in Africa;
- Publication of a bibliography of the Nile Basin;
- Survey of manpower in the field of water resources carried out in 16 African countries;
- Publication on hydraulic development of the Niger River;
- Publication on water development planning in African conditions (under preparation);
- A hydrometeorological survey of the catchments of Lakes Victoria, Kyoga and Albert. This was a detailed hydrological investigation of the catchments of the three lakes for determining the natural water balance in order to establish a basis for future planning of the conservation, use, regulation and development of waters of the Nile;
- Assisting the Governments of Guinea and Mali to establish a flood forecasting method, thereby permitting the establishment of protective measures for people and property;
- Helping Member States to strengthen their national meteorological services;
- Development of hydrometeorological networks in Africa;
- Holding a conference on the Role of hydrology and hydrometeorology in the economic development of Africa;
- Conference on Rural water supply in Africa.

Several studies have been made and reports produced on various aspects of water resource developments in Africa by country and by subregion which could be placed before the Committee in future. But one important aspect of Africa's water resources is the fact that the continent has about 50 international rivers shared by two or more States. In order to promote co-ordinated and rational development of these international river basins, the Economic Commission for Africa undertook an exhaustive study of these river basins.

Much more work has been, and is being done, concerning the many lakes of Africa, such as the exploration and utilization of underground water etc., which will be presented in future.

### Mineral resources

Operational activities of ECA have included:

Assemblage of basic data on African minerals, to form part of the material required for studies on the location of industries;

Building up of data on African mineral resources;

A review of mineral resources of the four subregions of the continent (published studies are available);

Studies of problems associated with diamond smuggling;

Publication of a coal map of Africa;

Advising Governments on the organization of their geological researches and the development of mineral resources;

Collection of materials on mining services, mining legislation and agreements (23 countries already done).

ECA has many more on-going programmes in the field of mineral resources development which will be reported to future sessions of the Committee.

### Cartography

In the field of Cartography, the following projects have been undertaken:

A map of the African continental shelf has been compiled to form a basis for rational exploration of available natural resources;

A centre for training in photogrammetry, photo-interpretation and aerogeophysics had been established in Nigeria. The centre should open its doors to students in 1972;

A similar centre is due to be opened in Yaoundé, Cameroon, in 1973;

A map documentation and reference centre was established at the ECA secretariat for use by Member States. Charts and maps are regularly published by the centres.

### Other activities

Institute for natural resources management. ECA is collecting information about syllabi, course content etc. from universities which have established courses in natural resources management. This will be followed by a mission to identify centre(s) in Africa where an institute for research and training in natural resources management could be established in Africa.

In the past, the United Nations Economic and Social Office in Beirut (UNESOB) has not worked directly in the field of natural resources development. However, indirectly, research by UNESOB as well as technical assistance and advice provided by it through its regional advisers and other staff members on their missions to various countries of the region has had a bearing on the development of natural resources in the region.

Noting the importance of the subject and hoping that adequate financing resources would be made available to UNESOB, development of natural resources was included in the work programme for 1971-1976. Under this item, UNESOB plans to undertake studies which would ensure a more comprehensive knowledge of the state of natural resources, their depletion and their efficient and economical exploitation.

VIII. Food and Agriculture Organization of the United Nations

The work of the Food and Agriculture Organization of the United Nations (FAO) is devoted to the world-wide growth and improvement of agriculture and nutrition, for which it assists its member countries in relating demands for food production realistically to the development and utilization of natural resources for agriculture and in the formulation and implementation of development policies and projects. The Organization is concerned with survey, planning and development of physical and biological natural resources and with their rational utilization, management and conservation for agriculture, fisheries, forestry and animal production.

Natural resources for agriculture, forestry and fisheries are water, minerals, soil, solar energy and also genetic resources of plants and animals. The development and utilization of these natural resources are part of practically all the activities of FAO in the field of agriculture. A complex process of controlling, utilizing and combining these natural resources is required to attain sustained and improved production of food and agricultural commodities, the creation of employment opportunities and socio-economic objectives. FAO therefore emphasizes the need for an integrated approach to the development and use of basic natural resources for agriculture, including inputs required for their optimal utilization.

