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DEVELOPMENT (UNCSTD)

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PREFACE

Following the announcement in December 1976 that the United Nations Conference on Science and Technology for Development (UNCSTD) would be held in late 1979, the United States Government offered its services to countries desiring technical assistance in preparing their national papers for the Conference.

In the Spring of 1978, USAID was contacted by the Government of the Islamic Republic of Mauritania (GIRM) with a request for support in preparing its national paper for the UNCSTD. USAID contracted for the services of the International Science and Technology Institute, Inc. of Washington, D.C., which sent a three-man team to Nouakchott, Mauritania, in June 1978. The team was to assist the GIRM in three areas: science and technology policy; industry; and agriculture.

It was originally anticipated that the team would work closely with counterpart representatives of the GIRM in drafting material for the National Paper. This proved impossible due to other commitments of government staff. It was therefore decided by the GIRM that, after a series of meetings with officials in the public and private sectors, each team member would prepare his own paper in his subject area. This paper was to reflect his understanding of the situation in his area and his judgement as to what actions would be most appropriate for Mauritania. The team was advised by

the GIRM "to be creative" and not to be limited or bound by the UN Guidelines for preparing papers for UNCSTD. The papers prepared by the team will then be used by the GIRM to whatever extent it desires to prepare the Mauritania National Paper for the UNCSTD.

Accordingly, this report is presented in three sections:

- I. Science and Technology for Improving National Resources; Agriculture and Food;
- II. Industry Sector Notes;
- III. Science and Technology Policy Requirements and Implications for Mauritania.

SCIENCE AND TECHNOLOGY FOR IMPROVING
NATURAL RESOURCES, AGRICULTURE AND FOOD

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SCIENCE AND TECHNOLOGY FOR IMPROVING
NATURAL RESOURCES, AGRICULTURE AND FOOD

SUMMARY

Mauritania has a critical problem of general aridity accentuated by a prolonged drought. Livestock numbers exceed available field supplies, resulting in overgrazing and the destruction of natural vegetation. This, combined with the cutting of trees for fuel and charcoal, has resulted in a rapidly spreading desertification process with soil deterioration and the formation and movement of sand dunes. Food is in short supply.

The selection of appropriate science and technology for solving these critical problems can be facilitated by the use of climatic, soil, vegetation and hydrologic data to identify, describe and map the nation's land areas into agroecologic zones with reduced risks and a minimum of local field testing.

Two broadly different situations are seen associated with relative difficulties in introducing and placing helpful science into use. The most readily managed situation is the introduction of technologies that do not require major changes in people's life styles. Such is the introduction of improved seeds, fertilizers, pesticides, veterinary medicines, improved animal breeding, and even the transition to irrigated agriculture. Small scale trials have indicated ready response to the use of such technologies.

The second, and more difficult set of circumstances, are those in which there are many interdependent physical, biologic, economic and cultural constraints that must be managed simultaneously or removed before science and technology applications can be fully effective. Such is the situation in the people-livestock-range-forest complex. People are having economic difficulties in survival. In consequence, attempts are made to increase livestock numbers with increasing destruction of native vegetation. Cutting of trees compounds the problem and desertification and accompanying soil deterioration processes are accelerated. A few alternative points for intervention into this complex are suggested.

Research for agriculture, for livestock improvement and for reforestation and control of desertification is now administered within three Directorates of the Ministry for Rural Development. With the limited staffs and facilities and the interrelatedness and overlapping of the problems of their respective sectors, close coordination of effort is needed. This could be accomplished through a directorate in the Ministry for Science and Development. Also a Research Council with representation from the three research areas could be formed to jointly plan, coordinate and review research programmes and to determine that interdisciplinary cooperation is focussed on major problem areas.

The transition of the agriculture and livestock sectors from subsistence to economically viable levels will require many additional infrastructures to supply and reinforce technology adoption and use. A major need is training for substantial numbers of people in the major disciplines involved in a scientifically based agriculture. A transport system is needed to move produce from farms to

consumers. A marketing and pricing system and organization are essential. Credits are necessary and local sources of improved seeds, pesticides, veterinary medicines, tools and machinery must be provided.

The necessary steps in the adoption and effective use of science and technology in improving Mauritania's natural resources, agriculture and livestock sectors will require the helpful assistance of the world community of nations.

1. Introduction

A number of Mauritania's development goals are concerned with natural renewable resources, agriculture and livestock, and with food supply. These goals aspire to the conservation and development of natural resources, to stopping desertification, to making the nation self-sufficient in the production of food, and to improving the quality of life of its people. The attainment of these goals will require the concerted efforts of all the nation's citizens, the careful use of all available resources and the cooperation of other countries in the wise use of science and technology in the solution of urgent and pressing problems.

Many of the problems are associated with inadequate and poorly distributed water supplies. About three-fourths of the land surface is in the Saharan desert zone, receiving less than 250 mm of annual precipitation. In consequence, vegetation is too sparse to support livestock grazing except in the best favored spots and at an occasional oasis. An additional 15 percent of the land receives 250 to 500 mm of rain, enough to support modest herbage for some livestock grazing but insufficient for cultivated crops. Only about 4 percent of the land receives enough rain (500 to 700 mm) for crop production and this for only a limited period each year.

Not only is natural precipitation limited, it is highly erratic with frequent droughts. Further, many of the storms are of such high intensity that the water can be only partially absorbed by the parched soils. The present drought has continued for almost a decade and has accentuated the already critical problems

of overgrazing, deforestation, soil degradation through wind erosion, and national food deficits.

This brief sketch of the situation emphasizes that limited water supplies are the dominant constraint to be considered in programmes to strengthen agriculture. Human and livestock pressures contribute to the destruction of a fragile natural vegetation, resulting in soil deterioration and contributing to a decline in the agricultural capacity to produce adequate food. Discouraging as this may appear, there is evidence that the application of science and technology to the conservation and effective use of land and water resources can improve the environment and insure substantial increases in food production. Problems encountered in the various sectors of agriculture and renewable resources, technology needs, and some procedures for identifying and transferring such technologies are briefly described.

2. Inventory and Characterization of Natural Renewable Resources

A reliable inventory and evaluation of the important components and characteristics of the country's renewable resources is an important initial step toward developing appropriate conservation, development and management practices. Such inventories are also an essential base for formulating public policies and programmes for managing these resources. Needed are more climatic stations widely distributed over the country to record rainfall, temperatures, humidity, water evaporation, wind and other variables over an extended period of years. Moderately detailed maps of the soils and their classification into capability units for such varied uses as

grazing, producing cultivated crops, irrigation and growth of forests, are also vital to developing a stable agriculture. Problems of wind erosion, active sand dunes, water logging and salinity also need identification and measurement. Further, information about the vegetation types and their productive status is needed as a basis for such activities as grazing management, reforestation and range revegetation.

Especially significant is the development of a reliable inventory of water resources. Measurements are needed on underground waters and surface waters. The major surface water resource is the Senegal River which must be shared with other countries. Little is known about the locations, quantities and qualities of underground water, but they could have an important impact on many areas in the country.

A good start has been made on the inventory of many of these important resources. But completion of the task will require the services of additional well-trained specialists over many years. Also needed is such back-up support as transport, aerial photographs and weather instruments. Such data are the basis for much of the national planning effort. Techniques for appraising and analyzing these data are being perfected and expanded by resource scientists in many countries. Their cooperation and assistance are urgently needed.

One basic principle for identifying agro-technology suitable for transfer to a given ecological zone is to seek it in similar ecological zones, regardless of location. Such matching ecological zones are determined primarily by similarities in climatic variables, soils and hydrologic characteristics. The type of

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vegetation present is also almost certain to be similar. Therefore, on the basis of climate and natural resource characteristics, Mauritania's land area can be described and mapped in terms of a series of ecological units. Under the International Biological Programme, sponsored by the United Nations and many cooperating countries, ecological maps have been prepared for arid regions in many parts of the world.

Agro-technologies can be selected and transferred to ecological zones in Mauritania from similar ecological situations elsewhere. Such transfers can be made with minimum local testing and with adaptations being made more on local economic and cultural considerations than on need for extensive preliminary screening for adaptation to soil and climatic situations. Such information and technology transfers can be valuable for improved crop production under rainfed or irrigated conditions, for reforestation, for range grazing improvement, and for control of desertification.

3. Crop Production Agriculture

All of mankind is ultimately dependent on plants for food and fibers. Through the application of science and technology to plant culture have come the major world increases in food and fiber supply and quality over the past century. Mauritania, like many developing countries, has shared only partially in these technical advances. However, the country is now taking steps toward the importation, testing and use of many facets of science and technology that will insure a better quality of life for its people.

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4. Irrigation Agriculture

Present information indicates that of about 2,000,000 hectares of land in the Mauritania flood plain of the Senegal River, about 100,000 hectares are adapted for successful irrigation. Development of modern irrigated farming on such an area would be a major step toward food self-sufficiency. However, investment costs are high, presently exceeding \$5,000 per hectare and the major projects involved are still in the planning phases.

A number of small irrigation projects, based on pumping water from the river, are now coming into production. Pronounced increases in production are being obtained over the previous system of planting following recession of the river flood waters. Where, until a year or two ago, yields of about 300 to 500 kg/ha of sorghum were obtained, farmers with the aid of irrigation are currently growing two crops of rice per year with total yields of 9 to 12 tons per hectare and potentials for 15 to 18 tons. The farmers are readily adopting modern technologies such as irrigation, use of seeds of improved varieties, high plant populations, pest control, and changes in planting dates, harvesting dates, and cropping sequences. Currently improved rice varieties on trial have been brought from such diverse sources as China, Vietnam, California, and the International Rice Research Institute in the Philippines.

Looking to the future, new principles of crop production and of irrigation and soil science will be needed to devise packages of technologies that will maximize yields for several crops in addition to rice, and to secure the best

combinations of crops under different ecological situations. Such unsolved problems, as how to minimize the depredations of birds need solution. Efficient use of water has to date received inadequate attention. But in Mauritania, where water supply is the most limiting factor, criteria as to the best crops and practices will likely shift somewhat away from yields per hectare to yields per unit quantity of water as irrigation waters become scarce. This could result in a change from the increasing emphasis on rice to greater production of wheat, maize and sorghum or other crops that may be more economical of water.

Farm machinery and mechanized farming are extremely limited on the irrigated lands, with most of the tillage and weed control being carried out by hand labour. As the irrigated area is increased the need for better inexpensive hand tools and cattle drawn equipment seems likely. Seeking and testing implements used elsewhere and making modifications to meet Mauritania's unique conditions are foreseen. Also, the difficult clay soils being farmed create many problems in providing power and in timing tillage operations advantageously. Improved implements that will enable these clay soils to be tilled effectively with cattle power will be urgently needed as the area of irrigated land is increased.

5. Rainfed Agriculture

The area of unirrigated land suitable for cultivated crops is unknown, but it likely exceeds 150,000 ha. Pearl millet is the principal crop and average

yields are only about 200 kg/ha. The limited and precarious nature of precipitation on these lands indicates an urgent need for water conservation practices. Many such practices can be adapted from those in use in other countries and include changes in time of plowing and in date of planting, use of improved drought tolerant varieties, weed control, fallow and other practices to increase water absorption, decrease evaporation and transpiration losses and to store as much water in the plant root zone as possible.

Where wind erosion is a problem rough tillage, stubble mulching and other practices developed in arid regions should be studied and, where appropriate, adapted for Mauritanian conditions.

Limited studies of rainfed farming in the 450 to 600 mm rainfall belt indicate that doubling of crop yields is a practical potential. Such gains will not come, however, from continuing traditional practices. Experimentation and local testing and modifications of technologies from other arid zones is the primary base on which such improved yields can be attained.

6. Forest, Range and Desert Lands

Arid lands are fragile. Vegetation on them has a precarious existence. Scars from mismanagement or from natural disasters are evident for decades. Most of the indigenous plants are adapted to endure prolonged droughts and to grow rapidly and replenish internal food reserves during short periods of precipitation. If drought, excessive grazing, trampling, or cutting limits photosynthesis

and the resulting accumulation of root reserves during the habitual growth periods, even these hardy plants are unable to survive. If they die the roots that have held soil particles together disappear and a vicious and difficult to control cycle of soil degradation is initiated. Loose soil particles are moved by the winds and sand dunes build up. Blowing sand kills or covers vegetation in its path and large areas beyond the site of initial damage may be affected. Such is the current situation in much of Mauritania.

Up to 80 percent of the villages and towns of Mauritania are estimated to be adversely affected by sand dunes. Many thousands of hectares of grazing lands and forests are badly damaged and sand dunes are encroaching on much of the cultivated land. Near urban or other high investment areas special soil and dune stabilization structures may be justified. But in the open grazing land and forests relatively low-cost natural restoration processes must be utilized.

Other countries in arid lands have experienced similar disasters to that now occurring in Mauritania. Through research and repeated field trials plant species have been found and practices have evolved that make possible the revegetation and stabilization of similar areas of blowing sand. But these types of technology can only be adapted and effectively used when the causes of the problem have been removed. In Mauritania, the general causes are widely recognized: overgrazing; cutting of trees to make charcoal or for fuel and disturbance by human activities. Behind these practices, however, are the economic and social fabric of society, accentuated by the prolonged severe drought that has reduced so many

people's lives to bare survival.

So in this case, solutions to the crucial problems of soil and vegetation deterioration are so tied to the traditions, attitudes, economy and even survival of the people, that there is no possibility for improving the natural environment without first solving the related and causative social and economic situations. The solutions to the problem must be uniquely Mauritanian. However, the world community can help and their assistance is desperately needed. Studies and development programs should be addressed to finding a stable economic base for the people and promoting among them an awareness of the relationships between their actions and the feared processes of desertification.

Far reaching government policies for the protection and improvement of natural renewable resources are necessary. But such programs must be aligned with understanding and economic assistance for the people involved.

7. The Livestock Sector

Livestock numbers in Mauritania reached a peak toward the end of the 1960's. During the severe drought years from 1968 to 1974 cattle numbers declined nearly one-half and sheep and goats by over one-fourth. The large numbers of starving cattle were not only disastrous to the native vegetation, but with the death, starvation, or early slaughter of domestic animals, large numbers of livestock producers were forced to seek other means of livelihood, mostly in villages and the larger cities. According to estimates of the Bureau of the

of the Census the proportion of rural people who were nomads declined from 78 percent in 1945 to about 27 percent in 1975.

Since the most severe drought years of 1973-74 there has been a slight increase in cattle numbers and a larger increase in numbers of sheep and goats. Clearly, though, the livestock industry has many afflictions. The most important is the lack of adequate feed; the low rates of reproduction requires excessive numbers of breeding animals to maintain the herds. This is compounded with slow growth rates and low qualities of carcasses at slaughter and by the ravages of numerous diseases and parasites.

In addition to the ravages attributable to the drought, there are other problems needing study, and needing improved practices and the adoption of improved technologies. On a yearly average only about 40 percent of breeding cows produce a calf and about one-third of these calves die in the first year of life. During severe drought years losses may be much higher. In consequence, the proportion of cattle under three years of age is only about 20 percent. Management practices and improved technologies that would increase the calf crop and the survival of calves would make possible substantial reductions in the numbers of breeding animals without reducing the number of animals for milking or slaughter. Accomplishing such improvements will require improved selection and breeding practices, better health care and better feed and nutrition.

There is a lack of adequately trained animal scientists and technicians. The

number of veterinarians in the entire country is reported at twelve, with half of them being in Government administrative posts. These few veterinarians have an impossible task of providing health services for nearly ten million animals. Assistance is needed in the training of substantial numbers of veterinarians and assistant technicians.

The most urgent need for strengthening the livestock industry is an increase in the supply and quality of feed. In the short run this need for more forage for animals is in conflict with a necessity that grazing of range lands be greatly curtailed for a few years to permit recovery of native plants. Leaders of the livestock sector are looking to the potential of closer integration of livestock production and the production of crops on irrigated and rainfed lands.

Of substantial but secondary importance is improved quality of animal nutrition. The nutritional values of feeds consumed are not well known. The slow rates of animal growth suggest shortages of proteins, some vitamins, and possibly of minerals in the diets, in addition to the inadequate energy supplies. A recovery of range plants and good range management practices could double the annual quantities of available range forage.

With the full development and improvement of irrigated and rainfed crop production the inclusion of forage crops in crop rotations will prove beneficial to soils and would augment animal feed supplies. There are also additional sources of protein from development of the potential fisheries industry. These could be

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important livestock feed supplements.

Vaccinations and even limited veterinary services have brought some improvements in animal health and have reduced death losses. With the limited trained veterinarians livestock health measures have been primarily to meet emergency disease situations rather than to be preventative.

In partial summary, solutions for the problems of the livestock industry will likely require major changes in the lives, attitudes and economy of the livestock producers. Vast infusions of scientific principles and technologies are needed. This will require technical and advanced training of substantial numbers of people. Also, the close cooperation of a major international institution or one from another country concerned with range livestock production and doing research and extension to service a modern livestock industry is urgently needed. Substantial transfers of science and technology are needed, but they must come through local institutions and become part of the way of life of the Mauritanian livestock producers.

8. Food, Human Nutrition and Quality of Life

Although all aspects of agriculture have intricate problems with intimate relationships to science and technology, the proper perspective is lost if the foremost purpose of agriculture and agricultural science being to sustain and enrich human life is not kept constantly in the forefront.

The most obvious contribution of agriculture to the welfare of people is the quantity and quality of food produced. But there are other compensations. Productive farms and well managed natural resources have special values for all people. The beauty and quality of the environment are in large measure dependent on agricultural resources and practices.

Man is a creature of nature and benefits physically and mentally from close association with an agreeable natural environment. In consequence, interest and involvement with agriculture is one of the important concerns of the public and of government and should be reflected in enlightened comprehensive public policies.

At the present time about one third of Mauritania's food grains are imported. Nevertheless, it has been estimated by FAO that during the 1970-74 drought years the average per capita daily calorie intake declined from about 2,000 to 1,890, or about 5 percent. If true, this indicates that many people in Mauritania are inadequately fed, particularly since the daily calorie intake exceeds 3,000 in many countries and 2,000 is considered near the minimum required.

Less is known about the quality of food intake and about the adequacy of the diets of various segments of the population. Large numbers of people in the lower economic stratas must, however, be suffering from malnutrition. On an average, though, protein intake appears favourable, with about half being derived from plants and the other half from animal products.

Little is known about post harvest losses and marketing practices for food

products. There is a growing interest, however, in these aspects of the food situation. The need for more trained people and for international technical assistance in introducing scientific principles and technologies are great.

More detailed evaluations of the diets of various subgroups in Mauritania's population is desirable. Public policies favoring or disfavoring the production of particular food products should be based on a knowledge of the nutritional status of the people. Close ties between nutritional research and agricultural research and development programmes are an important step toward assuring that public policies in the agricultural and food industries are attuned to the welfare of the consuming public. A further emphasis on the science and technology of human nutrition would be an important step in providing an enlightened base for agricultural research and development.

9. Transfer and Management of Science and Technology for Agriculture

In the preceding sections on natural renewable resources and agriculture some of the crucial problems of Mauritania have been briefly described. Needs for training of scientists and technicians have been emphasized. Additional needs for technical assistance in providing capable cooperating scientists and in helping the nation identify, test, adapt and place useful technologies in practice have also been indicated. These steps, together with some associated equipment and related financial support, will help establish a base for increasing agricultural production two-to-several fold.

10. Training

Mauritania has a limited but moderately effective capability for training in agriculture. The only agricultural training school is at Kaedi. It graduates about 30 students per year at the secondary school - Junior College level. With this quantity and level of agricultural scientists output it is necessary to secure training for more advanced students in other countries. A preference has been expressed for training in such neighbouring countries as Senegal, Morocco and Nigeria. In addition, a few scientists selected for leadership roles should be supported for advanced graduate studies at some of the leading agriculturally oriented universities of the world. Among the needs for training outside of Mauritania is that for a number of veterinarians to help with the live-stock industry.

11. Need for Technology Transfer

The acute nature of several of Mauritania's problems indicates an urgency in finding solutions and placing them into action. The desertification process tends to gather momentum at some geometric power. To wait for the time-absorbing process of training scientists and the initiation and conduct of research to find solutions, and then to put them into effect could be disastrous. The damages inflicted by such delays may be almost irreversible.

In consequence, short cuts must be taken through identifying appropriate technologies for conserving and managing resources and for improving agricultural

production. These must be tested and adapted in the shortest practical length of time and incorporated into public programs and/or private practices.

12. Sources of Technical Assistance

To attain effective action programmes Mauritania must rely on the cooperation of scientists from other countries to help identify appropriate science and technology to alleviate urgent problems. These non-Mauritanian scientists and associate helpers in agriculture can, for the most part, come from institutions specializing in research and extension for arid lands. Such institutions may be universities or government agencies. Numerous countries have problems sufficiently similar to Mauritania to be good prospects for such collaboration. Such countries include those in the Sahara and Sahel regions of Africa and such others as Australia, China, the USSR, Mexico and the Western United States. In addition, France has long been concerned with arid land problems in Africa.

13. Suggestions for Science and Technology Transfer

Some suggestions for improving the science and technology transfer assistance programmes include the following:

The programmes and relationships should be in close cooperation with and fit into Mauritania institutions and conditions. Most decisions should be made close to the scene of action so delays can be reduced or avoided. Paper work for such programmes often seems excessive and largely non-productive. The duration of cooperation should be adequate to develop the cooperating Mauritanian institutions. Often this may appropriately include the periodic return of one

or more cooperating scientist after the major programme of cooperation has terminated. Such visits would provide advice and assistance in interpreting data obtained and assistance in planning future work. Also, because of Mauritania's limited financial and capital resources, international or bilateral technical assistance projects in the science and technology sphere should provide for training for Mauritania specialists, for needed equipment, for travel and major assistance with general operating expenses.

Among the specific requests was one for assistance in establishing a second experimental center and farm in a different ecological zone than the current one at Kaedi.

Some agricultural technologies already being introduced include irrigation practices, improved crop varieties, fertilizers, pesticides and veterinary medicines. These are so widely employed in the agricultural world and so well understood that they can move quickly into farmers' fields with only short testing periods.

Other technologies and expensive capital facilities need more cautious evaluations. The selection of plants and practices for reversal of the desertification process, for example, usually need careful testing and adaptation under representative conditions before starting public programmes or encouraging adoption by private land holders.

The urgency for beginning revegetation actions for stabilizing sand dunes, for

improving ranges and for reforestation is great. Furthermore, where the agro-ecological conditions are well characterized, the potential for selecting adapted plant species is fairly good. A reasonable compromise, therefore, is to combine action and research programmes. On at least trial areas, protected from grazing and other situations harmful to seedling plants, reforestation and practices for establishing other selected plants should proceed with reasonable dispatch. Such revegetation programmes should be accompanied by detailed monitoring of climatic, soil and plant conditions so successes can be measured and so factors associated with success or failure in plant establishment are known.

All evaluations of new or old technologies should include measures of costs and of benefits and involves estimates of cost/benefit ratios. The adequacy and accuracy of design specifications should be critically examined by skilled specialists before orders are placed for expensive facilities such as storage dams, irrigation canals, pumps, drainage systems, tube wells, and even fertilizers and pesticides. Mauritania must resist the temptation for importing any facilities or technologies that have not been repeatedly demonstrated as successful and reliable under comparable conditions elsewhere.

Although currently quite dependent on consultants and expatriate scientists and engineers for identifying and evaluating new facilities and technologies, strenuous efforts should be made to train and develop Mauritians with capabilities for handling these assignments.

Past experience indicates that selection of advisers to help identify and procure new technologies must be made with care. They must be not only technically qualified but also free of conflicts of interest, especially in being free from any close ties with firms that market equipment or contract for special services in fields related to the advice being given.

14. Constraints to Adoption of Agro-technologies

The more obvious constraints to rapid identification and utilization of science and technology for improving the natural resource, agriculture and livestock situation includes lack of trained personnel, lack of financial resources to underwrite costs, and extensive poverty among nomads and farmers that induces them to indulge in practices destructive to vegetation and soil and associated resources. There is also a lack of public awareness and understanding about the roles and potentials of science and technology in alleviating their problems.

There are handicaps in the lack of an adequate infrastructure in the country, particularly in rural areas, to support a modern agriculture. Few of the agricultural producing zones are connected to population centers by a good all-season road. Fertilizers, pesticides and other supplies are seldom locally available. Also lacking is a good marketing organization and network. This whole complex needs strengthening. One possible step might be the organization of farmer cooperatives. Such an organization might also serve as an agent to

handle short-term credit for farmers and livestock growers.

Perhaps an equally important and possibly more difficult constraint is the interrelatedness and interdependence of many of the country's critical problems that make attempts to deal with them individually likely to fail. For example, with so many people dependent on livestock, there is strong economic pressure to increase the numbers of grazing animals. But livestock numbers and grazing intensity have far passed the point of increasing returns for such a trend. The result is increasing destruction of natural vegetation and soils, reduced feed supplies, livestock starvation conditions, poor animal health, lower rates of animal reproduction, and higher death losses. Solutions to such a vicious cycle cannot be reached by simple measures. Needed are changes in the way of life of large numbers of people before the successful adoption of effective agro-technologies is possible.

15. Extension Programmes

Promotion and effective guidance for the adoption of technologies will necessitate development of a strong extension service. This could be largely staffed with graduates of the national agricultural school. Some experienced specialists from other countries could be of great assistance, however, in helping organize programmes and in developing effective methodologies for working with farmers and livestock producers.

16. Agricultural Research

The current and indefinite future dependence on scientific advisers and the cooperation and assistance of other countries in identifying, adapting and securing local adoption of new technologies should not be construed as indicating that Mauritania should not take steps to develop its own agricultural research capabilities. Strengthening and conducting needed research is a natural evolution of programmes set up to identify, test and adapt useful technologies. When problems occurring are unique to this country, it will likely be necessary to initiate independent pioneering investigations. But the transition to independent research should be deliberate and well planned, with periodic critical reviews of accomplishments such as that characterizing effective research in developed countries.

17. Institutional Development and International Cooperation

Mauritanian institutions dealing specifically with science and technology for the improvement of agriculture and natural resources have been developed primarily within the past decade. They are handicapped by inadequate facilities, limited staff numbers and by lack of financial support. The Centre National de Recherche Agronomique et de Developpement and the only agriculture school are located at Kaedi. In spite of limitations in staff, facilities and support, some important achievements in training and adaptive research have been made. The Research Centre is being assisted by cooperation with the OMVS regional

agronomy research project which includes Mali and Senegal. The Centre is under the Directorate of Agriculture. The agriculture school is directly under the office of the Minister of Rural Development.

The livestock research programme is headquartered in Nouakchott under the Directorate for Livestock. Research and action programmes for reforestation and desertification are also within the Ministry of Rural Development, but are managed in the Environmental Protection Service Branch.

The four major units concerned with science and technology for agriculture and natural resources are, thus, all within the Ministry for Rural Development, but each of the four is located in a different branch of the ministry. Since the problems facing the research agencies are so intimately intertwined a more effective coordination of activities could no doubt be achieved if they were brought under one administrative unit. Horizontal coordination at the highest level could also be provided by a joint research council to plan, coordinate and review agricultural research accomplishments.

Continuing linkages with some of the international research centres as administered under the International Consultative Group for Agricultural Research are encouraged for short-term applied field training, for assistance in devising improved farming systems research, and for procuring improved crop cultivars for field testing. The following linkages are suggested:

- o Barley and Dry Farming Systems -- ICARDA, Syria

- o Millet, Sorghum, Groundnuts and Farming systems -- ICRISAT, India
- o Wheat and Maize -- CIMMYT, Mexico
- o Rice varieties and production -- IRRI, Philippines, also IITA, Nigeria
- o Livestock management -- CIEA, Ethiopia

Mauritania has an important regional linkage and avenue for cooperation and identification of helpful technology through the recently formed organizations to assist in the drought problems of the Sahel Region. These include the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), The Club of the Sahel, the Friends of the Sahel and the subregional Organization pour le Mise en Veleur du Fleuve Senegal (OMVS). Full advantage of association in these regional organizations should be utilized because the programmes under way are so closely allied to solving the problems of Mauritania.

18. Conclusions and Recommendations on Natural Resources, Agriculture and Food

- (1) First priority in science and technology should be given to the training of specialists and technicians in subject areas most important to Mauritania's problems. A strong arid land orientation is needed in all training.
- (2) Consultants on bilateral assistance or other programs should all have a major responsibility to provide on-the-job training for their Mauritanian counterparts. They should train, by precept and example, the identification, adaptation and the placing into practice of appropriate technologies to help solve some of Mauritania's most pressing problems.

- (3) Data on climate, soils, vegetation and water resources should be utilized in identifying and mapping agro-ecological zones of the country. Matching such areas with similar zones in other countries is an important step in locating, identifying and transferring technologies adapted to specific Mauritanian conditions.
- (4) The value and role of science and technology in improving natural resources, agriculture and livestock could be established by first utilizing simple technologies that can be adapted with minimum adjustments in people's lives. Such technologies include: improved crops, fertilizers, pesticides, tools, equipment, veterinary medicines and improved animal breeding programmes.
- (5) A high and urgent priority must be given to combatting overgrazing, deforestation and desertification. Comprehensive social-economic-ecological studies are needed to identify and bring about the most helpful interventions that can effect a reversal of past trends.
- (6) Information on diets and human nutrition should serve as an important base for establishing priorities in the agricultural and livestock sectors as to products that should be favored in public policy and in technical assistance programmes.
- (7) Major constraints to developing efficient and productive agricultural and productive agricultural and livestock sectors include the lack

of a modern supporting infrastructure. Steps should be taken to create this for areas being strengthened. Needed are roads to markets, markets and favorable pricing systems, local availability of improved seeds, fertilizers, pesticides, tools, equipment, veterinary supplies, and other materials. Equipment repair shops are also needed.

- (8) The agricultural extension service should be greatly strengthened and the staff trained and assisted in working effectively with farmers and livestock producers.
- (9) Research should be strengthened to do applied adaptive studies to make technologies applicable to local situations. Research should also be strengthened toward solving unique Mauritanian problems.
- (10) An Agricultural Research Council is recommended to help plan, coordinate and review research programmes and to help organize interdisciplinary attacks on complex problems. A membership of about five capable scientists is suggested with representatives from the major directorates of the Ministry of Rural Development that have responsibility for research.



International Science and Technology Institute, Inc.

SECTION II
INDUSTRY SECTOR NOTES

BY

Nelson C. Wall

Consultant

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- (d) The strengthening of international cooperation among all countries and the design of concrete new forms of international cooperation in the field of science and technology for development;
 - (e) The promotion of cooperation among developing countries and the role of developed countries in such cooperation.
3. Utilization of the existing United Nations system and other international organizations:
- (a) Utilization of the existing United Nations system and other international organizations to implement the objectives set out above in a coordinated and integrated manner."

