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Comparative study on the national science and technology policy-making bodies in the countries of West Africa

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Preface

The Unesco series 'Science policy studies and documents' forms part of a programme initiated by the General Conference of Unesco at its eleventh session in 1960, which aims at making available factual information concerning the science and technology policies of various Member States of the Organization as well as technical studies of interest to policy-makers and managers.

The country studies are carried out by the government authorities responsible for policy-making in the field of science and technology in the Member States concerned.

The selection of the countries in which studies on the national science and technology policy are undertaken is made in accordance with the following criteria: the originality of the methods used in the planning and execution of such policy, the extent of the practical experience acquired, and the level of economic and social development attained. The geographical coverage of the studies published in the series is also taken into account.

The technical studies cover planning of science and technology policy, organization and administration of scientific and technological research, and other questions relating to science and technology policy.

This same series also includes reports of international meetings on science and technology policy convened by Unesco.

As a general rule, the country studies are published in one language only, either English or French, whereas the technical studies and the reports of meetings are published in both languages. Thus the present volume is issued in both these languages.

The present publication is concerned with a study of the structure, performance and effectiveness of science and technology policy-making bodies in the countries of West Africa. This sub-region reflects the diversities observed in Africa: densely populated countries and sparsely populated ones; land locked countries and those fronting the ocean; areas with tropical forests and areas with semi-arid vegetation; countries with planned economies and others with market economies; mineral rich countries and countries with no known mineral deposits. There are countries with English-, French- and Portuguese-speaking colonial pasts.

It is therefore considered that a study of West Africa is fairly representative of the situation in inter-tropical Africa as a whole and could contain material of interest to developing countries outside Africa.

The study was undertaken in 1981 by two consultants recruited from the sub-region concerned who visited 15 of the 16 countries and prepared a report on each, using the outline prepared for the purpose by the Unesco Secretariat, a copy of which forms Annex I. The various country reports are in Annex II.

A joint report was then prepared by the consultants using the various country reports. This report was discussed at a symposium organized by Unesco in Lomé, Togo, 6-9 July 1982. One participant from each of the countries of the sub-region was invited to the symposium, and participants from 13 countries actually attended. Present also were representatives of the Secretariats of the Economic Community of West African States (ECOWAS) and the Economic Community of West Africa (CEAO). The full list of participants is attached to the recommendations adopted at the symposium referred to above, aimed in general at boosting the development of science and technology in West Africa, and in particular in strengthening the national science and technology policy-making bodies in the sub-region (see Part VIII).

This document is primarily aimed at officials responsible for the formulation and the execution of scientific and technological policy at national, sub-regional and regional levels, but it may also be of interest to economic planners and educationists in institutions of higher learning.

The weaknesses revealed by the study, taken together with the recommendations made at the symposium referred to above, could assist Member States in Africa, and perhaps other developing countries outside Africa, in creating, and/or strengthening their national science and technology policy-making bodies with a view to making them equal to the tasks for which they have been created.

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* Attached to the recommendations is the full list of the participants of the Symposium.

** At the time of the collection of data for this publication Burkina Faso still bore the name Upper Volta.

Introduction:

Background, methodology and scope of the Study

The twenty-first session of the General Conference of Unesco, which took place in Belgrade in 1980, recommended that with the co-operation of the Economic Community of West African States (ECOWAS) and the Economic Community of West Africa (CEAO) a critical and comparative study be undertaken on the problems of scientific and technological development in the states of West Africa, in particular as regards the structure, the administration and financing of the science and technology policy-making bodies of these states (see para. 2064 of 21 C/5 approved).

Accordingly, Unesco recruited two consultants from the sub-region to visit separately a number of countries to study, on the spot, the legal arrangements and the methods used by these countries to stimulate, mobilize and organize their national scientific and technological potential for the implementation of their national development plans.

The Study conducted by the two consultants followed a guideline prepared for this purpose by the Secretariat of Unesco (see Annex I). A country report was prepared on each state visited. In all, 15 out of the 16 states* of West Africa were covered by the Study. The monograph on each country contains an examination of the science and technology policy-making body—its structure, its resources (human, financial, material and information), the links between it and the other sectors of the national economy and its impact on the development of the country concerned, have been dealt with.

The assessment of the impact of science and technology on development, has been carried out taking into consideration the overall and sectorial goals of the national socio-economic development plans of the countries, as well as the place of and the degree of integration of science and technology in these development plans.

The joint report emanating from the country reports attempts to make an inter-country assessment of the mode of operation of the national science and technology policy-making bodies of the sub-region.

Part I of the report outlines the main principles of the formulation and implementation of a national science and technology policy.

Part II deals with the degree of integration of science and technology into the various socio-economic development plans of the countries of West Africa.

In Part III is the description of the evolution and the current stage of development of the various science and technology policy-making bodies of the sub-region.