This summary of FAO's work in the field of natural resources is limited to water and the interrelation of its use with the development, use and conservation of other basic resources for agricultural production

FAO's activities in its regular and field programmes include:

(a) Assessment of availability, variability and quality of water resources, including rainfall, surface water, soil water and ground water. Ground water is considered part of the water resources system and is seen as an alternative or complementary potential source of water in most surface water development projects here the integrated approach is pursued which, however, does not only apply to the different sources of water (including soil water as a direct source for plant growth) and reuse of drainage water, but also to the integration with all inputs from other resources required for the most effective use of water. Users' aspects prevail in determining requirements at all levels of hydrological data collection water resources planning, development and management. A continuous process of planning is carried out through FAO's Perspective Study of World Agricultural Development, which includes land and water, forestry and fisheries and animal resources;

(b) Design of water development systems for agriculture, including reservoirs, spillways, barrages, canals, wells, river control works, drainage systems and irrigation and drainage distribution systems. FAO's programme includes a heavy commitment to the technical and economic aspects of design and construction of such water development works for agriculture;

(c) Water control and management, including conservation. Activities in this field cover estimation and evaluation of crop water requirements, water distribution, application methods and practices, the use of saline and sewage water, reclamation of problem soils, the introduction of modern drainage techniques and practices and projects to increase crop yield and quality through variety selection and better use of water and fertilizers. In respect of water conservation, this includes programmes on forestry and forest management, soil conservation and range management practices, land use planning, inland fisheries and related hydrobiology. All these activities have to take their proper place in water resources and use planning. The full utilization of the production capacity of natural resources, their conservation, and avoidance of inadequate or improper use of these means of production receive specific attention;

(d) Education and training, including rural youth programmes, rural sociology and public information. Specific attention is paid to training of cadres both at the professional and technical level, through in-service training, fellowships, seminars, meetings and pilot projects, and through co-ordinating regional land and water use programmes;

(e) Organization, administration, management and legal aspects of natural resources development and use, including assistance to member countries in draft legislation on natural resources development and conservation, water and soil, tenure, wild life, grazing, fisheries and forestry. FAO co-operates closely with international river basin commissions. At the scheme level, activities directly involve the operation, maintenance and management aspects and the creation, organization and staffing of institutions required for this purpose, including

irrigation districts and irrigation users' associations. Much emphasis is placed on this field in response to increasing awareness that major bottle-necks to development frequently occur through deficiency of organization, administration and management.

(f) Research, including the use, application and adaptation of new and proven techniques for surveys, updating of system analysis and interpretation, establishment of survey criteria and standardization. In order to gain better knowledge of water and soil resources, and to identify their development and use potential, applied research components are found in most of FAO's field projects. Work is carried out on all aspects of water application and use and conservation in agriculture through pilot projects, experimental stations and in co-operation with existing research institutes. FAO has co-operated with IBRD and UNDP in setting up the Consultative Group on International Agricultural Research. Such work is also a precondition for a useful exchange of experience, as demonstrated by the FAO/UNESCO World Soil Resources Map.

(g) Co-operation with other United Nations specialized agencies and programmes, and with international and national governmental and non-governmental organizations, universities and research institutes. This is achieved through FAO's various statutory bodies and commissions, through direct participation in technical meetings and field projects, and joint activities in the field of water;

(h) International conventions and agreements. FAO has accepted the responsibility for or is actively participating in international action related to the development of natural resources.

FAO's operational activities in all water fields can be summarized as follows (extracted from FAO report for 1971 to the ACC Sub-Committee on Water Resources Development);

UNDP(SF) projects dealing with all aspects of water planning, development and use	87
Other UNDP(SF) projects with a water development component	34
Participation with other United Nations agencies in projects on water	22
World Food Programme water projects	34
Funds-in-trust projects dealing with water	10
Individual technical assistance experts in water fields	68
Fellowships (September 1970/71) in water fields	58

#### IX. World Health Organization

##### General

The subject of water resources as a vital part of the total environment is a multiplex one involving various fields of interdependent activities. The World Health Organization's obvious interest in this field is concerned with the far-reaching impact of the uses and abuses of water resources in particular as they affect the human environment and ultimately the health of nations. While the great importance of other components of water resource activities is recognized, such as energy and mineral sources, such activities are not within WHO's sphere of responsibility.