The United Nations (UN) publication 78-02676 of September 22, 1977, entitled, Briefing material for advisers working the Governments during the preparatory period of the Conference, on page 13 provides the following guideline: "The essential role of the adviser is: (a) to seek in each case, if a predetermined goal can be reached through the application of science and technology; (b) to classify the problematique of such an application in each case; (c) to ascertain the general views and policies of the country in relation to science and technology for development, including in the international sphere. Advisers should be however, absolutely neutral and should avoid giving any impression that they are trying in anyway to determine

policies ... the advisers might themselves be tempted, at times, to write a national paper, or parts of ... They should nevertheless refrain from doing so ..."

The National Focal Point for the Islamic Republic of Mauritania is the office of the Chef du Service des etudes of the Ministere de la Planification occupied by Mr. Assane Diop. Upon contacting Mr. Assance Diop on June 6, 1978, the team was informed that the "national committee" had not met in the past two years and that they did not have a draft or even an outline of the National Paper for our review.

These notes were developed to assist the National Focal Point in developing the industrial section of the National Paper for the Islamic Republic of Mauritania.

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Appendices

I Appropriate Technology Research Institute for Mauritania

II Village Development - A Proposal for a Pilot Program in Mauritania

SUMMARY

The economy of Mauritania is dual in character. The traditional rural economy has not been affected by the modern industries created as a result of the iron ore deposits. It appears that the so called modern (industrial) sector employes less than 7 or 8% of the labor force while a large part of the wages paid are earned by non-Mauritanians.

A few large industries generate a large portion of the country's economy and they are a major factor in providing resources for government spending in support of public service. At present, due to lower prices for iron ore on the world market and other factors, the country is facing a difficult economic situation.

Unfortunately, Mauritania has to a certain degree been a victim of poor industrial planning and several large industries have been established only to determine at a later date that the technology was not appropriate or that the raw materials were not available. These large capital investments have not improved conditions and, to the contrary, have used up hard-to-obtain funds.

At present, some additional high-capital investments are being considered and planned for the period 1976-1980. These investments and industrial plans need to be reviewed to ensure that they are technically and economically feasible and if possible will generate employment for Mauritanians.

In section IV of this document some very basic suggestions are offered which would create an industrial science and technology base for the country. Once these institutions are operational the Ministry of Industry and other Government agencies will be better equipped to choose and select the most beneficial technologies and develop an industrial base for Mauritania.

1. Introduction

The Islamic Republic of Mauritania was established on November 28, 1960 after about sixty years of French rule. The country is situated in north-west Africa between latitude 16° and 26° North and between 5° and 17° West of the International Meridian. The nation has boundaries with Morocco, Algeria, Mali, Senegal and the Atlantic Ocean.

(A) General Characteristics

Mauritania is a large country with an area of about 1.7 million square kilometers (about 457,000 sq. miles) which is nearly twice the size of France. The climate in general is characterized by the lack of (or limited) rain. Three areas are clearly identified (a) that which is north of a line extending from Nouakchott to Nena which is within the Saharan Desert and has an arid climate; (b) that which is south of this line down to the Senegal Valley which is considered as the Sahelian area or sub-Saharan region; and (c) that which is the Senegal Valley which is hot and dry except for the area of the Senegal Valley. Daytime temperatures exceed 100°F for more than 6 months out of the year.

(B) Demographic Summary

According to recent (1977) census projections Mauritania has a population of about 1,490,000 inhabitants. Of this total it

it is estimated that 33% are Arab-Berber; 33% are Arab-Berber-Negroid; and the balance of 34% are Negroid. The following table presents estimated population living in 17 principal urban centers.

TABLE 1
Estimated Population Urban Centers

<u>NAME OF URBAN CENTER</u>	<u>POPULATION</u>
<u>CAPITAL CITY</u>	
Nouakchott	130,000
<u>INDUSTRIAL CENTERS</u>	
Akjoujt	13,000
F'Derick	2,200
Nouadhibou	23,000
Zouerate	20,800
<u>SENEGAL VALLEY</u>	
Boghe	
Kaedi	11,600
Rosso	19,800
Selibaby	19,500
	5,800
<u>EAST AND CENTRAL AREA</u>	
Aioun el Atrouss	13,600
Aleg	5,200
Atar	18,900
Boutilimit	7,600
Kiffa	16,700
M'Bout	4,900
Nema	9,200
Tidjikja	8,200
TOTAL -----	330,000

Source: Guide de l'investisseur industriel en Mauritanie.

On the basis of the 1977 estimates, the population density would be about 3 persons per square mile but in reality the distribution of population reflects primarily ecological conditions. The main factor determining the location and concentration of population is the availability of water. Close to 80% of the population lives south of the 17th parallel in about one-seventh of the nation's land area. The concentration of population in the north may well be less than 0.1 person per square-kilometer.

Life expectancy at birth is forty years. Because of the primitive and harsh conditions of life in the country, the child mortality is estimated at about 200 per thousand live births.

(C) Socio-Political Summary

The 1961 Mauritanian constitution created a presidential system for the government of the nation. The President (Chief of State and Head of Government) is elected by direct universal suffrage for a 5 year term. Legislative power is seated in a unicameral National Assembly (77 members) which is also elected by direct universal suffrage for a 5-year term. The Judicial System is independent of both the executive and legislative branches.

For administrative purposes the country is divided into 12 Regions and One District and the "Wilaya" of Tiris of Gharbia. As has been indicated, some areas are for more density populated

than others and this is best highlighted by Table 2 which presents population by Regions as well as "settled" and "nomad."

The first serious attempt at national planning began in 1962 and culminated in a four year plan, 1963-1966. Due to delays in approval of this plan it was later adjusted to cover the period June 1963-June 1967. The first plan had two basic objectives: (a) to reduce the country's dependence on foreign personnel; and (b) to prepare the basis for a subsequent development program to be initiated in 1969¹

After 1968 the strategy of development suggested by the the International Bank for Reconstruction and Development (IBRD) was adopted as a base for the second national plan. The period of time between 1967 and 1970 must be considered as a transition between the first and second national plan. The second national plan 1970-1973 set forth basic sector goals as a guide to annual investments and budget programs. It may be said that this program had the theme "Mauritanian Road to Development." It did present a realistic approach to the problems of achieving development but due to other circumstances most of the goals were not achieved.

The present third national plan 1976-1980 is aimed in part

¹Republique Islamique de Mauritanie. Plan quadriennal de Developpement Economique et Social, 1963-1966, Nouakchott, 1963

TABLE 2
Estimated Urban and Rural Population by Regions

Region or District	Population		Total Population
	Settled	Nomad	
District of Nouakchott	134,986		134,986
Region I - Nema	74,110	140,000	214,110
Region II - Aioun-el-Atrouss	62,262	72,000	134,262
Region III - Kiffa	89,192	53,000	142,192
Region IV - Kaedi	139,680	22,000	161,680
Region V - Aleg	104,915	54,000	158,915
Region VI - Rosso	121,460	96,000	217,460
Region VII - Atar	38,071	22,000	60,071
Region VIII - Nouadibou	24,385	3,000	27,385
Region IX - Tidjikja	32,513	42,000	74,513
Region X - Selibaby	74,545	20,000	94,545
Region XI - Zouerate	22,010	2,000	24,010
Region XII - Akjoujt	9,817	10,000	19,817
Tiris-El-Gharbia	7,386	3,000	10,386
TOTALS	935,332	539,000	1,474,332

Source: Toupet, Chares, Atlas de la Republique Islamique de Mauritanie, Editions Jeune Afrique, Paris, 1977, pg. 37.

to correcting the problems created by the droughts of the early 1970's. As a result of the drought literally thousands of nomadic herders lost all their animals and entire families moved to Nouakchott and other urban centers. The 1976-1980 plan emphasizes the development of the rural sector. Its goals include improving living conditions especially for the rural population, and increasing agricultural production both animal and vegetable. The objective is to make Mauritania self-sufficient in food production.

(D) Economic Summary

Recent national economic performance has been greatly affected by the 1968-1973 drought which resulted in crop failures and large scale losses of livestock. The gross per capital income, perhaps at about \$500 when the mining and fishing sector are included, is estimated at present to be about \$70 in the rural areas. In 1976, following the "reunification," the Mauritanian Government took control of the southern one-third of the former Spanish Sahara. Since "reunification" the Government has been forced to contend with a guerilla war launched by the Polisario Front. The economic situation was further aggravated by the recession in Europe in 1975, reduced demand for Mauritanian iron ore, low copper prices, and the high cost of food, oil and other industrial products. As

as result, inflation has become a serious problem for the economy.

According to the statistics presented by the Ministry of Economics in the Third Development Plan 1976-1980, the Gross Internal Product increased from 8,900 million UM in 1968 to 11,500 million UM in 1973 of which the industrial or modern sector contributed 5,320 million UM in 1968 and 8,460 million in 1973. The agricultural sector during that same period decreased its contribution from 3,580 million UM to 3,040 million UM. (The UM was worth about U.S. 2.2 cents in 1978).

(E) Education Summary

Limited progress was made in education during the first national plan (1963-66) with primary enrollment growing from about 18,000 to over 20,000.

In 1975 it was reported that primary enrollment was about 43,000 students and some 1,317 instructors were available to these students. There were also 4 "lycees" and 13 "colleges" in operation at the secondary level and an enrollment of 6,575 students was reported. The following technical or professional schools were also reported: Centre de Formation Mamadou Toure (120 students), Agricole de Kaedi (50 students), Ecole d'Infirmiers (78 students), Ecole Nationale d'Enseignement

Commercial et Familia (124 students), Etablissement Cominor (152 students) and Etablissement Somelec (35 students).

(F) Health Summary

The population of Mauritania is facing health problems related to four main diseases: tuberculosis, leprosy, malaria and trachoma. There are 68 doctors available (1 per over 20,000 inhabitants) as well as some 670 hospital beds in a total of 9 hospitals. Each region has a medical center and there are 19 maternity centers throughout the country.

2. Overview of Industry Sector

The modern sector in Mauritania is dominated by the extractive or mining operations. The manufacturing industry is very limited due to the small degree of development and the very limited size of the domestic market. The industry sector includes mainly mining, construction, wood working, automotive repair, electrical, plumbing, paint, chemical printing, fishing, water and power generation. The Direction de l'Industrie estimates a total of about 150 enterprises including small-scale industries. Employment in the modern sector including commercial and service activities is estimated at about 41,300 persons of which 40,000 are male and 2,200 are female.¹

¹Republique Islamique de Mauritanie, Troisieme Plan de Developpement Economique et Social, 1976-1980, Ministere d'Etat a l'Economic Nationale et Ministere de la Planification, Nouakchott, 1977, pg. 121.

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(A) Large Industries

The decision in the early 1950's to exploit the large iron ore deposits discovered in 1935 at Fderik (Fort-Gouraud) has had considerable impact on the economy of Mauritania and on the modern sector of the country. To exploit these iron ore deposits with metal content of about 60 to 65%, an international company was formed under the name of Societe des Mines de Fer de Mauritanie (MIFERMA). Shareholders of the original company included Usinor, British Steel Corporation, Italsider, and others. The IBRD provided a \$66 million loan guaranteed by France and Mauritania towards the financing of this enterprise. On November 28, 1974 the company was nationalized and continued operating under its present name Complexe Minier du Nord (COMINOR) owned and operated by the Societe Nationale Industrielle et Miniere (SNIM). The four open pit mines near Kadiet-ej-jill have been operating since 1963 and by the end of 1976 had produced well over 110 million tons of ore. Over the years the export of iron ore has grown and by late 1976 it represented better than 80% of total exports by Mauritania and over 35% of the Gross Internal Product. Additional details on the iron ore production may be found in the following Table 3.

As part of the mining operation, a railroad had to be built (the only railroad in Mauritania) between the mine sites and

TABLE 3
Iron Ore Exports 1963-1976

Year	Export in Metric Tons (000)	% of Total Export
1963	1,295	41
1964	4,893	77
1965	5,965	83
1966	7,157	87
1967	7,448	86
1968	7,703	83
1969	8,576	78
1970	9,770	77
1971	8,601	71
1972	8,622	68
1973	10,331	84
1974	11,777	71
1975	8,697	85
1976	9,664	N.A.
TOTAL	110,499	

Source: Toupet, Charles, Atlas de la Republique Islamique de Mauritanie, Editions Jeune Afrique, Paris 1977, pg. 45
----- Survey of African Economies, Volume 3,
International Monetary Fund, Washington, D.C. 1970, pg. 322

the port of Cansado (about 650 kilometers). The ore trains operating on this line are probably the longest in the world (about 2 km long) with as many as two-hundred cars each carrying about 100 tons of ore. They usually need four diesel locomotives of about 2,800 HP each.

At present the SNIM is developing a major new deposit known as the GUELBS iron ore project which will supplement and eventually replace the present operation which is close to being depleted of high grade ore. The SNIM complex employs about 4,800 persons of the reported 42,300 jobs in the modern sector.

Sometime in 1931, copper deposits were discovered near the town of Akjoujt which is some 240 kilometers from Nouakchott. For a period of time between 1956 and 1964 the Societe des Mines de Cuivre de Mauritanie tried to find the special process needed to refine the ore but they were not successful. In 1967 a new company Societe Miniere De Mauritanie (SOMIMA) was formed and they started exploiting the ore deposits. The Torco process was selected for the ore concentration which would go from about 2.7% concentration in the ore to about 60% in the concentrate.

During the month of February 1975 the SOMINA was nationalized and became part of the SNIM complex. In 1976, SNIM reported

producing 14,058 tons of better than 60% mineral concentrate. The process continues to be marginal and in view of present copper price in the world market it may not be profitable to continue operating this mine and concentration plant which together employ some 550 persons.

The SNIM is also operating the gypsum deposits located some 60 to 100 kilometers from the capital city at Sebkhna N'Drahmancha. In 1975 they extracted some 12,000 tons and in 1976 some 11,900 tons. At present the gypsum being produced is exported to the cement plant of Rufisque near Dakar in Senegal.

Of the eight industries in Mauritania considered as "large" by the Direction de l'Industrie, two are mining operations (iron and copper), two are food processing (fish) and four are in the construction sector. These eight enterprises employ about 10,600 of the total 42,300 reported earlier in this document.

Despite the abundance of fish in coastal waters, fishing in the past has made only a modest contribution to the national economy. In 1974 some 70,000 tons of fish were brought into the ports of Mauritania to be processed by the Industries Mauritaniennes de Peche (IMAPEC). This company (Spanish

capital) operates a freezing plant, a fish meal plant as well as a fish salting/drying operation. Total employment of all three is about 1,500 persons. Both the freezing and fish meal operation are working at about 50% capacity due to the lack of raw fish.

The construction industry continues to be a major activity in Mauritania; some 24 companies are active of which four are considered as "large." A very large portion of the construction activity is located in the capital city where the government continues to build housing for the ever-increasing population as well as much needed schools and government office.

(B) Small and Medium Industries

According to the Direction de l'Industrie some 75 enterprises may be classified as small or medium. Many of these enterprises are either in the construction sector or in the wood or metal working group. As has been indicated above, the size of the domestic market together with the limited know-how of the present population, scarcity of raw materials and other limiting factors, make it very difficult for a small or medium size industry to survive (Table 4 summarizes industries by type).

TABLE 4
Industrial Enterprises
1978

Activity	Number of Enterprises				Total
	mini	small	medium	large	
Mining	-	-	-	2	2
Fish processing	-	-	3	2	5
Construction	-	4	16	4	24
Wood or Metal Working	93	13	2	-	108
Food Processing	-	10	-	-	10
Chemical	-	4	-	-	4
Textile	-	-	1	-	1
Printing	-	2	1	-	3
Sanitary or Electric Installation	31	10	1	1	43
Automotive Repairs	43	6	1	-	50
TOTALS	167	49	25	9	250

Source: République Islamique de Mauritanie, l'Industrialisation de la Mauritanie, Direction de l'Industrie Nouakchott, March 1978, pg. 14

(C) Artisan Industries

Little or no information is available on this sector. The so called "mini" industries registered by Government sources total some 167 enterprises in three main groups: (a) wood and/or metal working; (b) electrical or plumbing installations and (c) automotive repairs. It is further estimated that another 40,000 persons work full or part time as "artisans" throughout the country.

3. Present Industrial Plans

The present government of Mauritania recognizes the fact that the industrial sector is relatively weak and has attempted to remedy this situation through strategies and plans outlined in the third National Development Plan 1976-1980. Four main ideas are presented in that plan involving new industrial enterprises:

- o Import substitution of items being consumed internally;

the following gains are anticipated:

Employment generation

Increase of the Gross Internal Product

Increase of value added through manufacturing

Better balance of payments

Adaptation of products to local market

- o Utilization of local raw materials;
the following advantages are anticipated:
 - Employment generation
 - Increase of the Gross Internal Product
 - Lowering of prices to consumers
 - Better balance of payments

- o Export promotion;
the following outputs are anticipated:
 - Employment generation
 - Increase of the Gross Internal Product
 - Improve balance of payments
 - Decentralization of industry and better regional balance

- o Diversification of industrial production;
The following advantages are mentioned:
 - Reduction of rural-urban migration
 - Improvement of economic stability

All four of the above concepts and corresponding advantages have been integrated into the Industry Policy as set forth in the Third National Development Plan as part of three main objectives:

- o Utilization of both human and natural resources
- o Integration of the industrial sector into the national economy
- o Improvement of the balance of payments

As part of the Third National Development Plan a number of new industrial activities are being considered and which are reviewed in the next section of this document.

(A) Industrial Activities Being Considered

o Sugar Refining and Processing: This industry has been located near Nouakchott to process some 30,000 tons of sugar tablets (cone shaped). The industry was to employ about 500 persons and the original investment was in the order of 1.125 million UM. The process has not proven feasible and the plan is now closed.

o Flour Mill: A study is being conducted to determine the feasibility of establishing an enterprise to produce some 6,000 tons per year of flour, crackers and related products. Estimated cost is in the order of 220 million UM and would employ about 78 persons.

o Milk Processing: The study has been completed and financing is being negotiated for this industry to be located near the capital city. The plant would process 60,000 hectoliters of reconstituted milk per year. Estimated cost is in the order of 120 million UM and 30 persons would be employed.

o Cotton Weaving: This project is being studied and the feasibility study is yet to be completed. The project is to be developed in two phases at a total cost of about 2,274 million UM. Production would be some 64 million square meters per year and total employment in the order of 3,000 persons.

o Garment Industry: The plant has been constructed and is now getting ready to start operation. It is to produce 1,000,000 garments per year and the initial cost is about 40 million UM. When operating it will employ about 300 persons.

o Foot Wear: Study is being made to establish a plant near Nouakchott to produce some 750,000 pair of leather sandals per year. The study is still being carried out.

o Steel Rods: This project under the SNIM is nearly completed (started in 1976). The mill will produce about 7,000 tons of steel rods (construction) and other metal shapes. Investment is estimated at about 750 million UM and employment will be in the order of 250 persons.

o Copper-Sulfuric Acid: SNIM is considering this project and the study is nearly completed. The plant would produce 30,000 tons of copper, 1.9 tons of gold, 2.4 tons of silver and 120,000 tons of sulfuric acid per year. All products would be for the export market. The investment is considered to be in the order of 8,500 million UM and the enterprise would employ about 450 persons.

o Soap Factory: Feasibility study has been completed for a 2,000 tons per year soap factory either at Rosso or Nouakchott.

o Salt-Sea Water: Feasibility study has been completed by SNIM for a 30,000 tons of salt per year by evaporation (sea water)

near Nouakchott.

Other projects being considered at this time include the following:

Dry batteries (flashlight)

Soap

Cardboard

Motor Repairs (combustion engines)

Assembly plant Automotive

Metal Furniture

Cement Plant

Tannery

Silver plate and Silver smithing

(B) Manpower, Present and Projected

As was indicated in the introduction, the population of Mauritania is estimated to be in the order of 1.4 million of which 44% is below 15 years of age and 11% over 50 years of age (life expectancy is about 43 years). The active population (potential labor force) is estimated at about 627,000 persons (ages 15-59) of which about 52% are male and 48% are female. Better than 90% of this active population is presently unemployed or employed in agriculture in the traditional sector, since the modern sector only employs about 42,800 persons.

According to the published study conducted by the International Monetary Fund in 1970 on Mauritania, something in the order of 14% of the wage earners earned 65% of all private wages. This was due to the number of foreign experts working in the different industrial activities. Many of the larger industries in the country are highly capital intensive and the few employees needed must have relatively high skills. These industries will continue to select and train local persons within their own system as needed.

There are some educational and training centers as noted in earlier sections of this paper but if new industries are to be developed there will be an even greater need to speed up the entry of Mauritians into the higher grades of employment. There is therefore a need for a more extended vocational training system, together with the introduction of a system of apprenticeship. Some of the persons interviewed also indicated that there is another problem which is getting the workers to identify their personal interests with those of the firms employing them.

It appears that Mauritania is facing a "chicken or egg" situation in that they need to develop small and medium sized industrial activities yet in order to do so they need to train their manpower to enter these activities. But they cannot train manpower with their present facilities and even if they did they would

have no jobs for them at present.

There maybe a need to re-evaluate priorities and consider a long range program of technical training (5 to 10 years) to start developing some of the skills that will be required by the industries that are being promoted and will be initiated in the future as indicated in the third National Development Plan 1976-1980.

(C) Support System

From an industrial development point of view, support systems are very limited in present day Mauritania. By support systems this paper is referring to transportation, highways, markets, communications, water, energy, etc.

Again the Third National Development Plan 1976-1980 is attempting to resolve some of these problems or bottle-necks but there appears to be a lack of coordination in the plan to improve the infrastructure required for industrial development.

Mauritania is facing more pressing problems, such as rural/urban migration, lack of food, shortage of water, poor international market for their exports and a limited war on the northern border. It is therefore understandable that these problems have a higher priority at the decision making level of the government, but there is still a need to look at the development of industrial support systems as part of the long range plans of the nation. Some of

these concepts will be further reviewed in the following section of this document.

4. Constraints to Present Industrialization Plans

The economy of Mauritania continues to be dual in character. The traditional nomad and rural economy has not be affected by the sharp technical-industrial changes that have occurred in the north-east as a result of the mining operations and the fish processing plant. The modern sector continues to employ less than 8% of the available labor force and a considerable portion of the wages earned are paid to non-Mauritanians. The middle and higher level positions are predominately non-Mauritanian.

The concept of industrialization of Mauritania may in the near future not be an option but rather an imperative. It behooves the nation to make use of its temporary comparative advantage in the production of iron ores and other minerals and to create and expand the necessary investments in technology and capital goods to develop native industries rapidly. This needs to be done on a very well planned and highly coordinated manner. The following constraints to industrial development should be reviewed by the government of Mauritania.

(A) Industrial Technology

The foundations of industrial development are to be found in technology. Industrial technology as we know it today is based

on empirical knowledge or knowledge derived from science... There are, unfortunately, no short cuts to mastering technology. The design of any industrial product requires technical knowledge and this is also needed in determining the production process, the raw material alternatives, the energy requirements, the equipment selection and on and on throughout the total process. In present day Mauritania there appears to be no structure within the government responsible for the acquisition and/or development of technology. Furthermore, there is no system to direct and control the utilization of the technology being acquired - turn-key industries - or otherwise. This may well be the most damaging constraint to present and future industrial development plans.

(B) Industrial Design

The starting point for most industrialization programs is usually the preparation of comprehensive industrialization plans and pre-location of industrial activities. The industrialization plans result from economic market studies, review of technologies available, feasibility analysis, etc. The industrialization plan takes into consideration the demand for the selected product, the availability of needed raw materials, the technology most appropriate to the location, the cost of all these inputs, the technical level of the manpower, logistics and other variables.

This activity is usually carried out by a team of persons supported by other technical persons with expertise in the particular technology or product being considered. Together with this team, another group is responsible for the design of the product and both groups interact throughout the design process.

This whole industrial design concept and structure appears to be missing at present in Mauritania. There is reason to believe that faulty industrial design has occurred as in the case of the sugar refinery, the petroleum refinery and others. These expensive mistakes cannot be repeated, especially in a developing country where resources are so limited.

(C) Capital Investment

According to present plans the industries being considered and presented in Section II of this document are mainly high-capital investments. The sum total of estimated investment for the flour mill, milk processing, cotton weaving, garment plant, steel rods and copper-sulfuric acid industries total 11,784 million UM and will generate about 4,108 new jobs which signifies an investment of about 2.8 million UM per job created. This level of investment may be very desirable for a highly developed nation but would appear

to be rather high for a nation that is facing the need of massive employment and the lack of capital.

(D) Infrastructure

The present infrastructure of Mauritania is limited and may not be able to support the present industrial plans. Products produced by these planned industries need to reach the consumer but present day highways, transportation, market and distribution systems may not permit this. The same may also be true of other support systems such as water, electricity, telephone, waste disposal, fuel, housing and others.

(E) Raw Materials

Many of the industries now being considered are dependent on imported raw materials (cotton, milk, cereals, textiles, etc.) Again this may prove to be a very serious constraint to the development of these industrial activities and may well create a situation where the final product (plant output) is not competitive in the market place vis-a-vis imported products.

The constraints presented are but a highlight of the total problem. There are many other issues that are not presented at this time. In summary, the present industrial plans tend to develop only large, capital intensive industries

which will generate relatively few jobs, only a few of which are skilled and most of the latter positions will not be available to the average Mauritanian. From the science and technology point of view these industries will have imported technologies and will not assist in developing a science and technology base in this developing nation.

5. Possible Alternate Approaches

The UN Conference on Science and Technology scheduled for 1979 will be emphasizing the key role played by technology in industrial development and related activities leading to the generation of employment and the expansion of commerce. Most national leaders of developing nations agree with the concept that technology will foster industrialization, increase employment, stimulate trade and, in general, will improve the economic well-being of the nation. These national leaders are also aware of the fact that only a very small portion of the industrial production of the world takes place in the developing nations or Third World.

One of the most important questions that will probably be presented to the UN Conference in 1979 will be that of "appropriate technology."

It appears to many practitioners in the field of industrialization that developing countries require a special technology which is being called "appropriate technology." Most of the developing countries are faced with

the situation of having a large ratio of unskilled to skilled labor. The mix of skills within the skilled labor force is unbalanced in relation to needs. Furthermore, the countries are capital-poor. All of this adds up to the necessity of generating labor-intensive or low-capital technologies for these nations.

"Appropriate technology" as used by the practitioners means a technology that is optimal for a given developing country in view of that nation's economic, cultural and social conditions, resources, indigenous capabilities and as national goals. It does not have to mean the development of cottage industries or the use of lower level technology as some persons believe.

In the case of Mauritania, the industrial development goals may need to be changed or modified to include the following objectives:

- o to create the basic conditions leading to the systematic development of local processing of existing natural resources;
- o to increase the capability of the country to generate and/or import technologies that are appropriate to their industrial activities;
- o to promote the development of technical and managerial manpower for planned and existing industries;
- o to educate and train the governmental technical staff

so that they can deal more effectively with the planning and decision-making requirements, especially in the area of science and technology;

- o to create the necessary institutional infrastructure for the collection, dissemination, adaptation and use of industrial technology;
- o to enhance productivity and quality of products presently being fabricated;
- o to establish a system through which industry projects may be registered, cross-referenced, and evaluated prior to decision-making.

The suggestions presented in this section are aimed basically at strengthening or developing the capability to generate and apply industrial technology in Mauritania. In order to do this, two basic requirements need to be met: (a) the development of a cadre of trained industrial practitioners including engineers, managers, technicians and skilled labor; and (b) a demand for their services through institutions, research centers, private businesses or state-owned enterprises.

Assuming that the two basic conditions have been met then the following concepts may be considered:

- (A) Creation, development or expansion of technical units within the ministry of industries (and others as

appropriate) which will be responsible for technological decisions, policy-making and industrial forecasting.

These units will assist in developing national long-range industrialization programs and the industrial development of the country.

(B) Creation, development or expansion of an industrial project evaluation unit within the Ministry of Industry. The evaluation unit will review and evaluate all industrial projects to determine technical and economic feasibility and advise the appropriate decision-makers.

(C) Creation of a central facility for the generation, collection, classification and distribution of information on industries, industrial technology, research and design of products and other industrial data. This central facility may also conduct socio-economic impact studies related to the different technologies being considered or selected. A concept for such an institution is presented in Appendix 1.

(D) Establishment of at least one institute for industrial research. This institute would have on-going research on industrial processing of native food products (including animal food), processing of fibres, beneficiation or processing of native ores, industrial processing or manufacturing, forest products, alternate energy uses and agri-

cultural tools and machine design. If desired the institute could also develop pilot plants to test and further expand the industrial research and design (See Appendix 1).

(E) Establishment of an institute or unit for quality control and standardization. This institute provides one of the key elements necessary to insure exportable items. Quality control provides the foreign buyer the assurance needed and permits him to sell the produced items to consumers in other countries.

(F) Creation of a management-technical assistance system to help medium and small-scale industries. This is the delivery system of the technical extension service. Assistance would be provided to production units in the areas of technology, industrial techniques, management, marketing, purchasing, etc.

(G) Development of an industrial service laboratory to provide industry the following services: chemical analysis, metallurgical analysis, material testing, mineral analysis, quality control testing and certification, and general trouble-shooting.

(H) Encourage the development of technical societies, consulting

organizations and general scientific-technical service groups.

- (I) Stimulate within the educational system the corresponding curriculum development in the area of technical training, research, science and technical assistance.

- (J) Encourage research and testing of alternate technologies for the development of energy sources for both industrial and rural use. Renewable resources such as sun and the wind may be used in many locations in Mauritania. Systematic scientific research must be initiated to review and consider these resources and possible development of devices that permit the use of these renewable resources.

- (K) Improvement of technological training in existing vocational schools. New industries will require more craftsmen and technicians. Unless Mauritians are trained to fill these positions, they will continue to be occupied by non-Mauritians. There is a growing need to train craftsmen, technicians, and to develop educational material and trainers.

- (L) Develop a system that will determine the technological needs of existing and planned industrial activities. This system would have knowledge of the existing sources of supply of

technology, the cost and conditions under which the technologies would be available, the technical manpower needed to implement them, etc.

- (M) Development of policy to promote technology transfer. The government may wish to create policy instruments to promote research and development capability in local industries, attract industries that require certain technologies, motivate the use and adoption of imported technology and promote local science and technology research and transfer through the industrial sector.
- (N) Establishment of an Industrial Research Council to work at the national level and assist the government in formulating industrial research policy. This group would also review, evaluate and assign priorities to industrial research. The council would provide coordination to all industrial research activities within the country.
- (O) Creation of a development activity at the village level to start generating small-scale industries in the villages of Mauritania. The concept is offered as a suggestion in Appendix 2 of this document.

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APPENDIX I

APPROPRIATE TECHNOLOGY RESEARCH INSTITUTE FOR MAURITANIA

The transfer of technology from the developed nations to the developing countries is performed in many different ways. The most common are: through participating universities, laboratories, specialists, on-site-training, publications, scientific journals, technical studies, research and commercial firms that sell or license technology.

Many developing nations fail to use the simplest and most inexpensive system which is: use of non-proprietary technology. Much of the technology of the developed nations of the world is in fact non-proprietary and nearly all of it has been published in one form or another over the years. The body of non-proprietary technology which is freely available includes: expired patents, technical and scientific texts, reports and papers; industrial technology; communication technology, and technology in construction, transportation, health, and agriculture.

Why then do not the developing nations make use of this free body of knowledge? The main reason is that the developing countries lack the capability of assessing, selecting, developing, adapting, and applying scientific and technical knowledge as illustrated on the following page in Diagram 1:

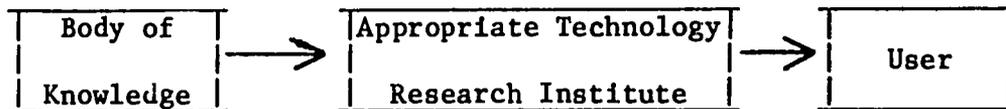
Technology in Developing Nations



As presented above, the body of knowledge does not reach the end-user (industrial, agricultural, commerce, services) because there is a GAP between the two and developing countries have no means or system to bridge the gap.

This problem is not new and in many countries the solution has been to create a bridge or delivery system between the body of knowledge and the end-user. Diagram 2 below presents this bridging concept:

Technology Delivery Systems



As presented, the appropriate technology research institute (ATRI) draws from the universal body of knowledge and proceeds to assess, select, develop, and adapt this knowledge to meet the needs of the end-user. Once this is done, the ATRI delivers the "appropriate" technology to the needed sectors of the developing nation. In other words, the gap has been bridged and knowledge is allowed to flow.

The ATRI is usually created to focus on one or two main sectors. It is not a magic box and cannot provide good services to all sectors at one time.

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The sectors or areas usually considered are the following: food production (agriculture, livestock, water-soil management); health (delivery systems, water and waste treatment, disease control, contraceptives); urban planning (urban design, transportation systems, construction, industry location); resource management (development of energy, remote-sensing, forest resources, marine environment); industrialization (industrial development, production, quality control, use and acquisition of technology).

Let us assume that the ATRI is to focus on the industrialization process. Then the profile of the ATRI could be as follows:

Areas of Activity

- (1) Establish capability to conduct industrial research;
- (2) Stimulate curriculum development, teaching, research and technology development;
- (3) Assist in developing engineering and management institutions;
- (4) Establish regional productivity centers;
- (5) Implement industrial development programs to create new small-scale industries and generate employment;
- (6) Establish a technical-management assistance system to provide aid to small-scale industry;
- (7) Develop a national technical cadre;
- (8) Research new industrial processes;

(9) Create expertise on the search, selection, adaptation and use of technology.

(10) Assist in negotiation of technology importation.

There are many good examples of ATRI's that are now operating in developing countries, such as: Asian Technology Institute, Bangkok, Thailand; Fundacao Educacional do Sul de Santa Catarina, Brazil; Instituto Centro American de Investigacion y Tecnologia Industrial, Guatemala, Guatemala; and Instituto Nacional Tecnologico, Santiago, Chile.

The ATRI concept may well be the single most important institution for the initial steps of scientific and technological development of the Islamic Republic of Mauritania.

APPENDIX II
VILLAGE DEVELOPMENT
A PROPOSAL FOR A PILOT PROGRAM IN
MAURITANIA
N.C. WALL

Objectives.

The objective of this pilot program is for the Georgia Institute of Technology to develop and test a methodology which, when implemented, will increase production, income and welfare of rural families in villages within Mauritania. The pilot project will cover all aspects of village development including health, agriculture, leadership and others too numerous to mention.

Background.

Of the 41 independent nations of Africa, the Islamic Republic of Mauritania has about 369,000 inhabitants considered as urban dwellers (25% of total) and some 1,100,000 inhabitants considered rural or rural-nomad dwellers (75% of total population of 1,481,000).¹ Recent economic developments have been greatly affected by the 1968-1973 drought which resulted in crop failures and large scale losses in livestock

¹ Toupet, Charles; Atlas de la Republique Islamique de Mauritanie, Groupe Jeune Afrique, Paris, 1977 pp. 34.

through starvation, out migration of population and premature slaughter of stock. The gross per capita income, estimated at perhaps \$500 when the modern mining and fishing sectors are included, is estimated to be well below \$70.00² in rural areas, one of the lowest in the world.

It may also be said that villages and their inhabitants in Mauritania generally are faced with poor agronomic practices, poor infrastructure, weak marketing systems and a poor technical base. Together with this, each village also faces a unique and specific set of constraints only applicable to their individual case.

This project is meant to serve as a pilot project or model which once successful can be replicated in other areas of this developing nation.

Project concept.

This project is based on the concept that development at the village level requires direct participation of the local inhabitants at all levels from planning through implementation.

Through this project, five selected villages will be assisted in the development and implementation of productive activities which will be

² Department of State, USA, Background Notes, Mauritania, US Department of State, Washington, DC, November 1976, pp. 1.

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"matched" to the potentials of the geographical area being served. At the same time the constraints to production will be removed or lessened. At the end of the project, the village should have the capability to plan and implement development activities and this capability will also exist to some lesser degree at the Provincial and Regional level.

The selected villages will provide a "showplace" for other villages to imitate or emulate. The government could, through this pilot program, initiate a "technology transfer" program simply by having villagers from other areas visit or train in these selected villages. In any case, just by "osmosis" some of the knowledge is going to be transferred to neighboring villages even if no other action is implemented. Furthermore, this pilot project will provide the government planners with data and information on how to improve the villages or assist in considering how new laws will affect the life of the villages of the nation. More important, though, will be that a field-tested methodology will have been developed which may then be transferred to other villages in the country.

Scope of Work.

As proposed, the project will consist of three phases: Phase I will cover one year and will be utilized in setting up the corresponding organization and selecting the five target areas. Once the selection

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and organization have been completed, the staff assisted by the local participants will initiate the corresponding "audit" of the villages and their immediate areas. The audits should be completed during the first year. Phase II will last three years and it is during this part of the program that the improvement of the economic infrastructure will be initiated. The production activities and improvements that have been identified will be implemented and monitored to evaluate results. The final Phase III will also have a one-year duration and in it the successful methodology will be documented and transferred to host-country counterparts for future implementation in other areas of the country.

Throughout the three phases, the following major components will be implemented as part of the scope of work:

- A. Auditing of the local resources and identification of advantages and short-comings of the area.
- B. Preparation of action programs to upgrade existing activities, lessen short-comings and initiate new activities.
- C. Strengthening the planning, implementation and evaluation capability at the village and regional level.
- D. Improve both agricultural and industrial production.
- E. Identifying, promoting and implementing other economic development

F. Improvng the social, health, educational and economic infrastruc-
ture of the village.

G. Developing a successssful methodology for each village and transfer-
ing this technology to the host country.

A. Auditing of the Local Resources, Identification of Advantages and
Shortcomings for the Area.

1. Developing an information base of the village and its immediate
area. Data on agricultural and industrial production, raw materials,
transportation energy sources, imports and exports (to and from other
villages), manpower as well as education, housing, health, water, etc.,
will be collected and organized.

2. Analyzing the information gathered and systematic upkeeping of it
as well as upgrading and updating it on a continuous basis.

3. Determining from the audit, what are the advantages and shortages of
the village and preparing (with the village leadership) the corres-
ponding action plans.

B. Preparation of Action Programs to Upgrade Existing Activities,
Lessen Shortcomings and Initiate New Activities.

1. Selecting potential productive activities (agricultural - indus-
trial - commercial) as well as possible upgrading of existing activities

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and preparing an action program to initiate these changes or additions. The action plan to include both short-term and long-range goals.

C. Strengthening the Planning, Implementation and Evaluation Capabilities at the Village and Regional Level.

1. Conducting planning sessions, jointly with host-country counterparts to establish the implementation plan on the basis of the audit and other information.
2. Establishing priorities and determining "how to" resolve problems.
3. Preparing evaluative procedures to monitor the planned activities during and after implementation.
4. Training the counterparts so that they can assume these tasks in the future.
5. Developing a low-cost information system so that in the future the village may modify or initiate other activities.

D. Improving Both Agriculture and Industrial Production.

1. Development and introduction of appropriate technologies for crop production and post crop processing.
2. Development and introduction of appropriate technologies for live-stock production and food processing.

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3. Development and introduction of appropriate technologies for existing or new small-scale industries.
4. Development and introduction of appropriate or alternative energy sources and their technology.
5. Strengthening of the support system for both agricultural and industrial production.
6. Development of a comprehensive extension system to serve both agriculture and small-scale industry.

E. Identifying, Promoting and Implementing Economic Development Activities.

1. Establishment of rural small-scale industries through provision of funds and technical assistance.
2. Identification, development, field testing, and delivery of appropriate technology for agricultural processing as well as for small-scale industries.
3. Development of simple appropriate technology devices to be used at village level.
4. Development of an "economic development" concept at the village level by the local inhabitants.

F. Improving the Social, Health, Educational and Economic Infrastructure of the Village.

1. Development of a village water system (for both human use and irrigation).
2. Development of a minimal sanitation system at the village level.
3. Development of a "basic level" educational system.
4. Development of water and soil management systems.
5. Development of other infrastructure as may be determined by the village from section A.

G. Developing a Successful Methodology for each Village and Transferring This Technology to the Host Country.

1. Development of on-going evaluation system to monitor success or failure of each tested concept.
2. Developments of a methodology on the basis of the field tests.
3. Development of a training program to allow for the transfer of this technology and methodology.
4. Implementation of the technology and methodology transfer.
5. Replication of system by trained counterparts on other areas of the host country.

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Sample Inputs

This proposal is an attempt to address the specific constraints at the village level. Its purpose is to increase production, income and welfare of the rural families in the selected villages. Since villages in Mauritania do not exist in isolation and, since they are the lowest level of Government organization, this project will also provide assistance to the Provincial and Regional agencies responsible for furthering the development of these units.

As an example the following inputs are planned within this project:

1. At the regional level one development/planner with rural development experience to provide support to the Office of Regional Planning.

His responsibilities will include among others:

- a) assisting in the development of an information gathering and analysis capability;
- b) coordinating "sponsor" inputs with regional and governmental inputs into the project area; and
- c) coordinating future "sponsor" assistance in the preparation of long-range plans.

2. For each of the five selected villages a Rural Development specialist will be provided to work with a counterpart group. His responsibilities include:

- a) help organize and conduct audits to collect data for future planning and

evaluation activities within the target villages;

b) help organize and coordinate training of individuals that will in the future assume the planning and implementing of production activities based on village desires; and

c) plan and coordinate other "sponsor" assistance to production activities as well as social and economic infrastructure development.

3. For the five villages three agricultural specialists will be provided to work with one counterpart for each village. Their responsibilities will include:

a) development and introduction of appropriate technologies for crop production;

b) development and introduction of appropriate technologies for livestock production;

c) development of a farm level data collection and analysis system for identifying appropriate technologies;

d) development with village councils of village production plans;

e) establishment of a "village farm center" to assist in the implementation of village agricultural plans;

f) training of agricultural field and livestock technicians (counterparts); and

g) providing short-term assistance in plant and animal science.

4. For the five villages three industrial-economic development specialists

will be provided to work with one counterpart for each village. Their responsibilities will include:

- a) help organize and conduct audit to collect data for future planning and evaluation activities within the five villages;
- b) prepare feasibility studies for establishment of new activities or improving of existing activities;
- c) prepare technical studies for establishment of an appropriate technology delivery system;
- d) identify, test and deliver technologies that are appropriate to agricultural production, agricultural processing or smallscale enterprises;
- e) design, fabricate and deliver appropriate technology devices applicable to local needs (agricultural, industrial or other); and
- f) establish a technical-management assistance system to provide support to small-scale enterprises that develop as a result of this project.

5. Other specialists will also be required as needed to provide support in the area of improving social, economic, health and education infrastructure at the village level. Support will also be provided in such areas as roads, water, transportation, soil conservation and others too numerous to mention.

Funding

The very nature of this project, using bottom up planning to determine the path development needs to follow, makes budgeting difficult. At this time, staffing needs, budget, outputs, end-of-project status and other sections are left open to be done after acceptance by sponsor of this "concept draft."



International Science and Technology Institute, Inc.

SECTION III

**SCIENCE AND TECHNOLOGY POLICY REQUIREMENTS AND IMPLICATIONS
FOR MAURITANIA**

by James E. Beverly

Consultant

SCIENCE AND TECHNOLOGY POLICY REQUIREMENTS AND IMPLICATIONS
FOR MAURITANIA

ABSTRACT:

Mauritania had an estimated population of 1.4 million in 1977. The 1976 GNP per capita was estimated at \$320 in the modern sector and \$70 per capita in the traditional sector. Three-fourths of Mauritania is in the Western Sahara Desert. The agricultural and mineral resource base has been declining due to draught and depletion. There is no formal structure and mechanism for science and technology policy, planning, implementation, control or evaluation. Eight measures are suggested to accelerate the development of scientific and technological capabilities and to assist Mauritania in becoming an enlightened user of science and technology.

SCIENCE AND TECHNOLOGY POLICY REQUIREMENTS AND IMPLICATIONS
FOR MAURITANIA

PREFACE AND SUMMARY

This report is a very brief introduction and outline of the elements and structure of science and technology (S&T) policy, planning, procedures and management with reference to the developmental requirements of the Islamic Republic of Mauritania. The subjects are broad, quite complex and require volumes for adequate treatment. It is hoped that this modest effort will at least serve to orient its readers on a systematic basis and provide them with a basic vocabulary and set of references for the deeper study this vital subject demands.

This report is divided into four parts and a set of six appendices to Part IV. The Introduction, Part I, indicates how this paper came about in relation to the 1979 United Nations Conference on Science and Technology for Development and includes some general background information on Mauritania. It also presents some extensive definitions of science, technology, research, development and policy. A thorough understanding of these basic concepts is necessary to fully appreciate the remainder of the report.

Part II discusses the current situation of S&T in Mauritania in terms of organization, problems and constraints, including major barriers to the use and development of S&T, and ends with some conclusions concerning S&T in Mauritania. Presently, there is no formal S&T structure in Mauritania.

Part III constitutes the bulk of the report as it discusses institutional needs for S&T organization and policy. Its four sections describe governmental structure and mechanisms for policy making in S&T, the components of national science and technological potential (STP), national and international research and development (R&D) systems for S&T, and, finally, technology transfer and assessment as components of national S&T policy.

The concluding Part IV presents eight suggestions for the development of scientific and technological capability in Mauritania. Their purpose is to aid Mauritania in becoming an enlightened consumer of science and technology. It should be noted that some of the detail and procedures involved in implementing these suggestions may be found in Part III and in the six appendices to Part IV. As indicated initially, this report is only an introduction to -- and not a manual on -- S&T policy development and execution.

SCIENCE AND TECHNOLOGY POLICY REQUIREMENTS AND IMPLICATIONS
FOR MAURITANIA

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- F. "TUPAC AMARU" Government Plan, 1977-1980, Lima, Peru, Supreme Decree No. 020-77-PM, 4 October, 1977.

References

I. Introduction

A. United Nations Conference on Science and Technology for Development - 1979 (UNCSTD).

1. Following the announcement in December 1976 that the UNCSTD would be held in late 1979, the United States Government offered its services to countries requesting technical assistance in preparing their national paper for the Conference.
2. In the spring of 1978, USAID was contacted by the Government of the Islamic Republic of Mauritania (GIRM) with a request for support in preparing its national paper for the UNCSTD. USAID contracted the services of the International Science and Technology Institute of Washington, D.C., which sent a three-man team to Nouakchott, Mauritania, during June, 1978. The team was to assist the GIRM in three areas: science and technology policy, agriculture, and industry. This draft report for the GIRM is on the science and technology aspects of the national paper and will be used by the GIRM in whatever manner it deems appropriate.

B. General Background on Mauritania

1. The 1977 estimate of population for Mauritania is 1.4 million of which only one to five percent are considered literate. Ninety

percent of the population is involved in agriculture and livestock with only perhaps some twenty percent considered in the money economy. Per capita share of of gross national product is estimated at U.S. \$320. Traditional sector per capita income is estimated at U.S. \$70. The capital city of Nouakchott has an estimated population of between 140,000 and 200,000 including many displaced nomads. There are ten other urban areas having populations in excess of 10,000. Some 500,000 persons live the nomadic life concentrated around oases. Three-fourths of the country is in the Western Sahara.

2. The country has perhaps forty native born technically trained people supplemented by about one hundred expatriate experts. Twenty technical graduates are expected to return to Mauritania from training abroad next year. The 1964 Lagos Conference (UNESCO and ECA) "recommended that African nations fix as a target to be attained by 1980 a ratio of 200 R&D scientists per million population."
3. Mauritania is emerging from a feudal socio-economic system, remains in a pre-development stage and has no S&T infrastructure. The formal UN guidelines suggested for preparing the national papers for the UNCSTD therefore to a certain extent may not apply to Mauritania.
4. The recent droughts, which have killed some forty percent of the livestock and rendered large areas useless for agriculture and grazing, has caused massive dislocations in the traditional way of life. An increase in movement to the cities is further hindering efforts for orderly

development. Many development plans are on the drawing boards, or are just being implemented, but will require several years for significant results to appear.

5. Major development goals applicable to Mauritania, in addition to basic survival, have been identified by the Club du Sahel and the CILSS (Comite Permanent Intretats de Lutte Contre la Secheresse) in 1977 as 1) food "self-sufficiency," 2) building up a new stable eco-system, 3) developing and maintaining a high rural employment rate, and 4) improving the quality of life in the rural areas. These groups also observed "the core problems that plague the Sahel cannot be modified from one day to the other" it will take years to solve them and alleviate much of the damage.
6. It is expected that science and technology can and will play an essential role in achieving these objectives. How S&T can fit into this difficult, complex and challenging situation is discussed in later sections of this report.

C. Some Definitions of Science, Technology, Research, Development and Policy

1. In order to provide a common basis for discussion and analysis of S&T, the following definitions are suggested. Except for the definition of policy in Section 11 below, which was phrased by the consultant the definitions in Sections 2 through 10 are taken verbatim from Pages 135-137 of the 1977 UNESCO Report No. 41, "Science and Technology in the Development

of the Arab States" (Science Policy Studies and Documents Series). This report is on the August 1976 Rabat Conference of Ministers of Arab States Responsible for the Application of Science and Technology to Development (CASTARAB), sponsored by UNESCO and ALESCO - the Arab Educational, Scientific and Cultural Organization (Mauritania had three observers at the Rabat Rabat Conference). These definitions enlarge on those used in the January 1974 Dakar Conference of Ministers of African States Responsible for the Application of Science and Technology to Development (CASTAFRICA) and documented in UNESCO Report No. 35 "Science and Technology in African Development" (Mauritania had three men in its delegation to the Dakar Conference).

2. "Taken as human activities, science and technology are undoubtedly ambiguous and elusive concepts. The term science signifies the enterprise whereby mankind makes an organized attempt, by means of the objective study of observed phenomena, to discover and master the chain of casualities; brings together in a systematic form the resulting knowledge; and thereby furnishes itself with the opportunity of using, to its own advantage, an understanding of the processes and phenomena occurring in nature and society. There are of course numerous sub-systems of knowledge that have been developed, one of which - technology - relates directly to the production or improvement of goods or services and is therefore of major economic importance. It should be stressed that UNESCO does not exclude any such sub-system of

knowledge in its understanding of the term science, which consequently also covers the social and human sciences.

3. From the point of view of governmental policy, the concept science and technology today means the whole of the innovative activities of a nation. This includes:
 - o Scientific and technological research (R), which means the processes of study, experimentation, conceptualization and theory-testing involved in the generation of new discoveries in the field of science and technology;
 - o Experimental development (D), which consists in the process of adaptation, testing and refinement which lead to practical applicability;
 - o Scientific and technological services (STS), represents a mixed group of activities which are indispensable both for the progress of research and for the practical application of science and technology. They collect, process and disseminate the scientific and technological information needed for such purposes;
 - o Innovation, which means bringing into being a new product or process thereby ensuring that new ideas and inventions are used effectively in the national economy. This also includes the transfer of technology whereby known products or processes are introduced in countries where they have not been utilized or produced before.

However, from the point of view of governmental policy, the concept science and technology does not include the teaching of sciences or engineering, which falls under educational policies; nor does it cover the actual production of goods or services which come under the governmental policies dealing with industry, agriculture, health, transport, etc. ("It may be useful to recall at this stage that science policy is not science itself. It serves science, and from science in return it expects services for the good of the community. Science policy must not be confused with the performance of scientific work. With the progress of society as a whole in mind, science policy sets itself the objective of offering to scientific activities the optimum conditions for development).*

4. On close examination of what goes on in the highly developed as well as in an increasing number of developing countries, it may be said that modern science and technology policy comprises several functions: planning, coordination, management and promotion, and actual performance of research and scientific service work; it also helps to define the nature and orientations of public policies in general, and fulfills an important advocacy role for science and technology in society. These various functions will be described briefly below with a view to encouraging countries participating in CASTARAB to assess their present performance, and to take the necessary steps for entrusting these functions to - or strengthening them in - their government machineries responsible for policy-making in the field of science and technology.

*Page 119, Science for Development, UNESCO, 1971, by Jaques Spaey, et al.

5. The Planning Function

The first aspect of planning is anticipatory and therefore long term in character. It consists mainly in defining broad objectives and in deciding between options and results in periodic statements determining the ranges of resource allocation for the national scientific and technological activities.

The second aspect of planning is short term, and therefore more concrete and practical. It focuses on such problems as budget allocations, adjustment of the national R&D effort between competing needs and wants, and the preparation of decisions on major R&D programmes. Both aspects of planning rely heavily on complete and accurate information.

6. The Co-ordination Function

The co-ordination function aims at coherence, oversight, and consistency between the activities of mission-oriented government departments (and the private sector, if any) which have the operational responsibility for the R&D programmes and the related scientific and technological services.

7. The Management and Promotional Function

This function is action oriented; it creates the necessary conditions for the realization of objectives. Action is initiated by granting the resources; evaluation ensures that the use of these resources produces the expected results.

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8. The Execution Function

The execution function is related to the practical implementation of programme objectives. At this level the main problem is bench-level optimization of resources and effectiveness of operations. For R&D operations, the principal agent is the Research Unit Director, and the instruments are research management techniques.

9. The Function of General Policy Advice

This includes participation in the preparation of the National Development Plan advising on such crucial issues as the uses of the sea and the natural environment, the creation of alternative civilization blueprints which can reduce social or international tensions leading to conflict; the use of science and technology for national security purposes, the shaping of national ethics, and laws on the use of scientific discoveries and inventions.

10. The Function of Advocacy for Science and Technology

This function comprises organized support for scientific and technological activities per se, especially fundamental research which is by its nature long term and therefore tends to suffer by comparison with applied research. It also includes the protection of the legitimate interests of the scientific community, and of the responsibilities and rights of its individual members. It goes without saying that science or technology per se are rather weak competitors in the race for government allocation of resources; they need authorized spokesmen close to the highest echelons of power to help their case to be heard and to make sure that emergent discoveries and inventions

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are understood and made use of, whatever their origin (national or foreign) may be."

11. A Few Thoughts on Defining "Policy"

Policies are expressions of principles and purposes to guide action based on a set of premises and values within a procedural framework. The expressions, premises, values and procedures may be explicit or implicit, and may be communicated by writing, speech or demonstration. The results of the policy making process are legislative, judicial or administrative decisions and directives. "Policy instruments" express the creation, continuation, modification or termination of: laws, regulations, taxes, tariffs, incentives, standards, appropriations, budgets, plans, programs, projects, procedures, procurements, organizational structures, etc. as well as related actions, proclamations and statements of intention.

The process of policy formation and legitimation is a complex political activity in every society and involves the negotiation and coordination of conflicting interests, priorities and values.

(The USAID supported a RMS Project can be fruitfully studied as an exercise in "policy formation" which is still in process. Over one and one half years have been spent in its design which required some basic strategic policy decisions by the Government of Mauritania).

12. With reference to the difficulties of policy formulation, some of the introductory comments on page x of Goals for Mankind, Report to the Club of

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Rome, 1977, by Ervin Laszlo et. al., are relevant: "One can always question the extent to which goals are followed in individual, group, or national behavior, and one can ask how far people in some cases are in fact free to express their personal credos. There may be three layers of goals in reality: first, the overt and explicit formulations; second, the unexpressed and covert motivations that find expression in national and individual behavior not always in harmony with the formulated objectives; and third, the unconscious goals of individuals and societies which may conflict with all formulated motivations and may lead to internal frictions."

As an "outsider" in Mauritania, and as a professional, this consultant can only offer suggestions concerning the first layer. The other layers, which are of great, if not governing power, and are of much interest to him, are nevertheless beyond his ken and the scope of this assignment.

13. In conclusion, "Science policy is a part of general policy - the part which consists in improving the resources of science and promoting technological innovation to attain national goals. It has therefore very close links with other spheres of government directed at the same objectives.

A symbiosis exists between research and higher education: the universities train research workers and they carry out research. In practice, this symbiosis is so strong that one cannot isolate higher education from science policy. Between research and the economy the bonds are equally strong. At the outset it is merely a question of promoting the infrastructures of

governmental scientific public services which the economy needs, including the institutions of agricultural research and co-operative industrial research. Later on it consists in formulating an integrated strategy for the stimulation of economic growth in which a production policy and a policy of industrial organization will determine a research policy.

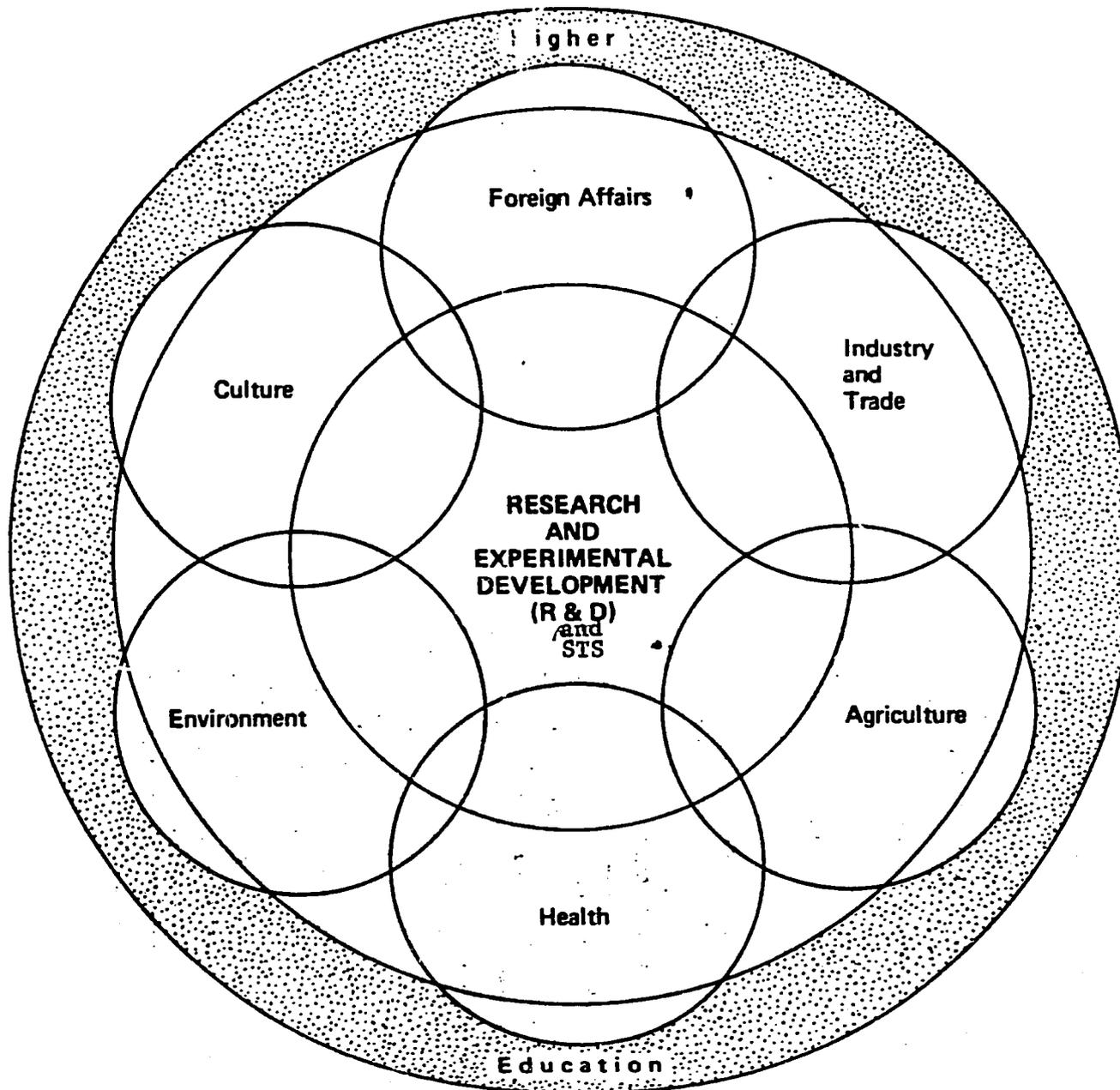
National science policy also faces various problems of international relations: first, those connected with international or regional organizations having universal scientific or technological objectives, and next, those arising from bilateral cooperation agreements.

The place occupied by science policy in the general policy of nations may be modest, or it may be very large, but it will always be a central one. Science policy is at the cross-roads of economic policy, social policy and foreign policy and is therefore the responsibility of the whole government and - by force of circumstances - the responsibility of the head of the government."*

14. The scope and inter-relationships of science policy in the national situation are illustrated in the diagram which follows from UNESCO.

*From pages 111 and 118 of "Science for Development: An essay on the origin and organization of national science policies," Jacques Spaey et. al., UNESCO 1971.

SCIENCE POLICY
and its principal interconnections with other aspects of national life



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II. Current Situation of Science and Technology (S&T) in Mauritania

A. Organization

1. There is no formal organization of S&T in Mauritania. There is no National Research Council or its equivalent nor much, if any, of a S&T "infrastructure." The only Ministry to have a Planning Unit is the Ministry of Planning and Mines. It is staffed by three Mauritanians who are supported by five experts from the World Bank. There are no policies on S&T at the national level nor in any of the Ministries. However, some consideration of S&T is implied in some sectoral programs and projects.
2. An encouraging legislative act on 8 June 1978 should improve the S&T situation. A law passed by the National Assembly approved the participation of Mauritania in the USAID RAMS Project. RAMS is a "Rural Assessment and Manpower Survey." The purpose of RAMS is to "assist the Government of Mauritania to develop information for decision making among alternative development strategies in Mauritania and to translate these strategies into specific projects." The major components of RAMS are a program of manpower studies and nineteen policy papers related to the integrated development of the rural sector.
3. RAMS project work will be carried out by a US contractor in collaboration with two inter-ministerial committees. One is the Inter-

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Ministerial Technical Committee comprised of Directors of the Departments of the seven concerned Ministries: Planning and Mines; Rural Development; Fundamental Education; National Education; Public Works and Labor; Health and Social Welfare; and Finance. This Committee (which has been operating informally for several months) will be chaired by the Director of Planning of the Ministry of Planning and Mines. The other Committee is composed of the Ministers of the same seven Ministries will be chaired by the Ministry of State of Planning and Mines, and is called the Inter-Ministerial Policy Committee.