The main organizational units active in the water resources field are the Community Water Supply and Sanitation, Environmental Pollution and Pre-investment Planning units within the Division of Environmental Health. However, a large number of other WHO units are also involved, either directly or indirectly. Top priorities were given to assistance of member countries for the development of safe community water supply and waste disposal. Various programmes have been developed over the past 20 years involving substantial allocations from the WHO regular budget, as well as other programmes undertaken in co-operation with UNICEF, UNDP and with bilateral assistance.

Programmes of assistance are primarily in the form of direct assistance whereby sanitary engineers are placed in countries to help in the development of better water supplies, control of quality and in waste water management. As of 1971 there are approximately 245 field projects in 90 member countries, all related to water resources in various degrees. Among the major programmes are the pre-investment projects in water supply, sewerage and water pollution financed with UNDP(Special Fund) assistance. There are now 25 such projects in operation in all regions of the Organization.

Equally important are the WHO programmes in training, research and development. These are carried out through fellowships, assistance to local institutions, publications, seminars and by collaboration through the new WHO International Reference Centres on Community Water Supply and Wastes Management.

The future of developing countries in this field are tremendous, and in recognition of this WHO has worked closely with other international and bilateral agencies to mount a more vigorous programme. Targets for the Second United Nations Development Decade established by WHO point to the need of over \$9,000 million of capital investment for community water supplies and \$7,000 million for sewerage. This has stimulated a closer co-operation and co-ordination between WHO and IBRD, which organizations have recently joined forces in a co-operative programme to carry out sector studies and to identify water supply, waste management and water pollution projects for investment.

A major preparation has been made by WHO for its participation in the United Nations Conference on the Human Environment.

#### Organization functions in water resource projects

The WHO units which deal primarily with water resources projects are briefly:

(a) The Water Supply and Sanitation Unit. This Unit deals comprehensively with systems for ensuring sanitary processing and delivery of water and food, sanitary removal and disposal of domestic and industrial wastes, hygienic quality of the environment, and engineering measures for protection of knowledge and technology gaps, and methods for closing such gaps; the development of criteria and technical guidelines; the dissemination of technology and feed-back of field problems between industrialized and developing countries; promotion and assistance to countries in planning comprehensive national programmes; continued consultation with the United Nations, the United Nations Industrial Development Organization

and the Food and Agriculture Organization of the United Nations during the planning and implementation of projects; and the evaluation of world-wide progress towards Second Development Decade goals;

(b) Environmental Pollution Unit. This provides technical guidance for the prevention and control of air, soil, surface and ground-water pollution, and encourages the training of personnel in this field; collaboration in methodology studies for ascertaining the effects of physical, chemical and biological pollutants on man and his environment; promotion and establishment of routine surveillance networks for radionuclides in the environment, and advice on measures for dealing with radioactive contamination; and stimulation of research, and promotion of uniformity in nomenclature, analytical procedures and expression of results;

(c) Pre-investment Planning Unit. This Unit provides advice and assistance to regional offices and Governments on pre-investment planning for water supply and wastes disposal for maximum beneficial use of funds; the development of criteria and guidelines, including sensitivity aspects, for project execution; the assistance in the negotiation of subcontracts and maintenance of a list of qualified consulting firms; the development of criteria and methodology for cost-effectiveness, progress review and evaluation; the provision of technical guidance and review in the conduct of sector studies of water supply and wastes disposal needs, and technical guidance to administrative units in the execution of their functions in pre-investment planning projects; the study and report, in co-operation with other units of the Organization, upon the short- and long-term effects of the construction of planned water supply and wastes disposal systems on the quality of urban life and the eco-systems of the areas affected; and the liaison on technical matters with other United Nations organizations as well as other international, regional and bilateral agencies which assist member States in pre-investment or investment programmes.

## X. International Bank for Reconstruction and Development

### Water

#### Irrigation

In November 1970, the International Development Association (IDA) extended a \$14.5 million credit to Indonesia to improve its irrigation and drainage systems. The project is scheduled for completion by 1975.

An IDA credit of \$US5 million to Afghanistan was signed in June 1971. Its purpose is to modernize the existing irrigation system in the Khanabad Valley in the north-east of the country. The project was prepared with the assistance of FAO and UNDP. It will be completed in 1974.

A credit was extended by IDA to India in August 1971 for an amount of \$39 million to assist the financing of the Pochampad Irrigation Project in the State of Andhra Pradesh. The first phase of the project includes a dam and canal system to irrigate 100,000 hectares from the Godavari River and is due for completion in 1976.