B. Problems and Constraints

1. Basically, Mauritania has few trained professionals in any field - social, economic, technical or managerial. It must rely heavily on expatriates funded by donor countries and international institutions and is itself unable to effectively plan, monitor, supervise, control, direct and evaluate development programs, progress and results.
2. The diminishing agricultural resource base (loss of farm land, trees and cattle, which have a negative net reproduction rate) and mineral depletions have severely reduced the standard of living and market availability of foreign exchange. This has forced Mauritania to seek substantial foreign assistance above and beyond disaster relief.

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3. The UNESCO Secretariat, in preparation for the 1974 Dakar CASTAFRICA Conference, used some two hundred experts in the field of S&T from both inside and outside Africa to identify twenty-five major barriers to the use and development of S&T (p. 138-39, UNESCO Pub. 35 - "Science and Technology for African Development"). These barriers, all of which apply to Mauritania to some degree, are listed below in four categories:

"Technical barriers due to lack of scientific knowledge connected with a specific technology:

- o Basic knowledge not yet acquired (more research needed);
- o Know-how not yet developed (more development needed);
- o Technology too sophisticated to be developed on the basis of the African R&D capability only.

Technical barriers due to lack of scientific development in general:

- o World R&D effort not oriented towards African problems;
- o Inadequate communication between African scientists and colleagues elsewhere;
- o Too few highly qualified scientists and engineers in Africa;
- o Inadequate scientific development budgets in African countries;
- o Unsophisticated markets (lack of knowledge on the part of potential users);
- o Lack of scientifically trained middle-grade government officials;
- o Lack of involvement of scientists in government planning;

- o Lack of co-ordination between science policies of African countries;
- o Lack of communication between African research laboratories;
- o Technology too sophisticated to be used on a broad scale.

Economic barriers:

- o Inadequate communication and transportational infrastructure;
- o Inadequate industrial infrastructure;
- o Shortage of venture capital;
- o Capital sources unacquainted with the technological possibility;
- o The widely dispersed market;
- o Lack of capital at low-interest rates;
- o Lack of continuity in the policies pursued, lack of effective planning;
- o General economic conditions not favouring industrialization.

Socio-cultural barriers:

- o Lack of basic education of the masses, illiteracy;
- o Lack of public awareness of possible technological benefits;
- o Cultural inertia resisting change (taboos and mores);
- o Awareness that human progress does not necessarily result from improvement of technologies."

Conclusions Concerning Science and Technology in Mauritania

1. Mauritania will continue to be a user and consumer, rather than a generator, of S&T for some time to come.

2. Mauritania should specifically become an intensive user of scientific and technological information (STI) related to its development needs, resources, problems and plans.
3. Mauritania has the opportunity to become a generator of STI in agriculture, forestry, fisheries, geology, climatology, resource management, applied sociology and related disciplines. This is the basis and starting point for Mauritania to develop its own research and development capability and to interact with the international S&T community.
4. As current and programmed social and rural development plans are implemented, changes, or lack thereof, in living and working patterns should provide scientific data and information to guide and improve future social, cultural and economic development (these changes may or may not have a technology component depending on the specific context). The USAID RAMS Project is planned to generate a large volume information of this kind.
5. Mauritania should utilize, wherever appropriate, results of similar techno-socio-economic development projects elsewhere in the world, both historical and contemporary.
6. In spite of the problems and constraints facing Mauritania, its government must make every effort to become an enlightened consumer-user of S&T. This should be the primary S&T objective and strategic

posture of Mauritania. This task, while difficult, should not be expensive to accomplish. It is necessary for three reasons: 1) to avoid repeating past socio-techno-economic errors; 2) to obtain the most economical, effective and efficient technology adapted to Mauritanian conditions and requirements ("technology transfer"); and 3) to assist the accelerated development of the indigenous Mauritanian capability and potential in science and technology.

The next part of this report discusses the kinds of institutions necessary for the organization and utilization of S&T in Mauritania.

III. Institutional Needs for Science and Technology Organization and Policy

This Part is divided into four sections. The first Section (A) discusses "Governmental Structures and Mechanisms for Policy-Making in Science and Technology." Section B presents the United Nations classification scheme of "The Components of the National Science and Technological Potential (STP)." Sections A and B are taken from UNESCO Science Policy Studies and Documents No. 41 "Science and Technology in the Development of the Arab States, 1977, the report of the 1976 Rabat Conference of Ministers of Arab States Responsible for the Application of Science and Technology to Development (CASTARAB) (A - p. 137-39; B - p. 159-60). Most of this material is of direct application in the Mauritanian situation.

Section C is "National and International R&D Systems for Science and Technology." It includes discussions of two useful diagrammatic presentations of R&D systems. The first is called "Cybernetic Model of National R&D System" and the second illustrates "Main Types of Levels of Links between the R&D Systems of two countries. Both diagrams are reproduced from UNESCO Science Policy Studies and Documents No. 35 "Science and Technology in African Development," 1974, the report of the 1974 Dakar Conference of Ministers of African States Responsible for the Application of Science and Technology to Development (CASTAFRICA). These diagrams can be used as models to guide the development of S&T organization in Mauritania, both nationally and internationally.

Section D includes a comprehensive discussion of "Technology Transfer and Assessment as Components of National Science and Technology Policy." This

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excellent presentation is also taken from UNESCO Document No. 41 on the 1976 Rabat CASTARAB Conference (pages 145-152). The diagram included in this section systematically relates horizontal and vertical technology transfer processes to the National Plan. It clearly indicates how the need for technology is derived from national, sectoral, program and project objectives and where technology assessment fits into the process. The diagram also identifies the steps and sequence of actions in horizontal technology transfer process which are directly applicable to Mauritania and merit most careful consideration.

The vertical technology transfer process, which refers to "classical" R&D, will apply to Mauritania in only a few instances for some time to come. It will be based primarily on the quantity and quality of scientific and technological information (STI) generated by national development projects in agriculture, forestry, fisheries, and livestock management.

A. "Governmental Structures and Mechanisms for Policy-Making in Science and Technology"

1. The governmental structure for the planning, decision-making, and implementation of the national science and technology policy should reflect the function and powers as well as the links between its various component organs.
2. In a number of countries, developed as well as developing, several new ministries have appeared during the last few years, in fields as energy, environment, culture, quality of life, etc. Among these new ministries, one often finds a Ministry for Science and Technology (or an

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7. The Management and Promotional Function

This function is action oriented; it creates the necessary conditions for the realization of objectives. Action is initiated by granting the resources; evaluation ensures that the use of these resources produces the expected results.

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equivalent governmental body) directly responsible to the President of the Republic or to the Prime Minister as the case may be.

3. In those countries where science and technology are kept outside the realm of day-to-day politics, the governmental science policy-making body is not headed by a cabinet-rank minister and a designation such as "National Council for Science and Technology" is then preferred. This is thought to have some advantages for the continuity of a country's policy for science and technology when frequent changes in political personnel occur at the level of cabinet ministers.
4. The reasons for creating such horizontally integrated governmental policy-making bodies in the field of science and technology are manifold, and some of the more important ones are mentioned below for consideration by CASTARAB.
5. The first is to be found in the obvious inability of the "vertical" ministries responsible for a well-defined sector of the economy (agriculture, health, industry, etc.) to deal adequately with the application of science and technology to development across the board, and from the dual point of view of objectives assigned, and of resources devoted to the national effort in Research, Experimental Development and Scientific/Technological Services. One of the major drawbacks of such a situation is that no single office in the government is responsible for "intersectoral" questions, or for developing new fields which do not fall

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within the competence of the traditional ministries. Under these circumstances, the national research and innovation effort is bound to generate "more of the same" rather than anything radically new in such fields as space, nuclear energy, environment, quality of life, urban decay, rural development, etc.

6. Another frequent inadequacy is to be found in the absence of any governmental authority responsible for the training (post-graduate studies), status, working conditions and employment of scientific researchers and other scientific/technological personnel in the governmental, academic and productive enterprise sectors of the economy. The resulting "brain drain" or emigration of talent is a well-known consequence of such a situation; it has crippled or at least impoverished the national scientific communities of many developing countries over the last decades.

7. The second reason lies in the acute "vulnerability" of research and scientific budgets in all traditional ministries. These activities, which are of vital importance for the long-term future of any nation and for the development of human knowledge in general, often undergo severe budgetary cuts or are badly hit by inflation if there is no one at the highest level of government to speak out for them, ensure an adequate promotion of science and technology through the successive national development plans, and hold the key of a so-called "double lock" on the budgets relating to science and technology (R&D + STS)

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of all ministries. It is well known that the lead-time between the setting up of research teams and the yield of applicable results takes on average seven years during which time a continuing effort is required. Any discontinuation in budgetary support for such research units leads to their disbandment and entails a total loss of the previous investments.

8. A third reason is to be found in the high degree of autonomy of the institutions of higher education in many countries, and most Arab States are no exception to this rule. While the universities and polytechnics of those countries account for most of the nations' research potential, it is difficult to enlist this innovative force into research oriented schools towards national needs or wants. Thus the research performed in universities and other institutions of higher education remains exclusively "discipline-oriented". Results are published in international science journals and serve primarily the advanced countries that can take immediate use of them, while the bill for obtaining these results is paid by the less developed countries - a paradoxical situation indeed. The existence of a governmental science and technology policy-making body and of a related funding system for so-called "mission-oriented" research, carried out in support of the long-term development policy of the country, permits the mobilization of a substantial part of the academic resources of the country for the solution of national problems. This is best done with the assistance of an authoritative scientific council empowered to make proposals for co-operative and interdisciplinary research programmes among various

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research teams working at different universities in the country or abroad (when international co-operation is necessary in order to optimize the effort).

9. Fourthly, there is a growing need in all countries for double-checking and stimulation, by means of competitive research teams of the often entrenched and somewhat crystallized autonomous organizations created by the governments for the study of demographic, economic, social, developmental or public health programmes and the like.
10. Lastly, mention should be made of the various tasks to be carried out at national level in connexion with technological transfer, commercialization of technology, technological forecasting and assessment.
11. What then are the various government organs needed to perform the above-mentioned functions and activities? International comparative studies carried out by Unesco have shown it is useful to distinguish four functional levels in governmental science and technology policy-making:

- (i) Functional level 1: planning, decision-making, interministerial coordination and assessment of results.

Planning includes the preparation of the section of the National Development Plan relating to science and technology as well as participation in the planning of technological transfers relating to the various sectors of the national economy. It also includes

the preparation, on an annual basis, of the functional State Budget for science and technology (R&D and STS).

The decision-making function concerns primarily the approval of the National Science/Technology Plan and the annual State Budget for Science and Technology, by the Council of Ministers and the Parliament. Interministerial co-ordination takes place first during the preparation of the Plan and the Budget, and then at the various stages of implementation of these policy-documents as approved by the government. The assessment function (sometimes called evaluation, monitoring or "control") consists in a continuing survey of the country's scientific and technological potential at the level of R&D or STS units, including ongoing research, results obtained, and their practical application.

- (i) Functional level 2: promotion and financing of research, experimental development (R&D) and scientific/technological services (STS) in the various "sectors" of the economy. The functions performed at this level are intimately linked with "interministerial co-ordination" and they normally represent the first steps in the implementation of the policy decisions taken by the government. They can be carried out through traditional budgetary procedures, i.e. by institutions, along administrative budget lines; or they can be carried out through "programme-budget"

procedures as applied in the so-called "management by objectives". Most countries apply a mix of these two financing procedures, and have set up one central body (or several sectoral bodies) often called the National Research Council(s) to handle the financing of R&D and STS according to well-defined programmes. This can be done by responding to requests for the funding of specific projects submitted by outside institutions, laboratories, research units and individual research scientists (responsive method), or by directing researchers to carry out specific projects called for by the national development objectives, the National Science Plan or the Science Budget (normative method). For this latter purpose, the National Research Councils sometimes support or create their own National Research Centers in various branches of science and technology.

Apart from funding projects in support of national development objectives, the National Research Councils often promote scientific and technological research for the advancement of science, with a view to improving the level and quality of research in the country, or to build up its scientific potential, in particular by supporting post-graduate education at universities and polytechnics.

- (iii) Functional levels 3 and 4 concern the actual performance of research and experimental development (R&D) and scientific and technological services (STS) respectively. They are the operational levels of national policy for science and technology;

as such, they are not dealt with in this section, which is primarily devoted to policy-making."

B. "The Components of the National Scientific and Technological Potential (STP)"

1. The national scientific and technological potential (STP) can be regarded as an interactive system of human, financial, material, informational and managerial factors, i.e. the whole of the organized resources that a country has at its sovereign disposal for the purpose of discovery, invention and technological innovation, and for the study of national and international problems that the application of science and technology involve. The order of magnitude, structure and combination of these factors vary considerably from one Arab State to the other, and give rise to highly differentiated patterns of scientific and technological development in the region. One of the main purposes of national policies in the field of science and technology is to rationalize the growth of the national STP and to optimize the effectiveness of its impact on overall socio-economic development.

2. Among the various classifications that exist of the components of the national STP, the following has proved a very convenient framework for apprehending scientific and technological activities in institutional terms. It has been developed by UNACAST, with the co-operation of all competent agencies of the United Nations system, for the purpose of identifying the institutional needs of developing countries in the field of science and technology. ⁽¹⁾ The classification which is

(1) For reference and further details, see the World Plan of Action, op. cit., pages 71-72 and 89-91.

reproduced below in order to facilitate the discussion of this topic by CASTARAB, comprises the following major elements:

- (1) National policy-making bodies in science and technology
 - 1.1 Central science and technology policy-making body
 - 1.2 R&D promoting and co-ordinating bodies in various sectors or fields (exact, natural and social sciences; agricultural, industrial, medical, nuclear, space sciences, etc.)
- (2) Higher education institutions in science and technology ("third level")
 - 2.1 Science faculties in universities
 - 2.2 Third level polytechnic schools and schools of engineering
 - 2.3 Third level schools of agriculture
 - 2.4 Schools or university faculties of medicine
- (3) Technician-training institutions ("second level")
 - 3.1 Technological training institutions
 - 3.2 Agricultural training institutions
 - 3.3 Medical training institutions
- (4) Research and experimental development (R&D) institutions
- (5) Scientific and technological public services (STS)
 - 5.1 Natural resources and environment services (such as topography and scientific mapping; hydrology services; geological survey and mining services; energy services; soil science services; services for integrated land-system surveys; meteorological

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services; astronomical and time services; seismological services, etc.)

5.2 Information and documentation services (such as national scientific and technological information and documentation centres; industrial information centres; data banks and information processing services; national science and technology libraries; patent offices, etc.)

5.3 Museums and collections (such as science and/or technology museums; scientific collections, etc.)

5.4 Standards, norms and instrumentation (such as national bureau of standards; national metrology services, quality control centres for maintenance of scientific instruments, etc.)

5.5 Extension and innovation services (such as agricultural services; technology transfer and innovation services; university polyclinics, etc.).

3. This classification, which can of course be further detailed, shows the complexity of the institutional framework of a nation's scientific and technological potential. Each country, except perhaps the very small ones, will need to have a minimum institutional capacity in each of the five major categories, the "mix" of which should reflect its particular needs."

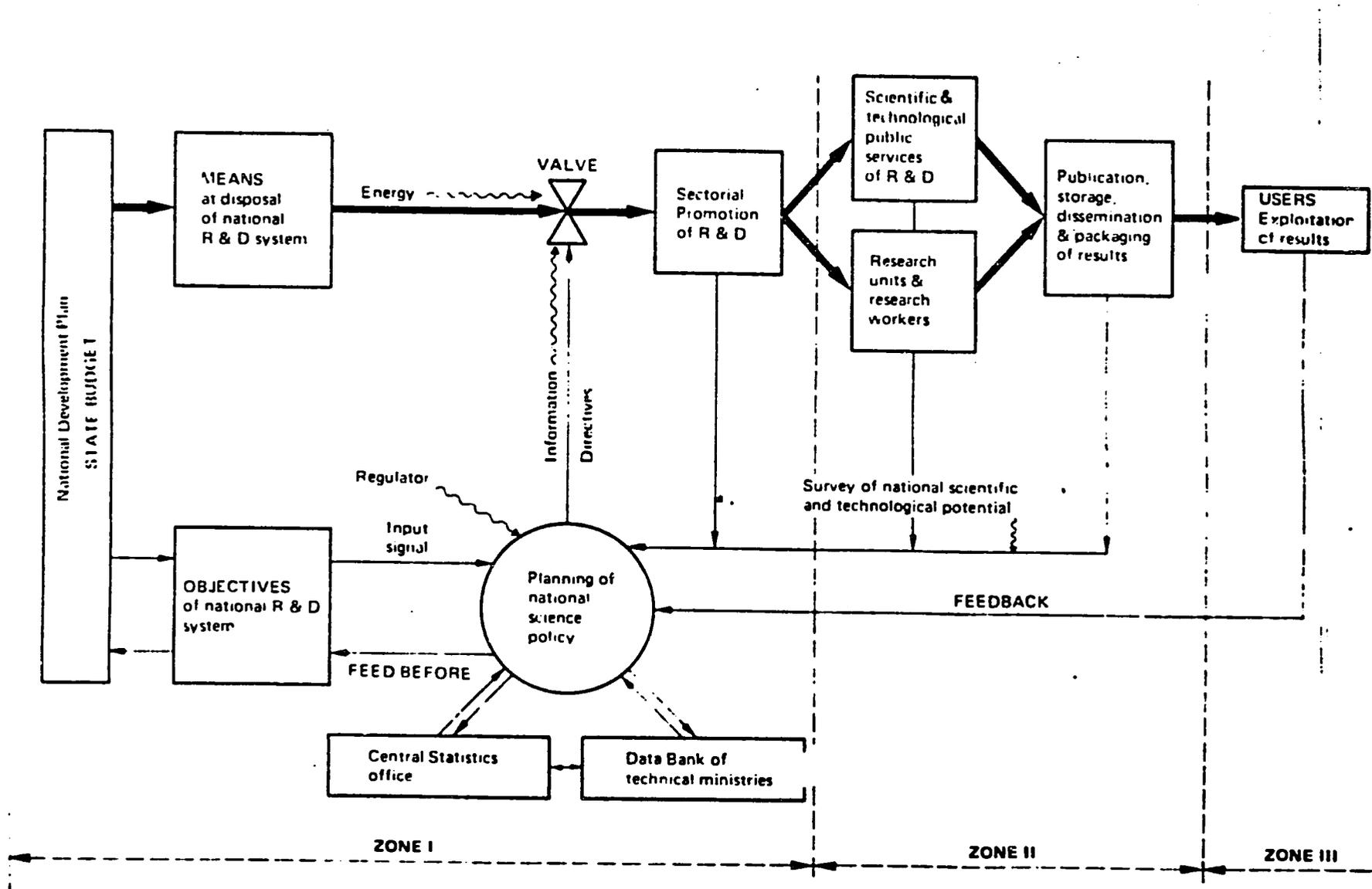
C. National and International R&D Systems for Science and Technology

1. The first diagram in this section is called "Cybernetic Model of R&D System." It illustrates the major policy, organizational, and informational elements and relationships in a generalized national R&D system and how they are linked by flows of information (feed-before and feed-back) and directives. The relationships between objectives, planning of national science policy, the national development plan, implementation structure and the users of S&T are clearly identified in the diagram.
2. Zone I shows the linkage between the planning of national science policy and programs, the National Development Plan, and the State Budget.
3. Zone II includes R&D activity and the supply of STS - scientific and technological-public services
4. Zone III consists of the users of S&T in both the private and public sectors.
5. The second diagram indicates the "Main Types and Levels of Links Between the R&D Systems of Two Countries." It illustrates four aspects of national and international activities in science and technology:
 - (1) the three organizational and institutional levels of national R&D systems: policy making, R&D management; and R&D performance;

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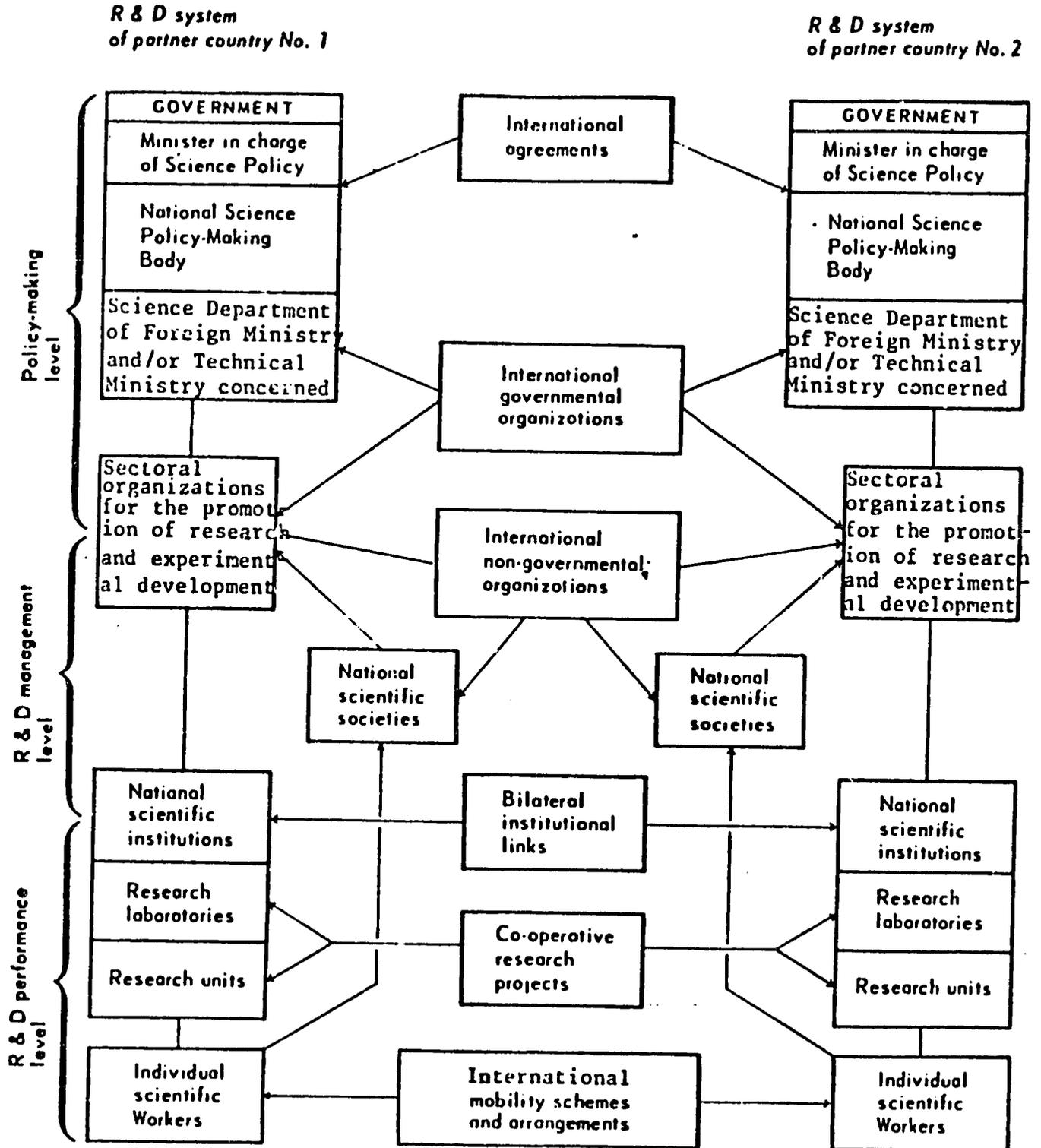
Diagram C

CYBERNETIC MODEL OF NATIONAL R & D SYSTEM



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Diagram indicating main types and levels of links between the R&D systems of two countries



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- (ii) the major components of each of the three R&D levels;
- (iii) the kinds of national and international S&T organizations and societies that can and do collaborate on specific R&D programs and projects.
- (iv) the various linkages and relationships that can be established between national and international S&T organizations at the policy-making, R&D management and R&D performance levels.

D. "Technology Transfer and Assessment as Components of the National Science and Technology Policy"

1. The transfer and assessment of technology has recently attracted the attention of governments of developing countries and of certain international organizations (such as Unesco, the United Nations Conference on Trade Development (UNCTAD), the United Nations Industrial Development Organization (UNIDO), the World Intellectual Property Organization (WIPO), etc.). An abundant literature now exists on this topic. Special emphasis is being laid on the transfer of technology in the context of the establishment of a New International Economic Order, which foresees, inter alia, the setting up of an International Code of Conduct on Transfer of Technology. ⁽¹⁾

⁽¹⁾ Ref. United Nations General Assembly resolutions 3201 (S-VI) and 3202 (S-VI), both dated 1 May 1974 and UNCTAD document TD/8/C.6/AC.1/2/Supp.1/Rev.1.

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2. Transferred technology not only influences the production factors and socio-cultural characteristics of the importing countries; it also has a strong effect on their national scientific and technological potential. These influences and effects can be advantageous or detrimental, depending on the conditions under which the technology transfer takes place. The following considerations are intended to draw the attention of CASTARAB to some of the more important issues of transfer of technology which are relevant to national science and technology policy-making.

The need to coordinate technology transfer in science and technology policy-making

3. Emphasis on technology transfer at the enterprise level, characteristically in the form of specific projects and programmes using imported technology, has obscured the impact of such transfers on the overall science and technology policies of nations.
4. As a result, there is an inherent danger, in the countries that are heavily dependent on the importation of foreign technology, of confining their national R&D to a role which remains outside the mainstream of the development planning process, whereas technology transfer is seen to relate solely to isolated development projects whose impacts on the economy as a whole are neither perceived nor assessed, for example, in terms of social costs. Unfortunately, such impacts may have far-reaching and long-lasting effects, far beyond those envisioned initially for a given development project. Unco-ordinated technology transfer projects

may also result in conflicting and even chaotic patterns of scientific and technological development.

5. Such a fragmented approach not only leads to an artificial dichotomy between science and technology, which seldom occurs in the highly developed countries, but it also engenders an implicit depreciation of efforts to build up an indigenous R&D capability. Indeed, if a higher value is constantly placed on imported technology which is believed to have a more immediate impact on the development process, the local R&D soon becomes a purely academic exercise, a costly option which developing countries can ill afford.

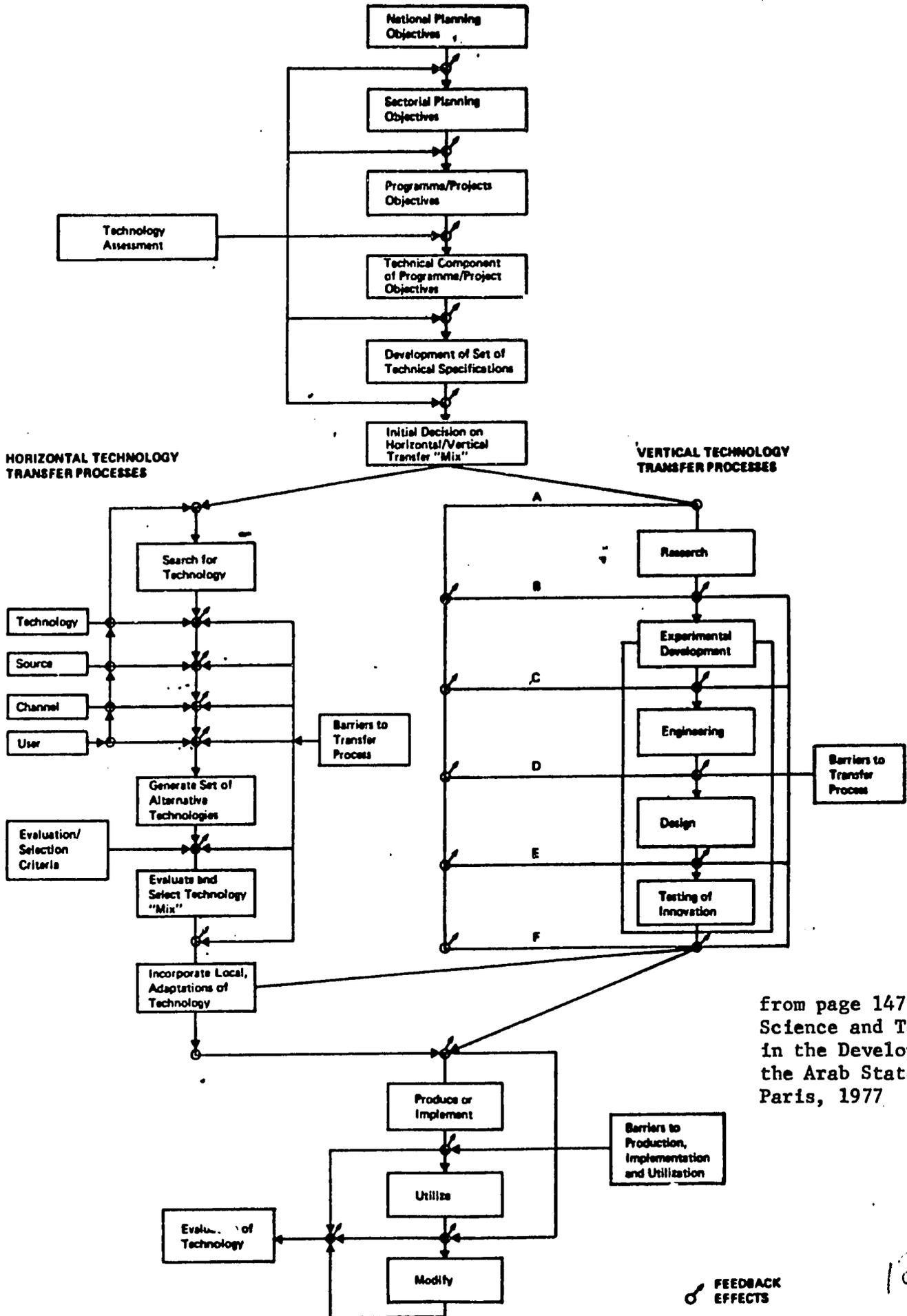
6. The damage done by following this erroneous and short-sighted approach is staggering and efforts to avoid it should be of prime concern to countries embarking on accelerated and self-sustained development. Many countries have erred in the past by not considering science and technology as inseparable parts of one integrated planning effort and by overlooking their joint interaction and impact on development. Lessons should be drawn from past mistakes and time seems ripe for adopting a more effective approach to the problem. The ultimate goals to be achieved by the Arab States in this respect should be:
 - (i) that the identification and selection of technology imports - which in most countries account for an overwhelming proportion of technological applications in the productive sectors of the economy - be made in cooperation with the local specialists in charge of the national science and technology policy;

- (ii) that indigenous R&D be conceived as a complement (and, whenever possible, be preferred) to the importation of foreign technology;
- (iii) that the choice combination of local R&D, on the one hand, and the importation of foreign technology on the other be considered as one of the most important decisions to be made in development planning, and in the formulation of national science and technology policies.

A framework for analysing technology transfer processes

7. Technology transfer processes as they relate to national planning are shown in a highly simplified form in Diagram I. As shown in this diagram, the need for technology derives primarily from national, sectoral and finally specific programme and project objectives. The critical choice of the technology itself depends in a large measure on the type of transfer process involved in the decision at hand. In this regard it has been found useful to distinguish between "horizontal" and "vertical" transfer processes.
8. The main link between horizontal and vertical technology transfers derives from the fact that technologies must often be adapted, and sometimes even radically adapted, when they are transferred. And to the extent that adaptation is necessary, and two processes are very likely to be interdependent. The judicious composition of the "mix" seems, moreover, to be one of the most important requirements for the

Diagram I
INTERRELATIONSHIPS BETWEEN HORIZONTAL AND VERTICAL
TECHNOLOGY TRANSFERS AND THE NATIONAL PLANNING PROCESS



from page 147,
Science and Technology
in the Development of
the Arab States, Unesco
Paris, 1977.

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technological development of the less advanced countries,⁽¹⁾

9. The diagram shows that the "mix" between horizontal and vertical technology transfer processes can occur at all levels (A-F) of the R&D process. Often there is little room for choice; limited resources impose almost exclusive reliance on horizontal transfer patterns which, themselves, are often subject to artificial limitations in the selection of technology sources (monopsony situation). In any event, it will be necessary to build up local R&D capabilities, if only for the purpose of selecting and adapting foreign technologies to local conditions. Therefore it is useful to examine both technology transfer processes and their interconnexions in some detail.
10. In general, it is apparent that countries wishing to master the horizontal technological transfer process must above all acquire the ability to:
- make an independent choice from among the various technological possibilities open to them;
 - adapt imported technologies to local conditions;
 - participate increasingly in the world production of original technological innovations in order to benefit increasingly from the favourable transfer conditions linked to bartering as opposed to mere purchasing of technology;

⁽¹⁾ cf. G.S. Ramaswamy and D. Banerjee in the Proceedings of the joint Government of India - UNIDO Inter-regional Seminar on Technology Transfer, New Delhi, December 1972.

- ensure the implantation and efficient management of the imported technologies by the local productive and service industries.

11. It must be admitted that the complex mechanisms involved in international technology transfers are not yet entirely understood. This last remark is particularly true of:

(i) transfers through local subsidiaries of transnational companies;⁽¹⁾

(ii) transfers between developing countries;

both of which might be given special attention by CASTARAB.

12. Since "technology" is primarily a matter of "know-how" (training and information), its international transfer is basically a "people process". Of course, this does not mean that machines are less important, but simply that man's role is predominant. It is the combination of men and machines together which forms operational technology. In the last analysis, there can be no technology transfer unless man himself is capable of effecting it. This is yet another reason for countries to maintain stocks of qualified scientists, engineers and technicians, since the numbers and competence of these specialists largely determines a nation's absorptive capacity for foreign technology.

13. In view of the foregoing CASTARAB may wish to underline that the

⁽¹⁾ In this context reference is made to the work of the ECOSOC Commission on Transnational Corporations, which held its first session in March 1975 (see "Report of the First Session, New York, 1975", document E/5655-E/C.10/6).

economic, scientific and technological policies of Arab countries should be planned so as to optimize the profits of all kinds which may be reaped from a wise combination of horizontal and vertical technology transfer processes, i.e. combining imported foreign know-how with a drive towards national technological innovation.

Implementation, utilization and assessment of technology

14. Whatever the mix of horizontal and vertical technology transfer, it is only where the transfer "packages", i.e. their informational (software) and material (hardware) components enter the mainstream of development that they make a real impact on the nation's productive system. It belongs to the national policy-making bodies in science and technology to monitor and evaluate the process, thus securing (i) a basis for technical modification and improvement of the technology in question and (ii) a perspective view of and factual experience for subsequent development operations involving the application of science and technology.

15. In the last few years a number of developed countries have developed evaluative tools and procedures that will enable them to establish more explicit policies for the regulation of technological growth and development so as to ensure, at least to the extent possible, that the positive effects of technology can be maximized and the negative ones identified and avoided in the interests of their societies.

16. In essence, then, technology assessment, represents an institutionalized attempt to develop objective, comprehensive, evaluative and forecasting information through the use of a variety of techniques and procedures concerning the multidimensional societal impacts associated with technological decisions. It is less concerned with the actual design or technical specifications of technology per se than with external effects its development and application will potentially have on the many aspects of social life and objectives.

17. The technology assessment process draws from a variety of methodologies and techniques in performing its evaluative functions. These include some that already familiar - cost benefit analysis, systems engineering, technological forecasting, risk and probability theory, computer simulation and modelling, etc; and others that have a new look - the "delphi technique" (consulting groups of experts), the use of "cross-impact" matrices and analyses, and the development of "relevance trees". The arsenal of approaches available, therefore, represents a blend of the old and the new.

There is no reason to believe that the technology assessment movement should concern only the industrialized societies. On the contrary, it is the developing countries at the beginning stages of industrialization that are more urgently in need of evaluative skills in selecting optimal technologies to meet their economic and social needs. While the various approaches and methodologies of technological assessment still need to be perfected, they are already operating in some respects. It would

therefore be important for CASTARAB to emphasize the need for improving both the analytical capabilities and the information base on which crucial technology transfer decisions are made in the Arab States, and to stress the important role that Unesco play in this respect.

19. Considering the fact that nowadays relatively few technological innovations originate from the Third World, the content of "technology assessment" differs significantly as between developing and developed countries whenever the crux of the matter lies in the foreseeable impact of untried technologies. In many developing countries, technology assessment is concerned first and foremost with the feasibility or desirability of transferring existing technologies. The forecasting of technologically feasible futures, specific to developing countries, will however very compel the Third World countries in turn to assess also new and untried technologies. The role, range of applicability and principal methods of technological forecasting will therefore be discussed in some detail in the following sub-section.

The role of technological forecasting in science and technology policy

20. Science and technology policy-making cannot be confined simply to the application of existing science and technology. It should also be forward-looking with a view to identifying and stimulating new avenues and opportunities for R&D and the application of science and technology

in the future. In this context, comprehensive technological forecasting which may be defined as national guesswork on future technological developments becomes an important instrument of planners and policy-makers.

21. A hundred different methods and approaches to technological forecasting can be found in the abundant literature which has been published on this topic in recent years.⁽¹⁾ In attempting to rationalize and classify these methods, one may distinguish at least four basic elements of technological forecasting - qualitative, quantitative, time and probability - all of which must be taken into consideration in order to use a technological forecast for responsibly planning application of science and technology to development. Since there is practically no method that includes all the four basic elements, a comprehensive technological forecast will of necessity be a combination of two or more complementary methods.

22. In order to facilitate discussion of the issue of technological forecasting by CASTARAB, the four basic elements mentioned above will be briefly defined:

(i) qualitative methods, involve the qualitative description of a future technological concept or phenomenon (examples: intuitive

(1) The following considerations on technological forecasting are based, inter alia, on H. Jones in "A systematic approach to technological forecasting", in: R&D Management, Vol. 6, No. 1, October 1975.

thinking, analogies, relevance-tree approach, morphological analyses, etc.); it should be noted that the qualitative aspect is the essential element in a technological forecast, without which the other elements are meaningless and valueless;

- (ii) quantitative methods, measure the level of the activity of the future technological concept in well-defined terms or units, preferably in technical terms of efficiency and performance or in economic values such as cost, market share, etc.;
 - (iii) time methods, permit a statement of the time in years ahead when the technological concept or phenomenon will become effective and real (examples: time series analyses, learning curves, input and output and relevance matrices, etc.);
 - (iv) probability assessments, provide a statement of the probability that the forecast will materialize (examples: Delphi, cross impact assessment, game methods, etc.).
23. Conducted in this form, technological forecasting is likely to provide a reliable basis for decision-making, even more so since almost all scenarios in this field may be broken down into lower level sub-unit scenarios, thereby allowing for the necessary degree of refinement in the methods applied.

The role of the patent system in the transfer of technology

24. UNCTAD, through its Committee on Technology Transfer and its Intergovernmental Group on Technology Transfer, has repeatedly drawn the attention

of governments to the limitations on access to technology by developing countries,⁽¹⁾ one of which is seen in inappropriate or non-existent national patent systems. In this context, the importance of utilizing the international patent system as an effective instrument of national development policy has been underlined, and the need for an adequate industrial property system of the type required by developing countries to improve their national scientific and technological infrastructure, taking into account their different stages of industrialization has been underscored.

25. In order to facilitate a comprehensive discussion of this topic by CASTARAB a detailed study of the protection of intellectual property and the transfer of science and technology in the Arab States has been prepared by Unesco, with the cooperation of WIPO and UNCTAD, and is given in Chapter III, Section 2, of this document.

Technology transfer in relation to the development process

26. There are nowadays, in the developing countries, strong arguments for the organization, co-ordination and control of the processes involved in technology transfer (both horizontal and vertical) in a comprehensive manner, with a view to achieving the objectives of the development plan. These arguments, some of which are presented here for further examination

¹⁾ A "pattern of limitations on access to technology by developing countries" is provided in UNCTAD document No. TD IBIAC.11/10/Rev.12 entitled "Major issues arising from the transfer of technology to developing countries", New York, 1975.

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by CASTARAB, include the need for

- (i) assessing the impact of technological innovations on culture, the social system and the economy;
 - (ii) providing mechanisms for the co-ordination of technology, intensive development projects and for the elimination of conflicting transfer mechanisms and arrangements;
 - (iii) increasingly the national capacity to monitor the technology transfer process, and to diagnose problems arising therefrom; and to organize concerted efforts designed to overcome these problems;
 - (iv) providing greater opportunities and more channels of communication between developing countries in order to exchange the experience acquired in the process of technology transfer;
 - (v) reducing the costs of acquiring technology through the "unbundling" of technological packages offered on the international market.
27. With regard to the last-mentioned problem, it is important to note that most of the technologies that are subject to transfer consist of a package of individual elements, some of which could be manufactured by the receiving country itself, leaving for importation only the most sophisticated elements or those for which it is not worth while to develop a domestic capability. It is readily seen that such unpackaging - which is widely practised in Europe and some countries of Latin America -

not only reduces the cost of transferred technology, but also strengthens the indigenous technological capacity of the receiving country. However, in order to benefit from unbundling, countries must satisfy at least two conditions:

- (i) They must be capable of analysing the technology package so as to identify components which could be unbundled, i.e. produced locally;
- (ii) they must possess sufficient bargaining power to obtain the unbundling from the exporting country.

In view of the obvious advantages of unpackaging as described above, it would seem worth while for CASTARAB to further examine this important aspect of technology transfer and to define appropriate action to be taken by Arab States at the national and regional levels."

IV. Eight Suggestions for the Development of S&T Capability in Mauritania

1. National Science and Technology Council (NSTC).
2. Science and Technology Policy Development Program.
3. Planning Units in Each Ministry.
4. Project Design and Review Procedure.
5. Technology and Contract Register.
6. Research and Development Project Register.
7. National Scientific and Technological Information System (NSTIS).
8. Science and Technology Monitor Program.

In the course of implementing these suggestions, it is understood that a number of training programs, seminars and high-level educational programs will be required within Mauritania and abroad.

1. National Science and Technology Council (NSTC)

Mauritania does not have a high-level government agency or unit basically concerned with the orderly application of science and technology to the development of the nation. Such an agency is necessary to ensure the maximum benefits of S&T to Mauritania's indigenous capabilities in S&T. The legislation passed on 8 June 1978 providing for the Technical and Policy Committees for the RAMS Project can serve as basis for creating a NSTC. The scope of the RAMS Inter-Ministerial Policy Committee could be expanded to include all areas and aspects of S&T. The Committee could also be enlarged to include other Ministries having an interest in S&T beyond the current seven: Planning and Mines; Rural Development; Fundamental Education; National Education Public Works and Labor; Health and Social Welfare; and Finance.

As recommended at the 1974 Dakar Conference of Ministers of African States Responsible for the Application of Science and Technology to Development (CASTAFRICA), which was attended by Mauritania, UNESCO may be able to provide assistance to establish an NSTC (see Recommendation No. 4 following) (pages 19-20). Table I below from the same Dakar Report shows the situation of policy making bodies in Africa as of May 1973. At that time, ten of the thirty-seven African States did not have a high-level science policy body. Mauritania was one of the ten.

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"Recommendation No. 4: SCIENCE AND TECHNOLOGY POLICY ORGANS IN AFRICAN COUNTRIES

The Conference,

Realizing the need to establish in each country, at the highest level, appropriate machinery to be responsible for the elaboration of national science policy and the co-ordination of science and technological activities,

Recognizing the most important role such machinery plays in the development of science and technology,

Noting, however, that some African countries have not created such machinery,

Recommends that:

1. Each of the countries that have not yet created such machinery should study the options available to it in this regard, and endeavour to establish, as early as possible, a machinery that best suits the level of technological development as well as the socio-economic and cultural conditions of the country.
2. Unesco, in co-operation with other institutions of the United Nations family, should assist those African States that have not established such machinery to enable them to do so, and also assist in the strengthening of such machinery where it has already been established.
3. Member States that have established their science policy planning

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machinery should keep it under constant review with a view to effecting the necessary changes at the appropriate time so as to ensure the effective functioning of the machinery.

4. Such machinery, in the performance of its functions, should also liaise closely with the national organs responsible for socio-economic development planning.

5. Unesco, in collaboration with other governmental and non-governmental agencies, should assist African Member States in implementing programmes within their National Development Plan, in particular by assisting Member States in project design and preparation under the various programmes in their National Science Plan."

TABLE I

POLICY-MAKING BODIES FOR SCIENCE AND TECHNOLOGY IN AFRICAN COUNTRIES (MAY 1973)

COUNTRY	Ministry of Science or ministerial science policy committee	Science planning body - general	Multisectoral body for co-ordinating scientific research	Co-ordinating bodies for scientific research					
				Natural sciences research	Agricultural research	Medical research	Nuclear research	Industrial research	Environmental research
Algeria	X ⁽³⁾		X ⁽¹⁾					X ⁽²⁾	
Burundi									
Cameroon		X	X		X	X		X	
Central African Republic			X						
Chad			X						
Congo			X						
Dahomey			X		X	X		X	X
Egypt	X		X	X	X	X		X	X
Ethiopia			X	X ⁽⁴⁾	X	X ⁽⁴⁾		X ⁽⁴⁾	
Gabon			X ⁽⁴⁾						
Ghana		X ⁽⁷⁾	X						
Guinea	X		X ⁽⁷⁾						
Ivory Coast	X		X		X ⁽⁷⁾				
Kenya ⁽⁸⁾									
Lesotho									
Liberia		X							
Libya									X
Madagascar			X						
Malawi					X				
Mali ⁽⁵⁾		X			X				
Mauritania									
Mauritius									
Morocco					X		X		
Niger		X ⁽⁷⁾	X		X				
Nigeria		X	X	X	X	X		X	
Rwanda									
Senegal		X	X						
Sierra Leone									
Somalia									
Sudan		X ⁽⁶⁾	X ⁽⁶⁾		X	X		X	
Tanzania ⁽⁸⁾		X	X						
Togo									
Tunisia	X ⁽⁷⁾	X							
Uganda ⁽⁸⁾		X ⁽⁷⁾	X						
Upper Volta					X				
Zaire		X	X		X ⁽⁷⁾		X ⁽⁷⁾		
Zambia		X ⁽⁷⁾	X		X	X	X ⁽⁷⁾	X	

(7) Situation not altogether clear

(1) Provisional (2) Government Department of Mining and Geology (3) Ministry of Higher Education and Scientific Research

(4) Projected (5) There is a Natural Resources Research Committee which undertakes co-ordination

(6) National Council for Research (7) Ministry of Planning cover science policy and R&D

(8) Note close relations with the scientific bodies of the East African Community.

2. Science and Technology Policy Development Program

Science and Technology (S&T) is not a sector by itself, but rather is a significant component in the operations of all sectors of the economy and the organizations which administer them. Each Ministry in the Government of Mauritania has operations that can and should benefit from the application of S&T. Therefore, it should become a NATIONAL POLICY, by Presidential Decree or similar declaration, that all National, Sectoral, and Ministerial Plans include a systematic consideration of S&T applications and benefits in their design, implementation and evaluation. The suggested National Science and Technology Council (NSTC) could oversee this program.

The Government of Peru in its 1977 TUPAC AMARU National Plan provides one useful example of how policies may be promulgated. A copy of this Plan, which includes basic policy statements on S&T in all sectors of the Peruvian economy, is attached as Appendix F below.

Four other Appendices also provide background and analytical material that should be useful in organizing and implementing the S&T Policy Development Program:

- Appendix A: Outline of Science and Technology Policies by Major Categories (UNESCO-SPINES)
- Appendix B: List of Fields in Science and Technology (UNESCO)
- Appendix D: Priority Areas for Further R&D (UN and CASTAFRICA, Dakar, 1974)
- Appendix E: Relative Importance of S&T Disciplines to National Development (CASTAFRICA, Dakar, 1974)

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3. Planning Units in Each Ministry

It is understood that only the Ministry of Planning and Mines has a Planning Unit. While this would appear obvious and necessary to that Ministry, a similar Unit should be part of every Ministry and larger Government Agency.

A Planning Unit is the necessary focal point in each Ministry to prepare its own Plan and also to serve as the coordinating link with the Ministry of Planning and Mines for the preparation of the National Development Plan.

A Planning Unit in each Ministry could also be responsible for assuring that a systematic consideration of S&T applications and benefits would be given in the design, implementation and evaluation of all Ministerial and related sectoral plans.

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4. Project Design and Review Procedure

In order to improve the quality of Project Designs, assure the selection of appropriate strategies and solutions, obtain the services of the most qualified supplier of expertise, construction, technology, etc., the Government of Mauritania should develop a straightforward and concise Project Design and Review Procedure (PDRP).

This procedure would be used not only in the project design stage, but also for project review and appraisal before, during, and after project completion. Essentially the same procedure would be used by all governmental units. The procedures would include criteria for the selection, assessment and evaluation of technologies.

The significance of sound project procedures is emphasized in the following quotation from "Science for Development", p. 38, Jaques Spaey.

UNESCO 1971:

"What characterizes the modern age is the way in which a research project is determined and how its execution is carried out. The definition of a research project is not only the translation into action of an affective preference, or a value judgment, or of an attitude of will. It is the result of a process of rational decision making, founded on a precise appreciation of the situation, the resources, the possible strategies and on the mathematical computation of the optimal methods, paths and combination.

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The carrying out of a research project no longer implies merely the use of intelligence or the simple translation into action of ingenious or clever ideas. It relies on the application of a program very exactly tailored to the definition of the objectives, and on the recourse, at each stage of the program, to the most appropriate methods of analysis and experimental investigation."

On the page following is a "Generalized Decision Making Sequence" that could be used as part of Project Design and Review Procedure

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A GENERALIZED DECISION MAKING SEQUENCE*

1. Statement of Objectives: goal, mission or purpose of organizational unit.
2. Situation Analysis: consideration of relevant past, present and future needs, resources, critical relationships, complementarities, time frames, opportunities, threats, constraints, trends, forecasts, assumptions, principles, policies, etc.
3. Diagnosis of specific problem(s).
4. Design of solution strategy or approach.
5. Identification of alternative solutions.
6. Comparative assessment of alternative solutions.
7. Selection of appropriate solution.
8. Implementation of solution.
9. Evaluation of implementation progress periodically, of final results, and at later post-completion intervals.
10. Feedback of evaluations and recommendations to current operations and to planning of future activities.

Note: Each step has a distinct set of information requirements. Each step also has a set of criteria or standards which may be explicit or implicit in the relevant context. In general, lack of clarity, precision and completeness at any step weakens subsequent steps, thus hindering present and future operations.

*This sequence is applicable to all levels and to all units in an organization. Only the subject, content, scope, purpose, resources, solutions and results will vary between levels, units, and organizations.

5. Technology and Contract Register

In order to control the quality, costs, timeliness, benefits and suitability of technology imported into Mauritania for temporary or permanent use, all such imports and related contracts, licenses, joint-venture agreements, etc., should be registered in a "Technology Register Office (TRO)." The TRO should be located in an appropriate organization or agency such as Ministry or the Mauritania Investment Commission.

Aside from controlling the inflow of suitable technology to Mauritania, the TRO would, in coordination with relevant government offices, laboratories and institutes, be responsible for the analysis, review and assessment of technology transfers or imports before they are completed. Each such review would be intended to assure that Mauritania selects the technology appropriate to local conditions, needs, resources and capabilities so as to optimize the effectiveness, efficiency and economy of the technology chosen.

UNIDO and the ILO have done much work on technology transfer and technological choice that is relevant to Mauritania. The experience of Technology Registers in such countries as Argentina, Brazil and Mexico could be made available to Mauritania through documentation or visits.

. Research and Development Project Register

There should be one central location in Mauritania where records are kept on the planning, initiation, status, completion and results of research and development projects.

Such a Research and Development Project Register (RDPR) would provide a basic control tool for the Government and would be a useful central source of information for planners, researchers and others interested in the development of Mauritania.

The Smithsonian Institution in Washington, D. C., operates an Information Exchange which could serve as a model (SSIE). The U.S. Department of Agriculture also has a "Current Research Information Service (CRIS)" that could be the source of much valuable data on problems similar to those faced in Mauritania. These services could be made available to Mauritania at a modest cost.

7. National Scientific and Technological Information System (NSTIS)

The basis for sound decision making, in science and technology and in all other fields, is adequate information. Unfortunately, Mauritania has suffered from decisions taken on the basis of incomplete, obsolete, inaccurate and biased economic and S&T information (STI). To avoid repetition of such mistakes, improve the quality of future decisions, and serve as the basis for developing its indigenous S&T capability, the Government of Mauritania should create a National Scientific and Technological Information System (NSTIS).

UNESCO's UNISIST program is specifically designed to assist Mauritania in establishing its NSTIS. The RAMS project has a documentation component that should be of assistance in starting the STI system in the agricultural sector. UNIDO has also assisted countries in starting technical information systems for industry and publishes useful series in the field. USAID, with the cooperation of the US National Technical Information Service, also makes available at little or no cost several technical announcement bulletins of direct application to Mauritania. Complete documentation is available in low-cost microfiche format.

Appendix C outlines "An Approach to Solving Scientific and Technical Problems" from the information point of view. It presents a straightforward problem solving sequence and identifies a wide variety of information sources, references, and institutions that could be of use to Mauritania. This is followed by a section which discusses the role of information in the problem solving process.

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8. Science and Technology Monitor Program

In parallel with the development of the National Scientific and Technological Information System (NSTIS), Mauritania should also develop a program for systematically monitoring and evaluating S&T reports, literature, and progress anywhere in the world that is relevant to its needs, problems, resources and opportunities. There is an ever-expanding volume of STI applicable to Mauritania: state-of-the-art surveys, technology assessments, new inventions, technology forecasts, etc., that should be acquired, analyzed and then applied to improve development plans, projects and policies. Qualified S&T personnel in the Ministries and government agencies should be systematically alerted on new STI developments and supplied with STI by the NSTIS. These people should be expected to devote a certain amount of time to review this material, incorporate it into their thinking and current activities, and then pass it on to others who might be able to use it.

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APPENDICES TO PART IV

- A. Outline of Science and Technology Policies by Major Categories
(UNESCO)(SPINES)
 - B. List of Fields in Science and Technology (UNESCO)
 - C. An Approach to Solving Scientific and Technical Problems
 - D. Priority Areas for Further Research and Development (UN and CASTAFRICA,
Dakar, 1974)
 - E. Relative Importance of Science and Technology Disciplines to National
Development (CASTAFRICA, Dakar, 1974)
 - F. "TUPAC AMARU" Government Plan, 1977-1980, Lima, Peru, Supreme Decree
No. 020-77-PM, 4 October 1977
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Appendix A: Outline of Science and Technology Policies by Major Categories
(UNESCO) (SPINES*)

"Science and Technology Policies:

NATIONAL SCIENCE AND TECHNOLOGY POLICIES: Science, technology and public policy. Institutions and mechanisms for governmental policy-making in S&T. Planning, programming and budgeting of R&D at the national level.

FORECASTING AND ASSESSMENT OF SCIENCE AND TECHNOLOGY: Forecasting of scientific breakthroughs. Normative and exploratory technological forecasting. Futurology. Assessment of significance and effects of new technologies.

TRANSFER AND IMPLANTATION OF TECHNOLOGIES: Horizontal and vertical transfer of technology. Implantation policies of new technologies. Patents and licences. Innovation and extension services. Propagation and fixation of new technologies. International aspects of technology transfer.

INTERNATIONAL SCIENCE AND TECHNOLOGY CO-OPERATION: International science policy studies. Organizational forms and operational methods of S&T co-operation and assistance at regional and world levels. International scientific unions. International scientific events conferences, prizes, etc. International co-operative research programmes. International scientific services. Bi-lateral arrangements.

*(From SPINES: International system for the exchange of information on science and technology for policy making, management and development, p. 74-6, UNESCO Doc. No. 33, Science policy studies and documents. 1974)

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LEGISLATION IN SCIENCE AND TECHNOLOGY: Legal status of the scientific workers, the scientific organizations, the scientific communities. Legal problems emerging from modern science and from new technologies or modifications of existing ones. Legal aspects of the vertical and horizontal transfer of technology. Legislation of patents and patents application.

SCIENCE AND SOCIETY: Functions of science and technology in contemporary society. Social impact and human implications of scientific advances and new technologies. Public understanding of and attitudes towards S&T. Out-of-school science education. Role of the mass media."

"Planning of Sectorial R&D Policies:

SECTORIAL R&D POLICIES: Institutions and mechanisms for the promotion of sectorial R&D. Methods for the planning, programming, and budgeting of of sectorial R&D.

AGRICULTURAL R&D POLICY: Agriculture, food, fisheries, veterinary sciences, etc.

MEDICAL R&D POLICY: Human biology and medicine, health, pharmaceuticals, public health, etc.

TECHNOLOGICAL R&D POLICY: Extractive industries. Manufacturing industries. Transport and telecommunications. Building and construction. Fuel, power and nuclear energy.

ENVIRONMENTAL R&D POLICY: Land, water, atmosphere, the seas, etc.

SPACE R&D POLICY: Satellites, missiles, space communications, etc.

DEFENCE R&D POLICY: Traditional weapons, nuclear weapons, biological and chemical weapons, etc.

SOCIO-ECONOMIC AND CULTURAL R&D POLICY: Housing, labour and employment. Mass communications. Trade, banking and finance. Leisure, tourism, etc.

OTHER"

Science and Technology Resources;

"ORGANIZATION AND MANAGEMENT OF R&D: Types of research. Characteristics and profiles of research institutions. Efficiency of research. R&D management methods. Selection and scheduling of research projects. Selection and career development of research workers.

R&D EQUIPMENT: R&D facilities, equipment, instrumentation and standards. Manufacture and maintenance of scientific equipment. Import/export of R&D equipment.

SCIENTIFIC AND TECHNOLOGICAL INFORMATION: S&T information policies. Institutional base for the information transfer process. Compatibility of S&T information systems. Training of information manpower. Communication between scientific workers, scientific meetings.

ECONOMICS OF SCIENCE AND TECHNOLOGY - FINANCING OF R&D; S&T as direct forces of production. Effectiveness of R&D. Connection between R&D operations and full scale production. Methods and procedures of R&D financing.

HUMAN RESOURCES FOR SCIENCE AND TECHNOLOGY; Relations between science planning and the planning of education. Supply and demand of S&T personnel. Content of S&T education. Training of research workers.

Appendix B: List of Fields in Science and Technology (UNESCO)*

The six pages which follow identify, in both French and English, the fields of science and technology in three basic groupings:

- A) 10 fields of discipline oriented R&D (138 sub-fields)
- B) 17 fields of mission oriented R&D (179 sub-fields)
- C) 5 fields of scientific and technological public services (STS- 62 sub-fields)

This comprehensive list of 32 fields and 379 sub-fields can be used in several ways:

- to identify areas for specific policy formation;
- to allocate fields of S&T to specific Ministries, institutions, agencies, etc.
- to identify gaps and needs in S&T, especially in STS, scientific and technological public services; and
- to otherwise assist in the management of S&T activities in Mauritania.

*P. 213-17, "Science and Technology in African Development," No. 35 Science Policy and Studies and Documents, 1974 Dakar Conference (CASTAFRICA), UNESCO, Paris 1974.