The financing of the Lake Alaotra Irrigation Project in the Republic of Malagasy will be assisted by an IDA credit of \$5 million signed in August 1970. Year-round production of a high-yield rice crop of 12,000 ha. will be made possible. The project should be completed by the end of 1975.

In Greece, a loan of \$25 million approved by the World Bank in June 1971 will finance the development of ground-water resources in the Thessaly Plain. Sixteen hundred production wells will be drilled and equipped and by 1976 an additional 40,000 ha. will be covered by an irrigation distribution system.

#### Water supply and sewerage

In February 1971, IDA awarded a \$3 million credit to Botswana for an urban water supply project to be completed in 1972.

The World Bank approved two loans in March 1971 totalling \$5.4 million for sewerage and drainage projects in Nicosia and Famagusta in Cyprus. The projects will serve about one quarter of the population in each city as well as accommodation for 4,000 tourists. The projects are scheduled for completion in 1974.

A World Bank loan of \$8.3 million to Kenya will serve to develop a new source of water for Nairobi, increasing present capacity nearly 50 per cent and allowing the system to meet the city's water needs through 1980. The project period is 1971-1974.

Two loans were made to Brazil by the World Bank in May 1971 for a total of \$37 million to finance the foreign exchange cost of the Sao Paulo Water Supply and Pollution Control Project. Piped water will be made available to 2 million additional persons. Rivers will be freed of 75 per cent of the present load of solids and 45 per cent of biochemical pollutants. The project is to be completed in 1974.

#### Multipurpose water schemes

A loan of \$45 million to Yugoslavia by the World Bank in June 1971 will finance a multipurpose water supply, irrigation and electric power project in the Autonomous Province of Kosovo. The project is expected to be completed by the end of 1975.

In May 1971, the World Bank approved two loans totalling \$90 million for water supply projects in Colombia. A loan of \$88 million will finance the second phase of the expansion of the Bogota water supply system and a \$2 million loan is for the Palmira water supply project. The two projects are scheduled for completion in 1977 and 1974, respectively.

#### Energy

In December 1970, the World Bank and Sweden lent \$42 million to the United Republic of Tanzania for a hydroelectric power project which, upon completion, will give the Tanzania Electric Company a total generating capacity of 237 megawatts.

A World Bank loan of \$23.2 million was approved in April 1971 for a hydroelectric power project in the Territory of Papua and New Guinea to help meet the demand on the highlands of New Guinea and in the ports of Lae and Madang. The project is to be completed in late 1975.

In April 1971, the World Bank approved a \$70 million loan to Brazil for construction of a 700-megawatt hydroelectric plant and associated transmission facilities at Salto Osorio on the Iguacu River. The last generating unit is expected to be operational in early 1976.

#### Mineral resources

A loan of \$9 million was approved by the World Bank to the Republic of Guinea in June 1971 to extend the transportation infrastructure for the extension of the Boke bauxite mining venture. The project will be part of an over-all expansion of Boke production and sales are expected of 9.2 million tons of bauxite annually compared to the present capacity level of 6.6 million tons.

The Bank, also in June 1971, approved a \$32 million loan to Botswana principally to finance water and transportation facilities and a township required to support a copper-nickel mining development project at Selibi/Pikwe in the north-east of the country. The project is expected to be completed in 1974.

A World Bank loan of \$50 million was made to Brazil in August 1971 for the development of a project to mine and export high-grade iron ore. A second loan of \$46 million was made for associated railway facilities. The over-all project is expected to result in net foreign exchange earnings for Brazil of \$50 million per annum based on expected minimum annual shipments of 10 million tons of ore. The project should be completed by 1974.

The World Bank Group, in the financial year ending 30 June, 1971, made loans totalling \$264 million to 18 developing finance companies to finance ventures in 12 countries. The proportion of these funds which went to support natural resources development through loans issued by these companies is not known precisely but can be assumed to be far from negligible.

As for technical assistance, in addition to the co-operative programmes set up with FAO and with WHO and which cover in part the field under consideration, an example of assistance of this type is the review of the development of water resources of the Lower Mekong Basin undertaken under the leadership of the World Bank at the request of the Secretary-General of the United Nations and of the Mekong Committee. Fourteen projects in the Basin have been earmarked for pre-investment study and the Bank has agreed to be the executing agency in co-operation with FAO and the Asian Development Bank.