Section 1. LIST OF FIELDS INCLUDED IN THE MATRIXES

Table 1. List-of fields of discipline-oriented R & D

A. 1. MATHEMATICAL SCIENCES	A. 5. EARTH AND SPACE SCIENCES
1 Algebra	1 Astronomy, Astrophysics
2 Analysis and functional analysis	2 Atmospheric sciences
3 Applied mathematics	3 Climatology
4 Computer science	4 Ecology
5 Geometry	5 Geochemistry
6 Logic	6 Geodesy
7 Number theory	7 Geology
8 Numerical analysis	8 Geophysics
9 Operations research	9 Gravity, Magnetism
10 Probability	10 Hydrology and Hydrobiology
11 Statistics (general)	11 Oceanography
12 Topology	12 Paleontology
	13 Pedology
A. 2. PHYSICAL SCIENCES	14 Seismology
1 Acoustics	15 Vulcanology
2 Crystallography	A. 6. ENGINEERING SCIENCES
3 Electricity and Magnetism	1 Chemical engineering
4 Electronics	2 Civil engineering
5 Fluid mechanics	3 Construction engineering
6 Mechanics	4 Corrosion and preservation engineering
7 Metallography	5 Electrical engineering
8 Nuclear physics	6 Electronics engineering
9 Optics	7 Hydraulics engineering
10 Solid mechanics	8 Industrial engineering
11 States of matter	9 Materials engineering
12 Theoretical physics	10 Mechanical engineering
13 Thermal physics	11 Metallurgical engineering
A. 3. CHEMICAL SCIENCES	12 Nuclear engineering
1 Analytical chemistry	13 Petroleum engineering
2 Inorganic chemistry	14 Processing engineering
3 Macromolecular chemistry	15 Sanitary and pollution engineering
4 Nuclear chemistry	16 Telecommunications engineering
5 Organic chemistry	17 Transportation engineering
6 Physical chemistry	18 Welding engineering
A. 4. BIOLOGICAL SCIENCES	A. 7. AGRICULTURAL SCIENCES
1 Botany	1 Agronomy (general)
2 Biology (general)	2 Agro-climatology
3 Biochemistry, Molecular biology	3 Agro-ecology
4 Biophysics	4 Animal breeding
5 Cell biology	5 Animal pathology
6 Entomology	6 Animal physiology
7 Genetics	7 Agricultural entomology
8 Microbiology	
9 Physiology (general)	
10 Radiobiology	
11 Zoology	

Section 1. LISTE DES DOMAINES MENTIONNES DANS LES MATRICES

Tableau 1. Liste des domaines de la R & D orientée-discipline

A. 1. SCIENCES MATHÉMATIQUES	A. 5. SCIENCES DE LA TERRE ET DE L'ESPACE
1 Algèbre	1 Astronomie, astrophysique
2 Analyse et analyse fonctionnelle	2 Sciences de l'atmosphère
3 Mathématiques appliquées	3 Climatology
4 Informatique	4 Ecologie
5 Géométrie	5 Géochimie
6 Logique	6 Géodésie
7 Théorie des nombres	7 Géologie
8 Analyse numérique	8 Géophysique
9 Recherche opérationnelle	9 Gravité, magnétisme
10 Calcul des probabilités	10 Hydrologie et hydrobiologie
11 Statistique (générale)	11 Océanographie
12 Topologie	12 Paléontologie
	13 Pédologie
A. 2. SCIENCES PHYSIQUES	14 Sismologie
1 Acoustique	15 Vulcanologie
2 Cristallographie	A. 6. INGENIERIE
3 Electricité et Magnétisme	1 Génie chimique
4 Electronique	2 Génie civil
5 Mécanique des fluides	3 Génie des constructions et des techniques de préservation
6 Mécanique	4 Génie de la corrosion et des techniques de préservation
7 Métallographie	5 Electrotechnique
8 Physique nucléaire	6 Génie électronique
9 Optique	7 Génie hydraulique
10 Mécanique des solides	8 Génie industriel
11 Etats de la matière	9 Génie des matériaux
12 Physique théorique	10 Génie mécanique
13 Physique thermique	11 Génie métallurgique
A. 3. SCIENCES CHIMIQUES	12 Génie atomique
1 Chimie analytique	13 Génie pétrolier
2 Chimie inorganique	14 Génie des procédés de transformation
3 Chimie macromoléculaire	15 Génie sanitaire et anti-pollution
4 Chimie nucléaire	16 Génie des télécommunications
5 Chimie organique	17 Génie des transports
6 Chimie physique	18 Génie de la soudure
A. 4. SCIENCES BIOLOGIQUES	A. 7. SCIENCES AGRICOLES
1 Botanique	1 Agronomie (générale)
2 Biologie générale	2 Climatologie agricole
3 Biochimie, biologie moléculaire	3 Ecologie agricole
4 Biophysique	4 Elevage
5 Biologie cellulaire	5 Pathologie animale
6 Entomologie	6 Physiologie animale
7 Génétique	7 Entomologie agricole
8 Microbiologie	8 Hydrologie agricole
9 Physiologie (générale)	9 Science alimentaire
10 Radio-biologie	10 Horticulture
11 Zoologie	

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Table 1 (continued)

8 Agricultural hydrology	7 Economic theory
9 Food science	8 Home economics
10 Horticulture	9 Income distribution
11 Phytopathology	10 International economics
12 Plant breeding	11 Labour economics
13 Plant physiology	12 Monetary and fiscal theory, credit and banking
14 Pisciculture	13 National economic accounting
15 Sylviculture	14 Organization of Production
A. 8. MEDICAL SCIENCES	15 Price and Markets
1 Anatomy	16 Public economy
2 Bacteriology	17 Rural and urban economics
3 Clinical genetics	18 Sectorial economics (Agricultural, Industrial Education, R & D, etc.)
4 Epidemiology	A. 10. HUMAN AND SOCIAL SCIENCES
5 Human biology and anthropology	1 Archaeology
6 Immunology	2 Architecture
7 Internal medicine	3 Behavioural sciences, ethology
8 Nutrition	4 Cultural/Social anthropology
9 Pathology	5 Demography and Population
10 Pharmacology. Chemotherapy	6 Ethnology
11 Physiology (human)	7 History
12 Psychiatry Psychotherapy	8 Law
13 Surgery	9 Linguistics
14 Toxicology	10 Pedagogy
15 Virology	11 Philology
A. 9. ECONOMIC SCIENCES	12 Political science
1 Business economics and management	13 Psychology
2 Consumption, savings and investment	14 Rural sociology, Land reform
3 Econometry	15 Sociology
4 Economic history	
5 Economic statistics	
6 Economic systems development and planning	

Table 2. List of fields of mission-oriented R & D

B. 1. AGRICULTURE	9 Natural pesticides
1 Agricultural mechanics and engineering	10 Pasture management
2 Crop production	11 Pest control
3 Crop protection	12 Savannah management
4 Crop processing	13 Soil management
5 Crop storage and preservation	14 Weed control
6 Farm construction, equipment and management	B. 2. FORESTRY
7 Fertilizer utilization	1 Forest conservation
8 Irrigation and drainage	2 Forest exploitation
	3 Forest products
	4 Forest protection

Tableau 1 (suite)

11 Phytopathologie	8 Economie ménagère
12 Sélection végétale	9 Répartition des revenus
13 Phytobiologie	10 Economie internationale
14 Pisciculture	11 Economie du travail
15 Sylviculture	12 Théorie monétaire et fiscale, crédit et banque
A. 8. SCIENCES MEDICALES	13 Comptabilité nationale
1 Anatomie	14 Organisation de la production
2 Bactériologie	15 Prix et marchés
3 Génétique clinique	16 Economie publique
4 Epidémiologie	17 Economie rurale et urbaine
5 Biologie et anthropologie humaines	18 Economie sectorielle (agriculture, industrie, éducation, recherche et développement, etc.)
6 Immunologie	A. 10. SCIENCES HUMAINES ET SOCIALES
7 Médecine interne	1 Archéologie
8 Nutrition	2 Architecture
9 Pathologie	3 Sciences du comportement éthologie
10 Pharmacologie, chimiothérapie	4 Anthropologie culturelle et sociale
11 Physiologie (humaine)	5 Démographie et population
12 Psychiatrie, psychothérapie	6 Ethnologie
13 Chirurgie	7 Histoire
14 Toxicologie	8 Droit
15 Virologie	9 Linguistique
A. 9. SCIENCES ECONOMIQUES	10 Pédagogie
1 Economie et gestion de l'entreprise	11 Philologie
2 Consommation, épargne et investissement	12 Science politique
3 Econométrie	13 Psychologie
4 Histoire économique	14 Sociologie rurale, réforme agraire
5 Statistique économique	15 Sociologie
6 Systèmes économiques, développement et planification	
7 Théorie économique	

Tableau 2. Liste des domaines de la R & D orientée-mission

B. 1. AGRICULTURE	8 Irrigation et drainage
1 Mécanique et génie agricoles	9 Pesticides naturels
2 Production agricole	10 Exploitation rationnelle des pâturages
3 Protection des cultures	11 Lutte contre les animaux nuisibles
4 Transformation des produits agricoles	12 Mise en valeur de la savane
5 Stockage et préservation des produits agricoles	13 Utilisation rationnelle du sol
6 Construction, équipement et entretien des locaux à usage agricole	14 Lutte contre les mauvaises herbes
7 Utilisation des engrais	

Table 2 (continued)

D. 3. ANIMAL HUSBANDRY

- 1 Animal health and disease control
- 2 Animal production
- 3 Animal products
- 4 Animal reproduction
- 5 Animal selection

B. 4. FISHERIES AND WILDLIFE

- 1 Fish finding
- 2 Fish farming
- 3 Fish preservation
- 4 Fish processing
- 5 Fishing boats and gear
- 6 Wild-life conservation and management

B. 5. FOOD, DRINKS AND TOBACCO INDUSTRIES

- 1 Alcoholic beverages
- 2 Animal feed
- 3 Dairy products
- 4 Edible oils and fats
- 5 Flour, starch and sugar
- 6 Food additives
- 7 Food processing, canning and conservation
- 8 Non-alcoholic beverages
- 9 Protein-food (meat, fish, eggs)
- 10 Tobacco

B. 6. CLOTHING AND FOOTWEAR INDUSTRIES

- 1 Footwear industry
- 2 Furs
- 3 Precious stones : jewelry
- 4 Textile industry
- 5 Wearing apparel

B. 7. MINERAL RESOURCES INDUSTRIES

- 1 Coal mining
- 2 Natural gas production
- 3 Crude petroleum production
- 4 Metal ore mining
- 5 Mining of crude chemicals
- 6 Oil shale
- 7 Quarry products
- 8 Uranium and radio active ores

B. 8. MATERIALS INDUSTRIES

- 1 Aggregates
- 2 Artificial stones
- 3 Asbestos
- 4 Bituminous binders
- 5 Carbon, graphite
- 6 Ceramics
- 7 Cement and hydraulic lime
- 8 Cork
- 9 Glass and glass products
- 10 Iron and steel
- 11 Leather
- 12 Natural fibres
- 13 Natural stone
- 14 Non-ferrous metals
- 15 Paper and paper products
- 16 Paints and varnishes
- 17 Plasters
- 18 Plastic materials
- 19 Rubber and rubber products
- 20 Semi-conductors
- 21 Synthetic polymer fibres and elastomers
- 22 Textiles
- 23 Wood and wood products
- 24 Water-repellent coatings

B. 9. CHEMICAL INDUSTRIES-INORGANIC

- 1 Alkaline elements and alkaline earths
- 2 Boron and silicon compounds
- 3 Carbon and carbon products
- 4 Fertilizer production
- 5 Hydrogen, and hydrides
- 6 Metallic salts
- 7 Non-metals (halogen, oxygen and nitrogen families)
- 8 Organo-metallic compounds
- 9 Phosphorus products
- 10 Pigments
- 11 Sulphur products

B. 10. CHEMICAL INDUSTRIES-ORGANIC

- 1 Adhesives
- 2 Detergents, soaps
- 3 Dyestuffs
- 4 High polymers
- 5 Intermediates and solvents

Tableau 2 (suite)

B. 2. SYLVICULTURE

- 1 Conservation des forêts
- 2 Exploitation forestière
- 3 Produits forestiers
- 4 Protection des forêts

B. 3. ZOOTECHNIE

- 1 Hygiène animale et lutte contre les maladies
- 2 Production animale
- 3 Produits animaux
- 4 Reproduction animale
- 5 Sélection animale

B. 4. PECHERIES, FAUNE ET FLORE SAUVAGES

- 1 Pêche
- 2 Pisciculture
- 3 Préservation des poissons
- 4 Transformation du poisson
- 5 Embarcations et matériel de pêche
- 6 Préservation de la faune et de la flore sauvage

B. 5. INDUSTRIE ALIMENTAIRE, BOISSONS ET TABAC

- 1 Boissons alcoolisées
- 2 Alimentation animale
- 3 Produits laitiers
- 4 Huiles et graisses comestibles
- 5 Farine, amidon et sucre
- 6 Additifs alimentaires
- 7 Transformation, mise en boîtes et conservation des produits alimentaires
- 8 Boissons non alcoolisées
- 9 Produits alimentaires protéinés (viande, poisson, oeufs)
- 10 Tabac

B. 6. INDUSTRIES DE L'HABILLEMENT ET DE LA CHAUSSURE

- 1 Industrie de la chaussure
- 2 Fourrures
- 3 Pierres précieuses, joaillerie
- 4 Industrie textile
- 5 Vêtements

B. 7. INDUSTRIES MINIERES

- 1 Extraction du charbon
- 2 Production du gaz naturel
- 3 Production du pétrole brut

B. 8. INDUSTRIES DE MATERIAUX

- 1 Agrégats
- 2 Pierre artificielle
- 3 Amiante
- 4 Liants bitumineux
- 5 Carbone, graphite
- 6 Céramique
- 7 Ciment et chaux hydraulique
- 8 Liège
- 9 Verre et produits en verre
- 10 Fer et acier
- 11 Cuir
- 12 Fibres naturelles
- 13 Pierre naturelle
- 14 Métaux non ferreux
- 15 Papier et produits en papier
- 16 Peintures et vernis
- 17 Plâtre
- 18 Matières plastiques
- 19 Caoutchouc et produits caoutchoutés
- 20 Semi-conducteurs
- 21 Fibres synthétiques polymères et élastomères
- 22 Textiles
- 23 Bois et produits en bois
- 24 Revêtements hydrofuges

B. 9. INDUSTRIES CHIMIQUES (PRODUITS MINERAUX)

- 1 Eléments alcalins et terres alcalines
- 2 Composés de bore et composés siliceux
- 3 Carbone et produits dérivés
- 4 Production d'engrais
- 5 Hydrogène et hydrures
- 6 Sels métalliques

B. 4. Extraction de minerais métalliques

5. Extraction de produits chimiques bruts

6. Extraction de schistes bitumineux

7. Exploitation de carrières

8. Uranium et minerais radioactifs

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Table 2 (continued)

6 Monomers	5 Pipes, fittings and valves
7 Petrochemicals	6 Pressure vessels
8 Pharmaceuticals	7 Sheet-metal products
9 Photographic products	8 Stampings
10 Synthetic pesticides	9 Wire products
11 Terpenes and essential oils	
B. 11. ELECTRO-MECHANICAL INDUSTRIES	B. 13. OPTICAL AND INSTRUMENTATION INDUSTRIES
1 Air compressors and gas handling equipment	1 Laboratory and scientific apparatus
2 Air conditioning equipment	2 Measuring and control instruments
3 Bearings	3 Optical instruments and lenses
4 Business and office equipment	4 Photographic equipment
5 Distilling equipment	5 Watches and clocks
6 Electric power transmission and distribution equipment	
7 Furnaces, heating equipment	B. 14. ELECTRONICS AND TELECOMMUNICATIONS INDUSTRIES
8 Gears	1 Computer industry
9 Grinding and size reduction equipment	2 Electron tubes
10 Household appliances	3 Integrated circuits
11 Hydraulic machinery	4 Lasers
12 Illumination equipment	5 Microwave links
13 Internal combustion engines	6 Radar
14 Industrial machinery and equipment	7 Radio and TV receivers
15 Machine tools	8 Radio and TV transmitters recorders
16 Materials handling machinery	9 Satellite communication devices
17 Mining machinery	10 Semiconductor devices
18 Nuclear power reactors	11 Sonar
19 Pneumatic equipment	12 Sonic and ultrasonic devices
20 Power generators	13 Telephone
21 Printing and duplicating machinery	14 X-Ray devices
22 Refrigerating equipment	B. 15. FUEL AND POWER INDUSTRIES
23 Rotating machinery	1 Coal processing industry
24 Textile machinery	2 Coking and gas industry
25 Turbines	3 Fuel cells
	4 Geothermal energy
B. 12. METAL FABRICATED PRODUCTS	5 Hydro-electric energy
1 Boilers	6 Nuclear energy
2 Cans and containers	7 Nuclear fuel and fuel elements; moderators
3 Electro-plated and coated products	8 Petroleum refineries
4 Machined and turned products	

Tableau 2 (suite)

7 Métalloïdes (familles du chlore, de l'oxygène et de l'azote)	18 Réacteurs nucléaires
8 Composés organo-métalliques	19 Equipement pneumatique
9 Produits phosphorés	20 Générateurs électriques
10 Pigments	21 Matériel d'imprimerie et de reproduction
11 Produits sulfurés	22 Matériel frigorifique
	23 Machines tournantes
B. 10. INDUSTRIES CHIMIQUES (PRODUITS ORGANIQUES)	24 Machines textiles
1 Adhésifs	25 Turbines
2 Détergents, savons	B. 12. FABRICATION DE PRODUITS EN METAL
3 Teintures	1 Chaudières
4 Hauts polymères	2 Réservoirs et conteneurs
5 Intermédiaires et solvants	3 Produits plaqués et galvanisés
6 Monomères	4 Produits usinés et tournés
7 Produits pétrochimiques	5 Tuyaux, raccords, et soupapes
8 Produits pharmaceutiques	6 Réservoirs et vaisseaux pressurisés
9 Produits pour la photographie	7 Produits métalliques en feuilles
10 Pesticides synthétiques	8 Pièces embouties
11 Terpènes et huiles essentielles	9 Produits tréfilés
B. 11. INDUSTRIES MECA NIQUES ET ELECTRIQUES	B. 13. OPTIQUE ET INSTRUMENTS
1 Compresseurs d'air et matériel pour la manipulation des gaz	1 Matériel de laboratoire et appareils scientifiques
2 Matériel de climatisation	2 Instruments de mesure et de contrôle
3 Paliers de roulements	3 Instruments optiques et lentilles
4 Equipement pour les entreprises et matériel de bureau	4 Matériel photographique
5 Matériel de distillation	5 Horlogerie
6 Matériel pour le transport et la distribution de l'énergie électrique	B. 14. ELECTRONIQUE ET TELECOMMUNICATIONS
7 Fours, matériel de chauffage	1 Ordinateurs
8 Engrenages	2 Tubes électroniques
9 Moulins et broyeurs	3 Circuits intégrés
10 Appareils ménagers	4 Lasers
11 Machines hydrauliques	5 Liaisons par micro-ondes
12 Matériel d'éclairage	6 Radar
13 Moteurs à combustion interne	7 Récepteurs de radio et de télévision
14 Matériel et équipement industriel	8 Emetteurs de radio et de télévision
15 Machines-outils	9 Communication par satellites
16 Appareils de manutention	10 Matériel à semi-conducteurs
17 Equipements miniers	11 Sonar
	12 Dispositifs soniques et ultrasoniques

Table 2 (continued)

9 Solar energy	8 Transport equipment
10 Thermochemical energy (fuels and combustion)	B. 17. BUILDING AND CONSTRUCTION INDUSTRIES
11 Tidal energy	1 Airport construction
12 Wind energy	2 Housing
B. 16. TRANSPORTATION INDUSTRIES	3 Inland waterways
1 Aeronautical industry	4 Port facilities
2 Automotive industry	5 Railways
3 Fuel distribution	6 Roads, bridges, etc.
4 Hover craft	7 Schools, hospitals and other public buildings
5 Pipelines	8 Tunnels and under- ground works
6 Railway rolling stock	
7 Shipbuilding and repair	

Table 3. List of fields for scientific and technological public service

C. 1. NATURAL RESOURCES AND ENVIRONMENT SERVICES	C. 2. SCIENTIFIC AND TECHNOLOGICAL INFORMATION AND DOCUMENTATION SERVICES
1 Astronomical services	1 Abstract journals
2 Energy services	2 Centres for Scientific and Technological Documentation
3 Cartography and photogrammetry services	3 Conference centres
4 Biometrical services	4 Industrial information centres
5 Geological survey services	5 Information processing services
6 Hydrological services	6 Libraries of sciences and technology
7 Integrated land systems surveys	7 Patent offices
8 Marine and fisheries services	8 Scientific journals
9 Meteorology services	9 Statistical analysis services and data banks
10 Mining services	10 Technology transfer centres
11 Scientific mapping services	C. 3. SCIENTIFIC MUSEUMS AND COLLECTIONS
12 Soil science services	1 Anthropological collections
13 Time services	
14 Vulcanological services	
15 Water supply services	
16 Wildlife conservation services	

Tableau 2 (suite)

13 Téléphone	B. 16. TRANSPORTS
14 Appareils à rayon-X	1 Industrie aéronautique
B. 15. COMBUSTIBLES ET ENERGIE	2 Industrie automobile
1 Industrie de transformation du charbon	3 Distribution du carburant
2 Production de coke et de gaz	4 Aéroglisseurs
3 Piles à combustible	5 Pipelines
4 Energie géothermique	6 Matériel ferroviaire roulant
5 Energie hydroélectrique	7 Construction et réparation des navires
6 Energie nucléaire	8 Matériel de transport
7 Combustible et éléments de combustible nucléaires modérateurs	B. 17. BATIMENT ET CONSTRUCTION
8 Raffineries de pétrole	1 Construction d'aéroports
9 Energie solaire	2 Construction de logements
10 Energie thermo-chimique (combustibles et combustion)	3 Voies d'eau intérieures
11 Energie marémotrice	4 Installations portuaires
12 Energie éolienne	5 Chemins de fer
	6 Routes, ponts, etc.
	7 Ecoles, hôpitaux et autres bâtiments publics
	8 Tunnels et ouvrages souterrains

Tableau 3. Liste des domaines intéressant la création de services publics scientifiques et technologiques

C. 1. SERVICES CONCERNANT LES RESSOURCES NATURELLES ET L'ENVIRONNEMENT	16 Services intéressant la préservation de la faune et de la flore sauvages
1 Services astronomiques	C. 2. SERVICES D'INFORMATION ET DE DOCUMENTATION SCIENTIFIQUES ET TECHNIQUES
2 Services intéressant l'énergie	1 Bulletins de résumés
3 Services de cartographie et de photogrammétrie	2 Centres de documentation scientifique et technique
4 Services biométriques	3 Centres de conférences
5 Services d'études géologiques	4 Centres d'information industrielle
6 Services hydrologiques	5 Services de traitement de l'information
7 Services d'études intégrées de systèmes d'exploitation des terres	6 Bibliothèques scientifiques et techniques
8 Services maritimes et ichtyologiques	7 Bureaux de dépôt des brevets
9 Services météorologiques	8 Revues scientifiques
10 Services miniers	9 Services d'analyse statistique et banques de données
11 Services de cartographie scientifique	10 Centres de transfert de technologie
12 Services de pédologie	
13 Services de l'heure	
14 Services de vulcanologie	
15 Services d'approvisionnement en eau	

Table 3 (continued)

- 2 Archaeological collections
- 3 Botanical collections
- 4 Entomological collections
- 5 Geological collections
- 6 Science museums
- 7 Technology museums
- 8 Travelling exhibitions for science and technology
- 9 Zoological collections
- C. 4. *STANDARDS, NORMS INSTRUMENTATION QUALITY CONTROL*
- 1 Biochemical control laboratories
- 2 Biological control laboratories
- 3 Bureaux of standards
- 4 Centres for scientific instruments manufacture maintenance and repair
- 5 Chemical control laboratories
- 6 Chemical analysis services
- 7 Drug control laboratories
- 8 Food control laboratories
- 9 Metrology services
- 10 Specification and norms services
- 11 Testing of materials (resistance and properties)
- 12 Water control laboratories
- C. 5. *EXTENSION AND INNOVATION SERVICES*
- 1 Agricultural extension services
- 2 Computation centres
- 3 Educational techniques services
- 4 Forestry services
- 5 Land-use development services
- 6 Livestock services
- 7 Nutrition services
- 8 Pest control services
- 9 Public health services
- 10 Rural engineering services
- 11 Sanitation services
- 12 Technological innovation services
- 13 University polyclinics
- 14 Veterinary services
- 15 Weather control services

Tableau 3 (suite)

- C. 3. *MUSEES ET COLLECTIONS SCIENTIFIQUES*
- 1 Collections anthropologiques
- 2 Collections archéologiques
- 3 Collections botaniques
- 4 Collections entomologiques
- 5 Collection géologique
- 6 Musées scientifiques
- 7 Musées techniques
- 8 Expositions scientifiques et techniques itinérantes
- 9 Collections zoologiques
- C. 4. *ETALONS, NORMES, INSTRUMENTS, CONTROLE DE QUALITE*
- 1 Laboratoires de contrôle biochimique
- 2 Laboratoires de contrôle biologique
- 3 Bureau des normes et étalons
- 4 Centres pour la fabrication, l'entretien et la réparation des instruments scientifiques
- 5 Laboratoires de contrôle chimique
- 6 Services d'analyse chimique
- 7 Laboratoires de contrôle des médicaments
- 8 Laboratoires de contrôle des aliments
- 9 Services de métrologie
- 10 Services de spécification et de normalisation
- 11 Laboratoires d'essais des matériaux (résistance et propriétés)
- 12 Laboratoires de contrôle de l'eau
- C. 5. *SERVICES DE VULGARISATION ET D'INNOVATION*
- 1 Services de vulgarisation agricole
- 2 Centres de calcul
- 3 Services relatifs aux techniques d'éducation
- 4 Services des forêts
- 5 Services concernant le développement de l'utilisation du sol
- 6 Services concernant l'élevage
- 7 Services concernant l'alimentation
- 8 Services de lutte contre les animaux nuisibles
- 9 Services d'hygiène publique
- 10 Services du génie rural
- 11 Services sanitaires
- 12 Services d'innovation technologique
- 13 Polyclinique universitaire
- 14 Services vétérinaires
- 15 Services de lutte contre les intempéries

Appendix C: An Approach to Solving Scientific and Technical Problems

To find solutions to well defined technical problems, we have three tasks.

We have to determine:

1. What organizations have expertise in the problem area;
2. Who are the men working in the problem area; and
3. What results of their work are available.

In practice, the search for these three kinds of information is often conducted simultaneously. Representative sources to be contacted, and a general approach to answering the above questions, are outlined below:

1. What organizations have expertise in the problem area?

A. Directories of Organizations

1. Thomas' Register of U.S. Manufacturerers
2. Engineering College Research and Graduate Study - Annual Directory (ASEE)
3. Industrial Research Laboratories in U.S. (Bowker)
4. Directory of Research Centers (Gale)
5. Directory of Information Resources in the U.S. - Physical Sciences, Engineering (Library of Congress)
6. Directory of Associations (Gale)
7. European Research Index (Hodgson - U.K.)
8. World Register of Production Engineering Research (OECD)
9. Standard Periodical Directory (Oxbridge)

10. Guide to American Directories (Klein)
11. Ulrich's International Periodicals Directory (Bowker)
12. The World of Learning (EUROPA)
13. International Bibliography of Directories (Bowker)
14. Directory of Scientific Directories (Hodgson)
15. Guide to European Sources of Technical Information (Hodgson)
16. Scandinavian Research Guide (Almquist & Wicksell-Stockholm)
17. Directory of European Associations (CBD-UK)
18. European Companies - A Guide to Sources of Information
(CBD-UK)
19. Kelly's Manufacturers & Merchants Directory (of the world - UK)

B. Services Agencies who can supply information on relevant Organizations

1. National Referral Center
Science and Technology Division
Library of Congress, Washington, D. C.
2. Science Information Exchange
Smithsonian Institution
Washington, D. C.
3. National Technical Information Service
U. S. Department of Commerce
Washington, D. C.
4. UNIDO
5. OECD
6. Information Services in England, Denmark, Norway, Korea, India,
Japan, etc. can also supply useful information. (See A.7, 14, 15
above.)

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C. Current newspapers, newsletters, and technical and trade journals can also supply leads to relevant organizations, both the text and the advertisements.

2. Who are the men working in the subject area?

A. The name of many of these men will be learned by contacting the organizations identified in 1 above and from the indexes and abstracts listed in 3 below.

B. Other leads to key people may be found by following up leads found in:

1. Current Index to Conference Papers in Engineering (Crowell-Collier Macmillan, New York)
2. Calls for Papers (CCM)
3. World Meetings (CCM, Special Library Association, etc.)
4. Science Citation Index and related publications of the Institute for Scientific Information (Philadelphia) (ISI)

C. Personal contact with men working in the field is desirable for several reasons:

1. To obtain unpublished information, to be ahead of competition.
2. To get a quick feel for the "state of the art" and trends.
3. To learn who else is doing what in the field (for later follow-up and cross-checking of information).
4. To find out when and where the next important meetings in the field will take place.

5. To find out what the most important recent publications are, or are about to be. (These are probably not yet indexed or referenced.)
6. To establish a long term relationship with the man and his organization.

3. What Results of their Work are Available?

- A. From personal contacts, unpublished data and reports may be obtained, as well as new material that has not yet been published, referenced, or indexed (leads thereto).
- B. Search published technical indexes by subject field, author, or organization. A few such English language indexes are:

General

1. Engineering Index Monthly
2. Applied Sciences and Technology Index
3. PANDEX - Current Index to Scientific and Technical Literature
4. U.S. Government Reports Announcements and Index
5. Business Periodical Index
6. British Technology Index
7. Patent Registers

Specialized

1. Chemical Abstracts
2. Computer and Control Abstracts
3. Electronics Abstracts Journal
4. Metals Abstracts

5. Petroleum Abstracts
6. Scientific and Technical Aerospace - Reports (NASA)
7. Solid State Abstracts
8. Food Science and Technology Abstracts

C. "Current Contents - Engineering and Technology"

This publication covers 900 journals and reproduces their Tables of Contents. It is issued weekly and all journals are covered cyclically. If an article listed is of interest, a full copy can be obtained on request. (ISI)

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THE ROLE OF INFORMATION IN THE PROBLEM SOLVING PROCESS

1. The critical role of information in the problem solving process is illustrated in the diagram on the following page which includes six elements - the problem-situation itself and five action steps:
 1. Diagnosis of problem
 2. Design of problem solution strategy
 3. Acquisition of information
 4. Analysis of information
 5. Adaptation and application of information

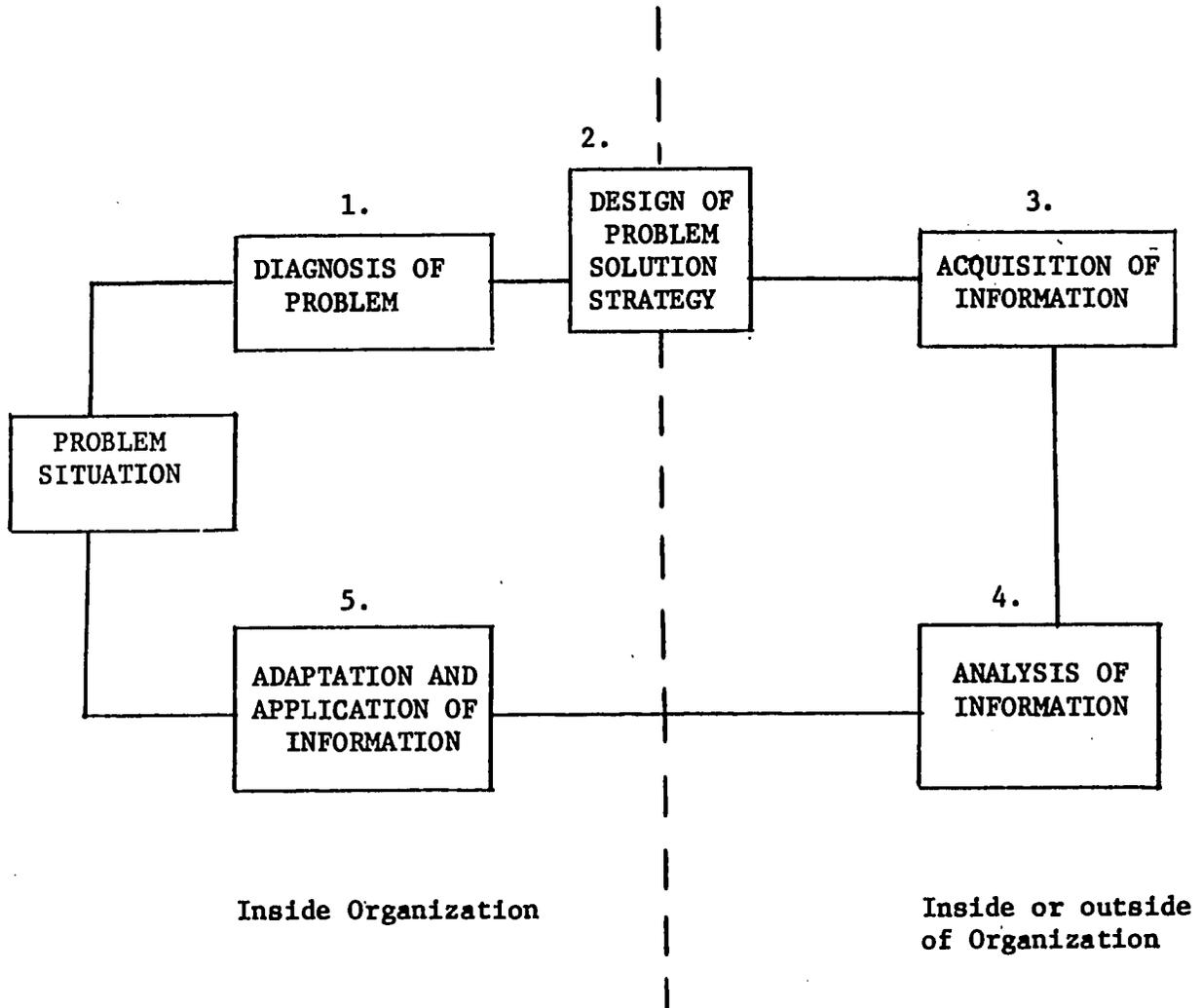
2. The line which connects the six elements indicates the flow of problem solving information in both directions on an iterative basis as required until the problem is solved. The vertical line indicates a possible organizational boundary. Depending on the size, staffing, and resources of an organization, the five action steps may take place within the organization, or steps 2, 3, and 4 may be executed outside the organization through the use of consultants, advisory services, data banks, etc. Action steps 1 (Diagnosis) and 5 (Adaptation and application of information) must take place within the organizational problem situation context.

3. The sequence of action from diagnosis through adaptation and application of information to resolve a given problem situation requires different skills and involves different types of information in each step.

4. The correct diagnosis of a problem is the key element in the sequence.

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ROLE OF INFORMATION IN THE PROBLEM SOLVING PROCESS



Solid line indicates flow of information in both directions.

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If the diagnosis is incorrect, all subsequent actions are irrelevant and wasted. You may have answers, but they won't help solve the problem at hand.

5. The development of diagnostic problem solving skills requires education, training and experience at all organizational levels - mechanics, clerks, supervisors, managers and policy makers. And at each level and for each problem, the diagnostician brings a distinct store of knowledge (information) to bear on the situation. It should be noted that the kind of information needed to properly diagnose a problem situation may be quite different from the kind of information needed to design a problem solution strategy.
6. Once the problem has been clearly identified in its situational context, one proceeds to Step 2: Design of Problem Solution Strategy. This step generates alternative approaches to solving the problem consistent with the over-all problem situation - objectives, resource availabilities, constraints, time-frames, assumptions, etc.
7. In the course of design of the problem solution strategy, it may be necessary to reconsider the diagnosis and to re-appraise the problem, as well as the situation, which may have changed. Such a reiteration may be required several times before the final strategy is determined, as the bi-directional flow of information is indicated in the diagram.
8. The person who designs the problem solution strategy may or may not be

the same one who did the diagnosis and may or may not be inside the organization having the problem. And he depends on a different set of skills and information than the diagnostician. He must know how to solve the problem, what solutions are relevant, feasible and appropriate, what specific information is required, where to go for it and how to get it. After all, you do not want to suggest searching for an \$800,000 process if only \$100,000 is available for investment, or methods for manufacturing a \$5.00 product when the competitive price is \$2.00. This step also identifies, directly or indirectly, the information needs. This brings us to Step 3: Acquisition of Information.

9. Large organizations often have the information required to solve a specific problem available from their own files, records, drawing, catalogs, data bank, patents, libraries or information centers. Smaller organizations may have a few directories, catalogs, abstract journals, indexes and technical journals and a small collections of documents related to their field of work. While these may or may not contain a solution to the problem, they may provide an indication as to where such information may be, what form it is in, who has it, and who could be contacted to acquire it. The smallest organizations (and countries) must go outside to acquire the information they need to solve their problems.
10. Given the exponential growth of scientific and technical information (STI) over recent decades, a large number of abstract and index journals

have come into being in all fields of S&T to assist in locating potentially useful information. Many of these journals are available in microform (micro-fiche and micro-film) and computer tape form besides their usual paper format. In addition, specialized services ("data banks") now have available, via telecommunication channels, literally millions of references, titles, and abstracts of STI. Europe, North America and South American are now linked by cable, satellite, micro-wave and land lines to make the acquisition of STI an instantaneous reality by telephone, telex, modem, and/or television console and printer at your desk.

11. As large, powerful and complete as many such systems are, for many organizations they create their own kind of special problem -- they make the acquisition of STI too easy and too quick (albeit not too cheap). What happens is too much information is acquired -- more information than can be properly analyzed in relation to the capabilities and problem at hand. A good librarian in a fair sized information center, with or without access to a "data bank", can generate more STI material than can be digested and analyzed by a competent engineer, economist or agronomist in a reasonable length of time.
12. This takes us back to the design of the problem solution strategy. If the information requested to solve the problem is not specific or precise, if it is general or vague, it may cause the acquisition of an excess of information. Rather than having only twenty abstracts or reports to analyze, a poorly phrased question may generate fifty or one hundred and fifty documents. If the wrong problem was diagnosed in the first place,

you can see how wasteful and confusing the process c

13. There are two lessons here: first, to be very careful in the diagnosis and the design of the problem solution strategy and the phrasing of the information request; and second, to avoid over-loading the analytical capacities of the individuals and organizations concerned.

14. What brings us to the last action step in the problem solving sequence: adaptation and application of information to resolve the problem situation. This requires a special and relatively rare set of skills ("know-how"). The prior steps of information acquisition and analysis can be considered "academic" or "theoretical" because they only involved dealing with words and concepts separated from the reality of the problem situation. The adaptation and application step is pragmatic in that it attempts to put information to work in the field, in the fact of a specific problem and tries to solve that problem. In the application of information we relate and connect information with reality. The quality, relevance and completeness of the solution can not be better than the information supplied and the skills of the man who uses it.

15. To summarize the problem solving sequence illustrated above: Step 1, Diagnosis, involves perception and cognition of the operational realities of a given problem-situation and its context. Step 2 generates alternative approaches to solving the problem. This step also identifies the kinds of information needed to solve a problem or to base decisions on. Step 3, Information Acquisition, can be straightforward and direct, or may involve

the use of data banks and extensive literature and patent searches. Step 4, Information Analysis, is as simple or as complex as the problem situation and the content and scope of the information (solutions) assembled. The Adaptation and Application of Information, Step 5, evaluates and fits the proper alternative or data to the realities of the problem situation and creates the synthesis and solution desired. It is significant to note that Steps 1 and 5 require intimate, first-hand knowledge of the problem situation. Step 5 must be implemented within the problem situation or the organizational context that generated the problem. Steps 3 and 4, on the other hand, can be considered as "second order abstractions" and can be implemented anywhere, either inside or outside the organization, depending on the availability of resources and qualified personnel.

The information flows involved in the problem solving sequence present very real dangers of sub-optimization within the information system. Given the rapidly expanding volume of scientific and technical information, which is being paralleled by the development of large scale data banks and automated information retrieval and dissemination services, it is now relatively easy to drown people in a flood of information. More information can be acquired than can be properly analyzed and effectively applied. The trap of sub-optimization of information acquisition (Step 3) must be avoided since the basic objective of information systems is to solve problems by applying (Step 5) the appropriate information derived from the analysis (Step 4).

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16. In conclusion, the effective and proper use of information is neither simple, nor obvious, nor widely practiced. Good information is necessary for sound decision making. But, if the decision making process itself is not well organized and understood by all concerned, even the best information will not be able to play its vital problem solving role.

Appendix D: Priority Areas for Further Research and Development (UN and CASTAFRICA, Dakar, 1974).

The 1974 CASTAFRICA Conference at Dakar mentioned S&T problem areas and priorities, in large part applicable to Mauritania, based upon the 1971 UN "World Plan of Action for the Application of Science and Technology to Development" as follows:

"The priority areas for further R&D identified in the Global Plan are:

- A. High-yielding varieties of staple foods
- B. Edible protein
- C. Fish
- D. Pest and vector control
- E. Tropical hardwoods and fibres
- F. Ground water
- G. Desalination
- H. Arid land
- I. Natural disaster warning systems:
 - (1) Volcanic eruptions
 - (2) Earthquakes
 - (3) Hurricanes, cyclones, typhoons
 - (4) Floods and tidal bores
- J. Indigenous building and construction materials
- K. Industrial design and research:
 - (1) Metallurgical processing
 - (2) Industrial chemicals
 - (3) Processing of natural fibres
 - (4) Plant and equipment design
 - (5) Small-scale and cottage industries
 - (6) Industrial research
 - (7) Appropriate technology

L. Schistosomiasis

M. Human Fertility

The Global Plan also identifies priority areas for the application of existing knowledge, as follows:

- A. Storage and preservation of agricultural products
- B. Control of livestock diseases
- C. Human disease control:
 - (1) Trypanosomiasis
 - (2) Smallpox
 - (3) Leprosy
 - (4) Cholera
- D. Housing construction methods
- E. Glass and ceramics
- F. Improvement and strengthening of science teaching in secondary schools
- G. Industrial expansion and advisory services
- H. Natural resources assessment and management

In considering the subject of possible areas, for regional co-operation, CASTAFRICA will doubtless wish to bear in mind the above global UNACAST analysis, particularly since it offers the advantage of making a clean distinction between the need for further R&D, on the one hand, and immediate salient opportunities for the application of already existing scientific and technological knowledge, on the other. There exists a relationship between these two aspects, because application of existing knowledge often requires a

certain amount of additional, supporting research and/or experimental development, for the purposes of adaptation so as to make the conditions and effects of application more consonant with local socio-economic constraints and objectives."

Appendix E: Relative Importance of Science and Technology Disciplines to National Development (CASTAFRICA, Dakar, 1974).

The 1973 UNESCO S&T Survey for CASTAFRICA (1974) of 20 African countries, including Mauritania, produced a ranking of S&T disciplines by relative importance to development:

1. Hydrology
2. Civil engineering
3. Crop production and protection
4. Astronomy
5. Mechanical engineering
6. Climatology
7. Applied mathematics
8. Construction engineering
9. Pedology
10. Ecology

Other disciplines following were public health, cartography, statistics, analytical chemistry, entomology, instrumentation and control engineering, electrical engineering, animal health, etc.

The same survey also identified specific development areas which were considered to be critically dependent on science and technology inputs.

The ranking procedures used resulted in the following listing, arranged in decreasing order by the number of countries (20 in total) who made judgments:

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- 19 - Agriculture
- 16 - Health
- 12 - Animal breeding
- 11 - Water
- 10 - Mines
- 8 - Industry
- 8 - Communications (including transport)
- 6 - Energy
- 5 - Environment
- 4 - Education
- 3 - Manpower (and other social)
- 2 - Construction
- 1 - Post and telecommunications

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General

THE PERUVIAN REVOLUTION

"TUPAC AMARU"

GOVERNMENT PLAN

1977 - 1980

LIMA - PERU
1977

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**THE "TUPAC AMARU" GOVERNMENT PLAN
IS APPROVED**

SUPREME DECREE N° 020-77-PM

THE PRESIDENT OF THE REPUBLIC

Having seen the Draft "Tupac Amaru" Government Plan, drawn up by the Commission of the Armed Forces and Police Forces, with the participation of the Sectors of the Administration and in which the relevant contributions of public opinion have been taken into account;

With the vote of approval of the Council of Ministers;

DECREES:

Article 1°.- The "Tupac Amaru" Government Plan is approved.

Article 2°.- This Decree shall be countersigned by the Ministers of War, of the Navy, of Aeronautics and of the Interior.

Signed in the Government House, in Lima on the fourth of October, nineteen hundred and seventy seven.

Major General of the Peruvian Army FRANCISCO MORALES BERMUDEZ CERRUTTI, President of the Republic.

Major General of the Peruvian Army GUILLERMO ARBULU GALLIANI, Minister of War.

Vice Admiral of the Peruvian Navy JORGE PARODI GALLIANI, Minister of the Navy.

Lieutenant General of the Peruvian Air Force JORGE TAMAYO DE LA FLOR, Minister of Aeronautics.

Brigadier General of the Peruvian Army LUIS CISNEROS VIZQUERRA, Minister of the Interior.

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A. PURPOSE

To consolidate the Revolutionary Process, not letting it drift towards a communist statism nor, in a reaction, go back towards forms of pre-revolutionary capitalism that have already been left behind; to complete and readjust the structural reforms, so as to achieve such an amount of progress that it makes the advance of the Process towards the achievement of its final objective, the Fully Participatory Social Democracy, irresistible.

B. GENERAL OBJECTIVES

To insure this purpose, the following General Objectives in the field of social and economic development must be achieved **within the medium term**, in a gradual manner and at the maximum pace that the available resources and the administrative capacity may permit:

1. To continue the transformation of the structure of the State, making it more dynamic and efficient and insuring the gradual decentralization and the progressive participation of the population.
2. To emphasize the policy of moralization in all the spheres of our national activity and to maintain the principle of authority and of respect for Law.
3. To continue the nationalistic and independent foreign policy, based on the firm and active defense of national dignity and sovereignty.
4. To increase production and perfect the productive structure of the country, giving priority to satisfying the basic needs of the population and increasing the production of goods with a high added value.
5. To perfect and promote in concert the sectors of the Economy.
6. To gradually reduce the social and economic as well as the urban and rural imbalances.
7. To promote the cohesion of the population, on the basis of the acknowledgement of the family as the foundation of society, of the national cultural values and of the regional characteristics of the country.
8. To raise the occupational level as high as possible, promoting a suitable use of labor in the productive process and the

development of activities which generate higher possibilities of employment.

9. To assure a minimum remuneration for workers so that they will be able to satisfy their basic needs and those of their families.
10. To institutionalize, through a Constitution, the structural reforms while making the indispensable readjustments that experience advises.

C. SPECIFIC OBJECTIVES AND POLICY GUIDELINES TOTAL AREA

1. POLITICAL STRUCTURE OF THE STATE

a. OBJECTIVE

A political structure that will permit a more dynamic and efficient government action, that will permit the gradual participation of the population for the progressive transfer of power and that will assure administrative deconcentration and decentralization.

b. POLICY GUIDELINES

- (1) To perfect and rationalize the Administrative Sectors of the State.
- (2) To enact the Administrative Decentralization Act and contemplate its gradual application.
- (3) To perfect the legislation on local governments so as to achieve a more dynamic and efficient administration.
- (4) To install in the second semester of nineteen hundred and seventy eight, a Constitutional Assembly to draw up the new Political Constitution that will contemplate, amongst other aspects:
 - The institutionalization of the basic structural reforms of the Revolutionary Process.
 - The structure and characteristics of the Executive, Legislative and Judicial functions of the State; and the mechanisms that will assure an efficient government action between them.
 - The exercise of political pluralism.
 - The incorporation of the principles contained in the Universal Declaration of Human Rights.

- The mechanisms for the participation of the population.
 - The planning function of the State so that it will fully serve the management of the Government Policy in line with the national and regional development.
- (5) To call general elections for the year **nineteen hundred and eighty.**

2. REGIONAL DEVELOPMENT

a. OBJECTIVE

Regional administration that promotes the full social and economic development of the different areas of the country.

b. POLICY GUIDELINES

- (1) To establish a regional development policy that links the regional economies and the national economies within the framework of the national development plans.
- (2) To promote the satisfaction of the basic needs of each region, mainly, with their own productive resources.
- (3) To link the regional productive structure within the context of global development projects.
- (4) To develop an industrial infrastructure in selected areas, in accordance with the regional development policy, promoting the installation of medium and large-sized industrial enterprises outside of Lima-Callao; and to integrate industrial activity to the other economic activities of the region.
- (5) To promote an effective administrative deconcentration and decentralization, assigning to the regions the executive functions of the Public Administration which are within their jurisdiction.
- (6) To promote the participation of the population in the decision-taking process on a regional level.
- (7) To give priority to the use of technical capacity, labor and other available resources in the investment projects.
- (8) To perfect the Marketing System, the pricing policy and the mechanisms of technical and credit support, seeking a rational and fair balance in the urban-rural relationship.

- (9) To create the conditions that incentivate the concentration of the dispersed population in the rural areas, endowing the small towns with the basic services.
- (10) To promote the effective occupation and development of the border areas.
- (11) To stimulate scientific and technological research for the best use of the resources of each region.
- (12) To integrate into the respective region, the production centers that maintain certain characteristics of isolation.
- (13) To establish remunerations policies that promote in an effective manner, work outside of Lima-Callao and of the large urban centers of the country.

3. REFORM OF THE PUBLIC ADMINISTRATION

a. OBJECTIVE

A dynamic, efficient and decentralized Public Administration for a better government action and an effective service to society.

b. POLICY GUIDELINES

- (1) To enact the Normative Law of Public Administration.
- (2) To simplify the sectorization of Public Administration and to invigorate the normative functions on a central level and the executive functions on a regional level.
- (3) To perfect the existing administrative systems and to establish the supply and informational systems.
- (4) To establish and consolidate a Regional Public Administration that will insure a coordinated action of the public function and the effective progressive participation of the population in the different regions of the country.
- (5) To establish a global remunerations policy for all public sector workers, including those belonging to enterprises with government participation, that will assure equity and reduce that existing imbalances.
- (6) To rationalize the administrative career of the public servant, establishing the norms that will regulate the working relations and fixing the rights, duties, inducements and punishments, so that he may achieve personal and social fulfilment within and outside his work.
- (7) To intensify the measures of professional and technical training of the public servant.

4. PLANNING

a. OBJECTIVE

Integral and permanent planning that is compulsory for the Public Sector and orientational for the Non-Public Sector.

b. POLICY GUIDELINES

- (1) To make social and economic aspects compatible in the development plans within integral planning.
- (2) To orient financial policy (fiscal, monetary, exchange, credit, etc.) toward the achievement of the objectives and targets of the development plans.
- (3) To draw up a long-term National Development Plan and improve the preparation and evaluation mechanisms of the medium and short-term plans.
- (4) To make planning for the Public Sector compulsory, particularly through the budget and continuous evaluation, orienting the economic surplus with a social and/or productive criterion.
- (5) To orient the productive activity of the Non-Public Sector toward satisfying the basic needs of the population by arranging production and supply programs between the State and Non-Public enterprises.
- (6) To establish mechanisms for the progressive participation of the organized population in the preparation and evaluation of the regional development plans.
- (7) To promote a greater knowledge and understanding of the development plans on the part of the population.
- (8) To update legislation on planning and improve the structure of the National Planning System.

- (9) To improve the Statistical System so as to satisfy the requirements of national planning.
- (10) To reorient national planning so that it not only considers general aspects of the macroeconomy, but quantifies the production goals, bearing in mind the socioeconomic situation in the different regions of the country.

5. NATIONAL CONTROL SYSTEM

a. OBJECTIVE

A National Control System that ensures the correct administration of public resources.

b. POLICY GUIDELINES

- (1) To improve the National Control System in such a way as to ensure fulfillment of its functions in all spheres of public activity, particularly in the control of results and of management.
- (2) To deconcentrate control activities so as to permit its effective application within the Public Sector at the regional level.
- (3) To coordinate the control functions of those specialized bodies of the public administration that are outside the System and carry out tasks in the control of public resources.
- (4) To provide for the suitable mechanisms that will permit an effective control action through the National Control System, of the resources furnished by the State in the multinational enterprises whatever their legal status.
- (5) To contribute to the moralization of the public function.

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6. PRESS AND INFORMATION

a. OBJECTIVE

Mass communications media with wide coverage as important instruments of truthful information on the national and international situation and of support for reforms, respecting the principle of freedom of expression.

b. POLICY GUIDELINES

- (1) For the national population to achieve an extensive and profound knowledge of the aims, objectives, Ideological Bases, plans and programs of the revolutionary process.
- (2) To maintain the principle of freedom of expression in the different procedures and methods of social communication.
- (3) **To perfect the Press Law.**
- (4) To substantially improve the production of films and of radio and television programs, orienting them towards the raising of the national culture and strengthening of national bonds.
- (5) To set up a radio and television system with a national coverage, rationalizing their geographical distribution and to give the National Radio of Peru a national and international scope.
- (6) To gradually transfer the daily newspaper with a national distribution.
- (7) To strengthen and extend to a regional level the daily newspapers owned by the Government.
- (8) To orient publicity to provide an objective and truthful information.
- (9) To insure that the social communications media achieve suitable technological development, to make this communication more nimble and to achieve a national coverage in an efficient manner.

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7. ADMINISTRATION OF JUSTICE AND SOCIAL READAPTATION

a. OBJECTIVE

- (1) An independent administration of justice with skilled personnel, that will insure the timely and inflexible enforcement of the law for everybody in the same manner.
- (2) A penitentiary system that will permit the social readaptation of the internee.

b. POLICY GUIDELINES

- (1) To Complete the organization of the administration of justice and to perfect its mechanisms, so as to make it more nimble and assure its independence.
- (2) To update and complement the legislation related to the administration of justice and social readaptation, adapting it to structural changes.
- (3) To regulate the career of the magistrate and of the auxiliary personnel and insure its permanent training.
- (4) To establish the necessary infrastructure of the readaptation centers and to train their technical and administrative personnel.
- (5) To perfect the methods of social readaptation, by means of the scientific and technical treatment of the internee, on the basis of obligatory work.
- (6) To promote the participation of the community in the prevention of crime, the treatment of the internee and aid to the freed prisoner as part of the defense of society.

8. INTERNATIONAL POLICY

a. OBJECTIVE

A nationalist and independent foreign policy that is oriented with particular emphasis towards the American Continent and more specifically to Latin America, maintaining the position that has been assumed at the level of the Third World and Non Aligned countries.

b. POLICY GUIDELINES

- (1) To activate the policy of cooperation with the border countries and to place greater emphasis on the border integration measures that have already been undertaken.
- (2) To intensify the measures, particularly those that refer to the economic field, through the processes of Latin American Integration and, specially, those which refer to the Andean Group and to SELA.
- (3) To strengthen and increase the links with the countries of the American Continent and particularly with the Latin American countries to assert regional unity and solidarity.
- (4) To continue the measures for the restructuring of the Inter-American System.
- (5) To achieve a more vigorous participation in the associations of raw material producing and exporting countries and in the negotiations between the developed world and the developing countries.
- (6) To maintain the position that has been assumed in the concert of the Third World countries and that of the Non Aligned countries, adapting it to our bilateral policy.

- (7) To promote measures that lead to the establishment of a New Law of the Sea, particularly through the general consolidation of the thesis of the 200 mile limit and to reassert the principle of the permanent sovereignty of States over their natural resources.
- (8) To intensify, on a worldwide level, the information oriented to making known the Revolutionary Process, its ideological foundation and its achievements.
- (9) To actively participate in the United Nations Organization for the achievement of the purposes and fulfilment of the principles stipulated in the Charter of that organization.
- (10) To actively participate in the establishment of a fair and equitable new international economic order.
- (11) To promote and support measures tending towards the elimination of dependancy and all kinds of foreign domination.
- (12) To establish rules that regulate the activities of multinational enterprises and eliminate their negative effects with regard to the interests of the country.
- (13) Pursue efforts in the different negotiating forums in the United Nations and regional agencies to achieve a limitation in arms purchases.

9. INTEGRATION POLICY .

a. OBJECTIVE

Dynamic policy of the country in the Latin American integration processes.

b. POLICY GUIDELINES

- (1) To consider the objectives of Latin American integration within national planning.
- (2) To adapt the industrial, customs and commercial laws to the participation of the country in the Latin American integration process.
- (3) To promote the manufacturing of non-traditional export products and perfect their marketing, to utilize the advantages of the wider market in a competitive manner.
- (4) To dynamize the industrial programming on a subregional level with regard to the integration agency, in harmony with the progress of the Liberation Program.
- (5) Incentive the production of the assignments received in the framework of the industrial programming of the Andean Group.
- (6) To promote the policy on the Common Regime of Treatment of Foreign Capital and on trademarks, patents, licenses and royalties for their application through the National Committee on Foreign Investments and Technology (CONITE).
- (7) To promote and disseminate the aims of Latin American integration at all levels.
- (8) To promote the measures of border integration.

- (9) To efficiently coordinate the action of Peruvian representations before Latin American countries, both with the Ministry of Integration as well as with the integration agencies of said countries.
- (10) To coordinate the measures linked with Latin American integration derived from the Latin American Economic System (SELA).

ECONOMIC AREA

10. REFORM OF THE ENTERPRISE

a. OBJECTIVE

Consolidation of the pluralist structure of the national economy, developing in concert the four sectors of ownership and **defining** the Social Sector so as to substantially increase production and the sources of work.

b. POLICY GUIDELINES

(1) State Sector

- (a) Enact the Normative Law of the State's Enterpeneurial Activity to adapt the operation of the government enterprises to the new role assumed by the State within economic pluralism and within the national economy in general.
- (b) To establish the form of the participation of the worker in government enterprises with the exception of those that are governed by special laws, within the characteristics stipulated by the entrepreneuria' legislation of the Government.

(2) Reformed Private Sector

- (a) To review the laws that govern the activities of the enterprises of this sector, establishing the orientations that define their role, their characteristics and their situation in production.
- (b) To perfect the legislation of the Labor Community so that it:

1. Promotes investment.
 2. Guarantees the management of the enterprise by the entrepreneur.
 3. The worker obtain a real and timely benefit from his participation in production.
- (c) To extend the Labor Community to the enterprises that do not have it, in accordance with the characteristics of each economic activity.
- (3) **Social Sector**
- (a) To define the Social Sector of ownership in such a way as to include within it all those enterprises in which the means of production are fully owned by the workers (Social Property Enterprises, Agrarian Production Cooperatives, Agrarian Societies of Social Interest, Farming and Native Communities) each entrepreneurial form maintaining its own characteristics.
 - (b) To perfect the Social Property Enterprises Act by reviewing its present structure, so as to ensure that each enterprise really be the property of all its workers and operate as a production unit with entrepreneurial autonomy.
 - (c) To promote and develop Social Property Enterprises so that:
 1. The programming of the resources to be assigned be subject to an ordering of the investments in accordance with priorities.
 2. To mainly develop activities that presuppose a high utilization of labor, in relation with the cost of their production and in which the personal effort and not the concentration of capital have the priority influence on the result of the enterprise.
 3. To promote as a priority the creation of production centers developed by the initiative of the workers.
 - (d) To perfect the General Law of Cooperatives.
 - (e) To enact the Law of Associative Farming Enterprises.

(4) Small Private Enterprises Sector

- (a) To promote and develop the Small Private Enterprise within its supplementary character to that of other ownership sectors.**
- (b) To promote the formation of management cadres for the enterprises of the different ownership sectors, placing emphasis on the Social Sector.**
- (c) To disseminate the aims and characteristics of the four ownership sectors.**

11. SCIENCE AND TECHNOLOGY

a. OBJECTIVE

Increase of the purchasing capacity and capacity of generation of science and technology adapted to our situation, that promotes national development and reduces dependancy.

b. POLICY GUIDELINES

- (1) To create a National System of Science and Technology to efficiently promote and link together the scientific and technological development.
- (2) To specify the legal framework and intensify the measures to rationalize the importing of foreign technology and stimulate the creation of national technology.
- (3) To reinforce the capacity for negotiation with multinational enterprises, with regard to the patents, trademark and royalties regime.
- (4) To promote the technological adaptation and transference that is suitable to the interests of national development.
- (5) To establish suitable services of technological information for research enterprises and centers and to promote the exchange of technological information.
- (6) To effectively integrate the Peruvian University and other public and private Research Centers within the National System of Science and Technology.
- (7) To promote through the national educational system, the formation of personnel suitable in number and in quality for scientific and technological research.
- (8) To increase the capacity of the agencies entrusted with drawing up the technical and quality control standares.

12. INDUSTRIES

a. OBJECTIVE

Increase in industrial production and perfecting of the productive structure of the country, giving priority to satisfying the basic needs of the population and increase in production of goods with a high added value.

b. POLICY GUIDELINES

- (1) To develop and consolidate the four ownership sectors in manufacturing industrial activity, so that they act in concert.
- (2) To draw up a Long Term Industrial Development Plan.
- (3) To perfect the productive structure (in the context of the Long Term Industrial Development Plan) oriented towards the satisfaction of the essential needs of the population, to the production of non-traditional goods, particularly in the areas in which you have competitive advantages and to the reduction of our dependancy in the supplying of capital goods and industrial inputs.
- (4) To orient investments towards the productive activities of essential goods and rationalize the production of sumptuary goods, in accordance with the needs of the country.
- (5) To perfect the industrial legislation to give it coherence and redefine the scope of the General Law of Industries.
- (6) To harmonize the activities of the Non Public Sector with the National Development Plans.
- (7) To supplement the laws on the small enterprise so as to promote the handicraft activities within the framework of regional development.

- (8) To promote the development of the metalworking industry, of support towards agriculture and the fertilizer and pesticide industries, seeking their linkage on a regional level.
- (9) To promote agroindustry within the sphere of global development projects on a micro-regional level.
- (10) To review and adapt the promotional regime of incentives, orienting them towards the production of goods that directly or indirectly satisfy the basic needs of the population and of regional development.
- (11) To perfect the mechanisms to insure an efficient quality control.
- (12) To rationalize the utilization of foreign patents for the production of goods for a final use.
- (13) To define a strategy that orients the participation of Peru in the industrial programming of the Andean Sub-regional Pact, that is compatible with the national development policy.
- (14) To regularize the situation of the clandestine industries and of their workers by incorporating them into the sector.
- (15) To produce, in a planned manner, the capital goods and inputs that are necessary for the development of the other economic sector in terms of amount, quality, opportunity and prices, using in a rational manner and subject to priority the national resources and potentialities.
- (16) To selectively schedule the imports of goods required by the manufacturing industrial sector, perfecting the mechanisms that permit their effective control.
- (17) To promote the training of the manufacturing workers for their integral improvement of a technical, civic and cultural nature, as well as the formation of management cadres.

13. COMMERCE

a. OBJECTIVE

Timely supplying of essential goods and services for priority consumption and production and a greater generation and collection of the economic surplus in foreign trade, contributing towards the achievement of a positive balance of trade.

b. POLICY GUIDELINES

- (1) To enact the General Law of Commerce.
- (2) To expand the participation of the State in foreign marketing, specifically of the products of economic importance and essential products.
- (3) To develop the necessary infrastructure for the marketing of essential goods and their inputs.
- (4) To reformulate the price control and regulation systems, limiting them to essential products and making them more efficient and timely.
- (5) To agree upon with the public enterprises of the different sectors the marketing of essential goods and services.
- (6) To diversify the foreign markets to reduce the dependancy on traditional markets and promote to the maximum extent the non-traditional exports.
- (7) To actively participate in the international agencies, forums, and associations for the obtaining of better prices for our traditional export products.
- (8) To rationalize the procedures and make more nimble the steps to be taken for foreign marketing and the granting of incentives.