#### Minerals

The main nuclear material is uranium which occurs in most regions of the world and is often found in areas where none of the other common minerals are found. Thus, although general mineral surveys should be carried out and may result in finding uranium-bearing ores, it is a fact that nearly all the major uranium sources have been found by special uranium prospecting missions and often where no other commercially attractive minerals exist.

The Agency has sponsored work in developing countries in looking for uranium resources through the provision of experts, by supplying equipment, by organizing training courses, by granting fellowships and by sending special missions. The IAEA is also the executing agency for two UNDP/Special Fund projects on uranium exploration in Pakistan and Greece.

The Agency is also actively engaged in developing a programme on the use of nuclear techniques in the exploration and exploitation of other minerals.

The successive stages from mineral prospecting through the evaluation, development and exploitation of mineral deposits all require extensive effort and costly investments. In these operations, nuclear techniques, which help towards greater efficiency and lower costs, are being increasingly adopted.

The Agency keeps abreast of the progress in this rapidly developing field by holding various kinds of meetings and by direct consultation with leading experts, e.g., the Symposium on Nuclear Techniques in the Prospecting and Development of Mineral Resources, convened at Buenos Aires in 1968.

The Agency provides considerable support to its developing member States, both in their research and development efforts and in their attempt to apply nuclear techniques in various areas of the mineral industry.

Technical assistance projects which have been and are being implemented within recent years range from relatively small projects involving the provision of suitable experts and relatively low-cost portable instruments or instrument modules which could be assembled within a particular country for field work, training and demonstration, up to long-range costly projects involving assistance in setting up a modern analytical laboratory employing techniques such as radiochemistry, neutron activation, X-ray fluorescence and online computer, which are usually financed both by the receiving country and the Agency, and may take several years for successive building up of instrumentation and personnel capability. Recently the Agency awarded research contracts on the use of nuclear techniques in geochemical prospecting, and on the use of radioisotopes in flow studies with some reference to the transport of mineral slurries, both of which are organized as co-ordinated programmes

#### Nuclear desalination

Some large desalination units for producing about 5 million gallons per day of drinking water are now in operation and larger plants are being considered but the cost of this water is quite high, about 50 cents per thousand gallons.

Larger units of about 100 million gallons per day capacity could be combined with nuclear power plants of about 400 electrical megawatts in a dual-purpose power and desalting plant and such units could be of interest to large coastal urban areas in 10 or 15 years' time. The IAEA has held or sponsored meetings in this field and will continue to do so in order that it can advise countries in good time about the prospects of using nuclear desalting plants.

Subcontractual work and advisory services. The Agency analyses samples for isotopic composition and advises regarding hydrological interpretations based on isotope data for water resources programmes (UNDP/SF) executed by other United Nations organizations. On a more limited basis, the Agency, upon request, makes advisory visits and some isotope analyses for member States in connexion with field demonstration projects using isotope techniques.

Technical assistance. The Agency furnishes technical assistance in the form of both equipment for nuclear methods and experts. Such assistance includes both environmental and artificial isotope techniques and covers a broad range of hydrological activity. Currently, technical assistance is in progress in 13 developing countries.

Training. (a) Periodically, the Agency conducts regional courses in isotope hydrology mainly for hydrologists of the countries of the region. Such courses, each of several weeks' duration, have been held in the Middle East, South America and South-East Asia. (b) The Agency awards fellowships for training in various aspects of isotope hydrology for nationals of member States. The fellowships range from two to several months' duration and are normally conducted in part at IAEA headquarters and in part at other institutes or laboratories, as may be appropriate.

Exchange of information. (a) The Agency organizes and conducts periodic symposia on isotope hydrology and panel meetings on special topics in isotope hydrology. (b) Information about the Agency's work in isotope hydrology is disseminated through its own publications, through published papers in the scientific literature; and through non-published technical reports for other United Nations organizations and for member States. (c) The Agency provides the technical secretariat for the International Hydrological Decade (IHD) Working Group on Nuclear Techniques in Hydrology, which co-ordinates international exchange of knowledge in isotope hydrology and sponsors publications. (d) At least a few times each year, IAEA furnishes lectures in the subject of isotope hydrology for international hydrological training courses.

Research. The Agency sponsors research by giving financial assistance and technical advice to individuals and/or institutions working on special problems in both environmental and artificial isotope hydrology. Such Agency-supported research is currently going on in 12 developing countries.