- (9) To permanently control the prices of the exports and imports to avoid under and over-invoicing.
- (10) To achieve better positions for our exports and imports trying to obtain as far as is possible government to government and enterprise to enterprise agreements.
- (11) To schedule imports in accordance with the needs of essential consumption and of priority production.
- (12) **To perfect the customs systems, making them coherent with the economic and industrial and integration policy.**
- (13) To promote the harmonizing of the joint demand with the countries of the Andean Group for products of which there is a shortage in the Region.
- (14) To reduce and control the engagement of the services that are required by foreign trade, trying to achieve their replacement by national enterprises.
- (15) To restructure and modernize the customs system.
- (16) To develop and implement the legal and administrative norms, particularly in what refers to the repression of smuggling, the cheating in customs income and the flight of foreign exchange.
- (17) To incorporate street vendors into the taxation regime.
- (18) To create the mechanisms for the participation of workers in commercial enterprises.
- (19) To develop an intensive plan of specialized training.
- (20) To develop an information system to facilitate the decision taking in the foreign and domestic trade activities.
- (21) To draw up a Global Fairs Law that regulate them in their different types on an **international, national, regional, zonal and local level.**

14. PUBLIC FINANCE

a. OBJETIVE

Public financial system that insures an optimum attraction of financial resources and their most efficient assignment and use in accordance with the development plans.

b. POLICY GUIDELINES

- (1) To perfect the taxation system so that:
 - (a) It insures that the tax income maintains a growing relationship with the Gross Domestic Product and this relationship be in line with the sectorial production structure.
 - (b) A higher selectivity be guaranteed in tax exemptions to support the production of essential goods, of employment and of regional development.
 - (c) The tax administration be improved, control being intensified to avoid tax evasion.
- (2) To specify the priorities of expenditures in the Public Sector so as to assure an efficient allotment of resources.
- (3) To harmonize the subsidies policy with the need to increase the domestic production of essential goods and services, to generate surpluses for investment and with the real possibilities of the Public Treasury
- (4) To schedule the public debt in accordance with the development priorities and always taking into account the debt capacity of the Public Sector particularly and of the country generally.
- (5) To enact a new Organic Law of the Public Budget.
- (6) To unify the tax administration by means of the integration of the agencies entrusted with the same.

15. MONETARY AND CREDIT REGIME

a. OBJECTIVE

Monetary and credit policy oriented towards achieving the harmonious development of the different sectors of production and of the regions of the country and, particularly, to increasing the attraction of savings by the financial system.

b. POLICY GUIDELINES

- (1) To assign the financial resources in accordance with the priorities that the development plans establish, which should be drawn up more specifically and in greater detail.
- (2) To establish a structure of interest rates that is sufficiently flexible, so that it adapts to the variability of supply and demand of financial resources and incentivates the domestic savings.
- (3) To incorporate into the formal financial system, all the financial middlemen, including the savings and credit cooperatives.
- (4) To improve the administrative-credit capacity of the financial development institutions, deconcentrating their power of taking decisions in such a way that their activities be oriented towards regional development.
- (5) To draw up new organic laws of all public financing institutions, adapting them to the needs of the financing policy.

16. BALANCE OF PAYMENTS

a. OBJECTIVE

Commercial exchanges and financial transactions abroad that will determine positive surpluses in the balance of payments and tend to reduce the dependency on the outside world in the credit and production fields.

b. POLICY GUIDELINES

- (1) To support the development of the productive sector that is export-oriented, taking into account the comparative advantages of international trade, seeking a greater diversification and added value for our exports.
- (2) To strengthen our negotiating capacity in international markets for the purpose of obtaining better prices both for exports as well as imports.
- (3) To reorient the import substitution policy in the sense of making the productive system less dependant on foreign inputs.
- (4) To reduce the use of imported services in the domestic economic activity.
- (5) To continue improving the scheduling of the foreign debt, in accordance with strict priorities for development and always taking into account the capacity of the country for assuming a foreign debt.

17. AGRARIAN REFORM

a. OBJECTIVE

Full development of the rural environment, strengthening the structural changes introduced by Agrarian Reform, significantly reducing underemployment, increasing agricultural and livestock raising production and productivity, diversifying economic activities and attempting the rational utilization of renewable natural resources.

b. POLICY GUIDELINES

- (1) To conclude the stage of transference to the farmers that benefitted from the Agrarian Reform.
- (2) To consolidate the new entrepreneurial forms, particularly 'associative enterprises, giving them a different dimension and changing their modality when it is necessary and implementing the counseling and control systems and the mechanisms that may be necessary for the fulfilment of the production goals.
- (3) To adapt the functions of the Public Sector in a manner that permits the appropriate guidance of the Agrarian Reform process and a global policy that involves social, economic and technological development measures. At the same time, establish the mechanisms that guarantee the multisectorial action that by its nature is inherent to the Agrarian Reform process.
- (4) To continue the actions destined to overcome the problems that the small farmstead offers.
- (5) To enact the Law of Farming Communities so that these adapt themselves to the principles of Agrarian Reform, eliminating all kinds of domination within themselves.

- (6) To significantly expand the agricultural area by means of:
- (a) A global policy of irrigations that considers large irrigation works and small and medium sized projects that have a short maturity period, giving priority to the latter, as well as to the intensive use of labor in the construction processes.
 - (b) The impulse towards the recovery of lands by means of drainage and other works of conservation of soils and waters.
 - (c) The impulse towards the utilization of modern technology in agriculture for the purpose of intensifying the use of land.
 - (d) The increase of the areas under farming and livestock raising use in the regions of higher and lower jungle by means of the execution of global projects that contemplate at the same time forest, fishing and wild game uses.
- (7) To link up on a micro-regional level, the new agrarian structure in the sphere of global development projects that contemplate agricultural and non-agricultural activities and the use of common services.
- (8) To link up marketing systems of agricultural and livestock products that guarantee adequate conditions in the stages of collecting, storage, transportation and distribution, so as to incentivate the production and regulate the supply, particularly that of foodstuffs.
- (9) To adopt a pricing policy for agricultural and livestock products that harmonizes the interests of producers and of consumers and that contributes towards avoiding the transference of financial resources from the rural areas to the city.
- (10) To establish a specific labor regime in line with the production relationships that exist in the associative enterprises.
- (11) To adapt the taxation regime in such a way that it harmonizes the interest of Treasury with that of the farming enterprises.
- (12) To intensify the measures for the training of the farming population within the framework of the Educational Reform.
- (13) To enact the General Law of Agricultural Credit and es-

establish a system that permits the dynamizing of the allotment of financial resources for agricultural, livestock raising, forestry and training activities with the support of the state development banks, the private banks and the rural savings and credit funds.

- (14) To establish the mechanisms that permit the suitable supply of inputs, equipment, machinery and spare parts for agriculture in rational terms of quality and prices.
- (15) To apply in farms a policy of an intensive use of labor in the exploitation of the land and in the improvement and expansion of the infrastructure.
- (16) To implement the application of the Law of Native Communities of Agricultural and Livestock Promotion of the Higher and Lower Jungle Regions as well as of the Forestry and Wild Game Law, within a policy that takes into overall consideration the problems of the Amazon region.
- (17) To reorder the jurisdictions of the Land Courts in accordance with geographic reality or suitably implement them so as to insure the application of the farming legislation, making the procedures nimbler and the low cost of the steps taken.

18. WATER REGIME

a. OBJECTIVE

Rational utilization of the water resources of the country and their distribution in accordance with the interest of the society and of national development.

b. POLICY GUIDELINES

- (1) To continue the inventory of water resources of the country and to draw up the National Plan of Water Uses, Irrigations and Irrigation Improvements, assigning priority to irrigation projects which have a short period for their maturity and with an intensive use of labor in their construction.
- (2) To extend the volumetric control for the use of the waters, particularly those that are destined towards irrigation.
- (3) To intensify the participation of the organizations of users and to insure the economic funds for the maintenance of the structures of water distribution.
- (4) To perfect the mechanisms for the control of the pollution of the waters.
- (5) To inform the population of the importance of the water resources, their conservation, prevention and rational use as well as the works that permit their use.
- (6) To intensify the studies and execution of the works for the use of underground waters.
- (7) To extend to all irrigation districts the crop and irrigation plans.

19. SOIL, FOREST RESOURCES AND WILD GAME

a. OBJECTIVE

Rational use of the soils, of the forestry resources and of the wild game to obtain the maximum economic yield and social benefit, taking into consideration the needs and interests of this and of future generations.

b. POLICY GUIDELINES

- (1) To develop a global policy for the treatment of renewable natural resources: soil, water, wild flora and fauna.
- (2) To increase the **rational** use of natural forests to satisfy as a first priority the needs of the domestic consumption of forestry products and to achieve significant and growing exports.
- (3) To promote enterprises devoted to the extraction, transportation and marketing of forestry products, that incorporate as the first priority, the natives and farmers of the upper and lower jungle.
- (4) To conclude the national inventory of the forestry and wild game resources.
- (5) To develop and disseminate the scientific and technological research that permits a greater and better use of the **soils**, forestry resources and **wild game**.
- (6) To assign to the Agricultural Sector normative responsibility for the activities of the forest industry.
- (7) To significantly expand the reforestation measures and to

restore the natural vegetation of the hydrographic basins to reduce the risk of natural catastrophes, to preserve their hydroenergetic potential and to expand their economic resources.

- (8) To promote the participation of the population in the protection and rational use of the renewable natural resources.
- (9) To establish a legal framework and to set up the specialized agency that will guarantee the conservation of the soils.
- (10) To protect the endangered fauna and flora that are in peril of extinction and to preserve areas of the national territory in their natural state (parks and natural reserves) for recreational and cultural purposes.

20. FISHING

a. OBJECTIVE

Rational exploitation of the hydrobiological resources, for the purpose of significantly contributing towards the supplying of foodstuffs to the domestic market and maintaining a high level in the export products.

b. POLICY GUIDELINES

- (1) To adopt the measures will permit the achievement of a suitable and efficient development of the fishmeal and fish oil industry.
- (2) To continue to establish the necessary infrastructure for the exploitation of the fish catch for direct human consumption in accordance with the potential and availability of the resource.
- (3) To promote a greater consumption of fish by the population, particularly of the species that are most highly
- (4) To intensify the studies oriented towards the use of the anchovy, in fishmeal and in other ways for direct human consumption.
- (5) To promote the creation of enterprises of the social sector seeking to organize the individual fishermen.
- (6) To promote the dynamization of credit support to all of the entrepreneurial forms of the Fishery Sector.
- (7) To intensify scientific and technological research of the fishing resources of direct and indirect human consumption to assure their rational exploitation.

- (8) To promote and reorient the development of fishing in **continental** waters.
- (9) To promote the measures of fishing training at all levels.
- (10) To intensify the measures that tend to guarantee the optimum quality of fishing products.

21. MINING

a. OBJECTIVE

Maximum development of the mining potential with the participation of the State and of the national and foreign private investor, the participation of the State being preferably oriented towards large mining.

b. POLICY GUIDELINES

- (1) To complete and perfect mining legislation.
- (2) To intensify the surveying of the National Geological Map as well as mining prospecting and exploration.
- (3) To draw up a Long Term Mining Development Plan for the industrial exploitation and transformation of our mining resources, giving priority to the expansion of our refining capacity.
- (4) To rationally distribute the reserved areas and those of special rights in the national territory, to supplement the development of mining activity, both on the part of the State as well as by private producers.
- (5) To maintain the participation of the State in the activities of large mining, alone or forming associated or special enterprises with national and/or foreign private producers.
- (6) To incentivate private enterprise to prospect on free areas and those of special rights of the State.
- (7) To promote to the maximum extent the exploration, exploitation and smelting of minerals at the level of small and medium sized mining, establishing a policy that will insure their continuous development.

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- (8) To promote the production of phosphates, brine pits, coal, radioactive minerals and other non traditional metallic and non metallic ores.
- (9) To promote the achievement of the highest degree of elaboration of the mining products.
- (10) To rationalize remunerations, conciliating the welfare requirements of the workers with the profitability and productivity of the enterprise.
- (11) To rationalize and integrate the activities of the state mining enterprises.
- (12) To perfect the legal and taxation regime, differentiating that of the small, medium sized and large mining, so as to achieve their maximum development, insuring the stability of said regimes.
- (13) To promote the exploitation and marketing of non-metallic minerals, particularly for construction and metallurgical inputs.
- (14) To tend towards the integration of the metallurgical mining activities in national development.
- (15) To promote metallurgical-mining scientific and technological research and the permanent training and formation of the workers.
- (16) To improve the hygienic and safety conditions in mining activities.

22. ENERGY

a. OBJECTIVE

Exploitation and rational and economic use of the different available energetic sources, working towards becoming self-supplying.

b. POLICY GUIDELINES

- (1) To carry out the global study of the national energy problem.
 - (a) Intensifying the research and evaluation of our energy resources.
 - (b) Analyzing the demand for energy in the country and its projection.
 - (c) Planning and scheduling the development of the energy resources of the country.
- (2) **Drawing up the Long Term National Energy Plan**
- (3) To promote and give priority to the substitution of the energy derived from oil by other power from conventional and non-conventional sources.
- (4) To implement the basis for the nuclear power development in the country.
- (5) To promote the employment of our coal resources for power purposes.
- (6) To establish a policy that incentivates the development of renewable power sources that are available in the country.

23. OIL

a. OBJECTIVE

Maximum development of petroleum potential by the State.

b. POLICY GUIDELINES

- (1) To complete the laws on hydrocarbons.
- (2) To increase the proven reserves of oil so as to insure our self-supply.
- (3) To maintain the domestic prices of oil byproducts at a level that avoids subsidies.
- (4) To complete the construction and to put into operation the Northern Branch and related systems of the North Peruvian Oil Pipeline.
- (5) To establish an efficient system for the production, supplying and marketing of oil and of its by-products, to adequately supply the needs of the population in the different regions.
- (6) To adequately increase the oil transportation capacity by sea, particularly that of coastal sailing.
- (7) To intensify research, mainly for the achievement of the maximum development of the petrochemical industry.
- (8) To promote the training of the oil workers for the full improvement.

24. ELECTRICITY

a. OBJECTIVE

Generation, transformation, distribution and marketing of electric power exclusively entrusted to the State, to satisfy the needs of the population and of national development.

b. POLICY GUIDELINES

- (1) To enact the General Law of Electricity.
- (2) To pursue the evaluation of the hydroelectric potential and to draw up the Hydroelectric Development Plan.
- (3) To pursue the evaluation of alternative sources of hydroelectric power and include them in the Electric Development Plan.
- (4) To expand the coverage of the electrical systems by the execution of generation, transformation, transmission and distribution of electric power works to efficiently satisfy the local and regional demands required for national development.
- (5) To continue the creation and expansion of electrical interconnection systems.
- (6) To assure a greater efficiency and achieve the deconcentration and decentralization of ELECTROPERU.
- (7) To establish the **National Rates System** that permits an adequate level of investment in the Sub-Sector and the placing of the electric service within the reach of the majority.
- (8) To promote the formation and training of the required personnel.

25. NUCLEAR POWER

a. OBJECTIVE

Utilization of nuclear power for the benefit of national development.

b. POLICY GUIDELINES

- (1) To enact the legislation that regulates the development of the field of nuclear power and its applications.
- (2) To set up a Nuclear Center with the necessary scientific and technological structure to assure the integration of nuclear power into national development.
- (3) To determine the reserves of radioactive minerals and to evaluate the national possibilities of uranium production.
- (4) To execute the necessary studies to define the installation of the first Nuclear Power Plant.
- (5) To promote the applications of the highest social and economic interest of nuclear power in the health, agriculture, food and industrial sectors.
- (6) To promote to the maximum extent the exploitation, exploration and smelting of radioactive minerals, establishing a policy that will insure their continuous development.

26. TOURISM

a. OBJECTIVE

Substantial increase of receptive tourism and promotion of domestic social tourism within the country so as to make the country and its culture known.

b. POLICY GUIDELINES

- (1) To conclude the inventory of the national touristic patrimony, evaluation and classification of resources, that once they have duly been assigned a priority will be authorized to be touristically exploited.
- (2) To incorporate touristic projects in the regional development plans.
- (3) To improve the touristic infrastructure and services and regulate the activities of tourist enterprises, adapting them for a better use of receptive and domestic tourism.
- (4) To develop global programs of social tourism, orienting part of the investment in tourism towards the construction of vacational centers, youth hostels and camps.
- (5) To stimulate investment of domestic and foreign private capital in tourism.
- (6) To orient public investment, to promote a rational growth of the touristic structure that will permit its diversified exploitation.
- (7) To promote the coordination of intersectorial efforts, to facilitate the movement of tourists.
- (8) To enact the relevant legislation that delimits the sphere of administrative jurisdiction and legal authority of the Tourism sector, regulate the internal legal structure of public agencies and permit the execution of coordinated action for the fulfilment of the National Tourism Plan.

27. TRANSPORT

a. OBJECTIVE

Transport system that contributes towards national integration and social and economic development.

b. POLICY GUIDELINES

- (1) To enact the General Law of Transport
- (2) To incentivate and promote the development and efficiency of the infrastructure of transport, taking into account the technical and economic criteria and the potential production areas.
- (3) To promote the expansion, renewal, and standardization of the equipment, giving first priority to the mass transportation of passengers and cargo.
- (4) To promote the development of the public and non-public transport enterprises to achieve the maximum participation in the transport of passengers and cargo of our international commerce. Incorporate into the sector the public transport companies.
- (5) To sponsor the formation and development of enterprises devoted to transport, mainly incentivating those that operate in the marginal areas of the national territory or that participate in our international trade.
- (6) To rationalize and integrate the means of the different forms of transport, to optimize the system.
- (7) To periodically regulate the transport rates, so as to insure the preservation and renewal of the equipment.
- (8) To promote the full training of the personnel of the transport system so as to obtain a greater efficiency in the services.
- ✓ (9) To increase the technological development and research in the transportation field.

28. COMMUNICATIONS

OBJECTIVE

A communications system, under the control of the State, that effectively contributes towards national development and integration.

b. POLICY GUIDELINES

- (1) To intensify the development of telecommunications by means of advanced technology.
- (2) To expand, in accordance with the regional development policy, the communications services to the localities of the country that do not yet have them, with priority in the border areas.
- (3) Establish legislation for the postal organization so as to make it possible to optimize its service.
- (4) To increase the technological research and development activities in the communications field.
- (5) To periodically regulate the rates of the communications public services so as to contribute towards their expansion and the efficient performance of the same.

SOCIAL AREA

29. POPULATION

a. OBJECTIVES

- (1) Population growth in harmony with the free decision of the inhabitants on their respective family sizes and which contributes to making effective the efforts being made by Peruvian society to achieve the levels of human development to which it aspires.
- (2) Significant reduction of morbidity mortality, particularly of the mother and child, which will permit the raising of the quality of living and life expectancy of our population.
- (3) Distribution of the population within the territory, in accordance with the objectives of national development.

b. POLICY GUIDELINES

- (1) To support and promote programs of populational, family and sexual education that orient those being educated at all levels, **as well as the community generally**, on the interrelation of the demographic factors with the social factors, on the value of human relations and the respect for life.
- (2) Support and promote actions which contribute towards the achievement of a genuine responsible paternity, as an option to freely and consciously determine the size of his family and to provide the educational and medical services that, respecting the ethical and moral principles, will insure the freedom of the couples in the exercising of responsible paternity.

- (3) To substantially improve the social and health situation of the mother, of the child, of those over 65 years of age and of the **mentally retarded** human being, developing the legislation, the infrastructure and the services devoted to this purpose.
- (4) To rationalize the distribution of the population, creating the conditions that permit and favor the settlement of the population in areas that are not very populated and in border areas and also incentivate the urban development in intermediate and minor populated centers to achieve a better relationship between the population and the natural resources of the national territory.
- (5) To maintain updated the studies on the dynamics of the population so as to permit a better integration of the population aspects within the national development policy.
- (6) To establish obligatory civil identification for a better evaluation of the population.

30. OF PERUVIAN WOMEN

a. OBJECTIVE

Revaluation of the condition of women and their progressive incorporation into the activities of the life of the country.

b. POLICY GUIDELINES

- (1) To facilitate the access of women to the different training programs of the Public and NonPublic Sector, placing special emphasis of farm women.
- (2) To promote the participation of women in the different levels of decision of the political, social and economic life of the country.
- (3) To promote a greater access of women to the educational system, tending to eliminate illiteracy and absenteeism.
- (4) To insure the effective application of coeducation so as to permit the same training opportunities for work to men and to women.
- (5) To promote the creation of centers of initial education and other facilities for the purpose of permitting for women a growing access to the productive life of the country.
- (6) To promote through the Educational System and the means of social communication, the dissemination of programs that are in accordance with a new image of women.
- (7) To amend the Civil Code and laws in general in the aspects that restrict the rights of women.
- (8) To expand the measures of mother-child protection with the participation of the population.

31 EMPLOYMENT

a. OBJECTIVE

Significant increase in the occupational level, promoting a suitable use of labor in the productive process and the development of activities that generate a greater possibility of employment.

b. POLICY GUIDELINES

- (1) To create mechanisms of coordination for the formulation of the employment policy and to establish rules for its execution on a national, sectorial and regional level.
- (2) To harmonize the employment, remuneration and pensions policies.
- (3) To execute and maintain up to date the studies on the occupational requirements of the country and insure that the training of skilled personnel adapt itself to these requirements.
- (4) To promote the maximum use of the installed capacity of the industrial plants to increase the number of jobs.
- (5) To schedule public investment, establishing a calendar of execution that tends to reduce the fluctuations in the use of labor, thus avoid mass unemployment.
- (6) To consider within public investment programs, projects with a brief maturity period that make an intensive use of labor and that are oriented towards the expansion and improvement of the economic infrastructure.
- (7) To grant preferential credit to projects that make an intensive use of labor.

32. LABOR RELATIONS

a. OBJECTIVE

Fair labor relations that permit the compatibility of the dignity, safety and welfare of the worker with the efficiency of the work center and the social and economic development of the country.

b. POLICY GUIDELINES

- (1) To reorganize the labor legislation in accordance with the structural transformations and with the Ideological Bases of the Peruvian Revolution, taking into account the rights and duties of workers and of employers.
- (2) To perfect the legal rules so as to guarantee stability in the job and harmony in labor relations.
- (3) To harmonize and delimit the rules of Labor Law with those of Social Security.
- (4) To achieve the deconcentration and decentralization of the labor administration agencies in accordance with the regionalization of the country.
- (5) To perfect the mechanisms and procedures for the timely prevention and solution of labor conflicts.
- (6) To promote permanent communication and dialogue with workers and employers.
- (7) To regulate the exercise of the right to strike so as not to affect the interests of the country and of the worker.
- (8) To perfect labor legislation to give a special treatment to the prevention and solution of labor conflicts in strategic activities so as to avoid their paralysis as a protection for the interests of the Nation.

- (9) To promote a real union conscience and an effective participation of the workers in the management of their union agencies.
- (10) To establish a global remunerations policy that will insure equity and reduce existing imbalances.
- (11) To improve the management of work, endowing it with the necessary means and insuring the permanent training and supervision of personnel.
- (12) To define the problems found in the Labor Communities, Production Cooperatives and Social Property Enterprises with regard to union organization.

33. EDUCATION

a. OBJECTIVE

Better levels of education, expansion of their coverage and reduction of illiteracy, implementing the Educational Reform.

b. POLICY GUIDELINES

- (1) To reduce illiteracy with the support of the population and of public and non-public agencies.
- (2) To intensify the application of non-teaching programs in the different levels and methods of the educational system.
- (3) To increase, improve and equip the educational centers; to promote the greater participation of the community and use its infrastructural resources with an educational potential. ✓
- (4) To reinforce education on the job and by means of work on the levels and methods of the educational system, linking it with the working activities of the community.
- (5) To promote effective participation of the community in the educational management through the Communal Educational Centers.
- (6) To promote the application of the First Cycle of Higher Education, adapting it to the requirements of the country and of the new productive structure.
- (7) To promote the adaptation of the formation of skilled personnel to the occupational requirements of the country, maintaining the studies on said requirements up to date.
- (8) To intensify the participation of Teachers in the application of the Reform and in the statement and solution of the professional problems that correspond to them.
- (9) To enact the Law on Teachers and other legal provisions that contemplate the regulation of educational work.
- (10) To promote through the Educational System, the formation of ✓

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- suitable personnel for scientific and technological research.
- (11) To enact the legal provisions and progressively implement the Civil Service of Graduates.
 - (12) To develop a policy that reasserts, promotes and disseminates the national and universal culture in its different expressions.
 - (13) To intensify the implementation of the National System of Recreation, Physical Education and Sports.
 - (14) To intensify intersectorial participation in the application of the Educational Reform.
 - (15) To safeguard the obligatory contribution of the enterprises to the financing of the education of the workers and of their families.
 - (16) To promote the reform of educational administration and the securing of financial resources from other sources than from those of the Public Treasury.
 - (17) To promote the creation and development of educational centers that collaborate with the State in the educational task (Private Educational Centers, Educational Centers of a Cooperative Management, Educational Centers of a Communal Management, Higher Schools of Professional Education).
 - (18) To promote the full care of the mentally retarded student for his suitable placement both in work as well as within the society where he lives

34. THE PERUVIAN UNIVERSITY

a. OBJECTIVE

Universities that really constitute higher educational centers, in which culture is preserved and the spirit of study and of research is encouraged and that, operating within a University System, effectively contribute to the progress of the country.

b. POLICY GUIDELINES

- (1) To Regularize university life so that the universities may adapt themselves to the norms of their sphere and that which is governing in the country.
- (2) To Systematize the Peruvian University on a functional basis and with an efficient administration.
- (3) To Encourage and support research, academic and social projection work as well as the work of preservation and promotion of culture linked with regional projects so as to raise university productivity in line with national reality.
- (4) To promote the planning and rationalization of the System of the Peruvian University and of each University.
- (5) To incentivate the formation, improvement and permanence of university professors.
- (6) To regulate the activity of the organizations of the university community sectors by means of provisions that insure their orientation towards educational, cultural, social and sports purposes.
- (7) To promote in the different sectors of the university community the full identification with the genuine aims of the University and the complete fulfilment of their obligations and responsibilities.
- (8) To promote in universities the execution of specific projects of scientific, technological and training research required by the public and non-public sectors.

35. SOCIAL SECURITY

a. OBJECTIVE

An efficient Social Security with a significant expansion of its coverage.

b. POLICY GUIDELINES

- (1) To perfect the financing system of Social Security so as to expand the sphere of loans and insure the correct collection and application of funds.
- (2) To perfect the coordination of the hospital system of Social Security with the Health Sector.
- (3) To encourage the deconcentration and decentralization of Social Security, transforming it into an efficient agency.
- (4) To conclude the process of administrative racionalization of the social security, transforming it into an efficient organization.
- (5) Not to permit the establishment of new special regimes of social security.
- (6) To increase the operational capacity of Social Security for the purpose of providing effective health service in the provinces of the country, giving priority to the rural sector and progressively incorporating the families of the insurees.
- (7) To perfect the Social Security laws so as to facilitate their application and make the procedures for the performance of the services be swifter.

36. HEALTH

a. OBJECTIVE

To handle health needs with a social outlook, tending to place it within the reach of all the population.

b. POLICY GUIDELINES

- (1) To enact the General Health Act.
- (2) To progressively integrate and rationalize the decentralized public health agencies.
- (3) To significantly expand the coverage of health services, giving priority to the binomial of mother-child.
- (4) To offer services of full care, giving priority to health promotion and protection measures.
- (5) To adapt the number and professional skills of the personnel of the health sciences and the auxiliary and paramedical personnel to the needs of the country and to reformulate the curricula of studies in line with the health problems of the country.
- (6) To promote the participation of the population in health prevention measures.
- (7) To perfect and consolidate the Graduate Service in this Sector.
- (8) To develop the health infrastructure, establishing a system of progressive levels of health care, from the home to the specialized hospital, within a rational regional distribution.
- (9) To promote scientific and technical health research, orienting towards these purposes a larger amount of financial resources and international technical cooperation. ✓

- (10) To expand the environmental pollution control programs and perfect the respective legislation.
- (11) To promote nutritional research and education and reorient the supplementary feeding programs, expanding their coverage.
- (12) To incorporate into basic industry the manufacturing of fundamental inputs for the pharminochemical industry.
- (13) **To expand the Basic Medicines Program and promote their distribution and sale on a national level.**
- (14) To intensify the repression of illicit traffic and the prevention of the improper use of drugs that produce dependancy as well as the rehabilitation of addicts, perfecting the respective legislation.
- (15) To stimulate in the Non Public Sector the development of activities that assist the State in its health policy, within the regulations of the Law.

37. FOOD

a. OBJECTIVE

Better food and nutritional levels for the population, particularly of children.

b. POLICY GUIDELINES

- (1) To establish a development policy in the rural sphere that will coordinate the integrated action of the State in support of the productive food activity, in harmony with the consumption needs on a local, regional and national level.
- (2) To significantly increase the production of food of an agricultural or livestock raising origin and to reduce our dependancy on imports with regard to the supplying of food.
- (3) To develop the food industry and promote its decentralization.
- (4) To perfect the marketing system to achieve adequate conditions in the supplying of food products, particularly by eliminating unnecessary middlemen.
- (5) To adopt a pricing policy on a regional and national level that will harmonize the interests of the producers and of the consumers.
- (6) To reinforce in a rational manner the entrepreneurial action of the State in the marketing of food.
- (7) To orient the population in food and nutrition, particularly to help children, older people and expectant mothers, and to regulate the commercial publicity of foods.
- (8) To promote the participation of the organized population in distribution and in price control through Consumers Defense Committees.

- (9) To intensify scientific and technological research referred to the mass production and conversion of foods; and to disseminate and apply its results.
- (10) To unify the policies with regard to production, food assistance and nutritional research activities.
- (11) To develop Food Statistics so that the Sector will be able to adopt immediate measures as well as supply information for planning production, consumption and marketing.
- (12) To promote the consumption of indigenous foodstuffs.

38. HOUSING AND CONSTRUCTION

a. OBJECTIVE

Significant improvement of the housing conditions of the Peruvian population and promotion of private and public investment in construction.

b. POLICY GUIDELINES

- (1) Progressively implement and divulge the National Plan of Urban Development with an intersectorial outlook.
- (2) To promote the construction of housing of an economic and multifamily type as well as infrastructural work in support of economic and social activities.
- (3) To promote the sustained development of construction activity and related industries on the basis of the action of the State, of the social sector and of private initiative.
- (4) To adopt the relevant standards to facilitate the designing and construction of housing with materials of the respective region and with an intensive use of labor.
- (5) To assign to the Sector the exclusive responsibility for the drinking water and sewerage services.
- (6) To rationalize production and regulate the marketing of construction materials as well as quality control and regulation of prices.
- (7) To reorient financing for housing so that it will permit the financing of projects of basic services for the lower income groups, drawing up an investment plan.
- (8) To expand the water and sewerage services and communal equipment, in accordance with the priorities that have been stipulated in the regional development policy.

- (9) To progressively eradicate slum housing with the participation of Local Governments and of the Non Public Sector.
- (10) To promote and offer technical assistance to lower income population groups for self-construction and communal participation in the building and improvement of housing.
- (11) To direct urban expansion towards unproductive and fallow lands, preserving farmlands.
- (12) To integrate into the urban system the Shanty Towns that possess the indispensable services.
- (13) To perfect the legislation on housing and particularly the administrative processing so as to accelerate the rationalization of the programs and projects of the Sector.
- (14) To develop and incentivate technological research in construction materials and constructive systems, taking into account the national, regional and local reality.
- (15) To regulate and control the construction of the buildings of the Public Sector and the communal equipment with the criteria of decentralization, austerity and functionality.
- (16) To promote the financing of construction, orienting it preferably to mass housing programs outside the large urban centers.
- (17) To increase financial resources through the securing of foreign resources for the execution of mass programs of services, progressive housing developments and Basic Centers.

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