Part IV deals with the financial resources allocated by the West African states to their national science and technology policy-making bodies.

Part V contains the assessment of the impact of science and technology on the economy of the sub-region.

The problems and the future prospects of the development of science and technology at the sub-regional level are examined in Part VI.

Part VII contains a number of conclusions and orientations aimed at boosting the development of science and technology in West Africa.

In the last part (Part VIII) of the report, recommendations have been reproduced *in extenso* which were adopted at a symposium organized in Lomé, Togo (6-9 1982) to examine critically the joint report initially prepared by Messrs Dazogbo and Akeredolu-Ale (the consultants), after their missions to the 15 countries of West Africa.

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* The countries visited were: Benin, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

Part I

Some basic principles governing the formulation and implementation of science and technology policy

Conceptual framework

Recent development of national science and technology policies throughout the world, particularly in developing countries, shows that the various governments are fully aware of the important role that science and technology can play in socio-economic development. This awareness has led to the great desire of the developing countries to acquire as quickly as possible an autonomous capacity in the field of science and technology which will ensure an endogenous and a self-sustaining development. It is, however, observed that these countries do not always take the relevant measures at the appropriate governmental level which will enable them to acquire the scientific and technological capacity on which endogenous development greatly depends. Many international conferences on science and technology have underlined as a serious gap, the absence in many developing countries, of a governmental mechanism for science and technology. More recently, the Vienna Programme of Action, adopted at the United Nations Conference on Science and Technology for Development (UNCSTD) held in Vienna in August 1979, recommended that 'the Government of each developing country should formulate a national policy for science and technology, which involves carrying out certain essential responsibilities such as the planning, budgeting, management, co-ordination, stimulation, promotion and execution of scientific and technological activities relevant to defined development objectives. It implies also the bringing about of careful interaction between factors responsible for growth and transformation'.*

The experience acquired by Unesco while giving assistance to certain Member States has revealed that in spite of the universal character of science and technology there is no universal typology or a standard pattern that can be used in organizing and creating national science and technology policy-making bodies; a standard juridical framework for such bodies is even rarer.

The science and technology policy structures in developed as well as in developing countries have shown that the political ideologies and the socio-economic background on which they have been created have greatly influenced:

— the number and the behaviour of the actors (government officers, the scientific community, political analysts etc.);
— the kind of governmental bodies created;
— the procedure for the formulation, adoption, implementation and the assessment of science policy.

Thus, depending on the political systems and the types of economic planning in vogue in these countries one should expect to have a variety of options regarding the planning of science and technology. Some of these are:

— the *laissez-faire* integration, which is in short, the withdrawal of the government from the sector concerned; the policy followed is as good as having none;
— the indicative planning which develops the resources involved, determines the objectives without enforcing them;
— the normative planning which enforces the objects to be followed and mobilizes the resources accordingly.

In spite of the multiplicity of situations, and although there is no common model for the formulation of science and technology policy, nor a typology which could suit all research institutions and scientific services, a certain amount of generalization is possible as regards the technique used in planning, the types of functions which the various organizations are expected to carry out and the type and nature of the links that must exist between the units of the system created. These are sometimes referred to as an operational network of scientific and technological institutions of a country or simply 'National scientific and technological system'. These general characteristics are dealt with below.

Scope and functions

Looked at from the standpoint of human activities, the words 'science and technology' are ambiguous and difficult to define. The word 'science' may be defined as man's organized attempt individually or in groups (large or small) through the objective study of empirical phenomena, to discover how things work as casual systems. By means of systematic thought, expressed principally in mathematical terms, it brings together the resultant body of knowledge so acquired to be used in understanding natural phenomena and society. Many branches of knowledge have of course, been developed of which one is 'technology'— which deals directly with the production or improvement of goods and services, and is therefore of great economic importance. It is worth noting that Unesco does not exclude any branch of knowledge, including the social sciences, from its definition of the word 'science'.

From the governmental point of view, the concept 'Science and technology' means, nowadays, the totality of activities in a nation that lead to innovations. These include:

1. *scientific and technological research (R).* This is the whole of the process — study, experimentation, conceptualization and theory-testing involved in making new discoveries in the field of science and technology;
2. *experimental development (D),* which consists in the processes of adaptation, testing and refinement which lead to practical applicability. Included in R&D activities is the training of scientists and engineers to make them more proficient in their respective fields;
3. *scientific and technological services (STS),* which represent a mixed group of activities crucial to the progress of research and to the practical application of science and technology. These services collect, process and disseminate the scientific and technological information needed for such purposes.

* Vienna Programme of Action paragraph 18.

4. *innovation*, or the development of a new product or process with a view to ensuring that fresh ideas and inventions are used effectively in the national economy. In effect, innovation also includes the 'transfer of technology' which enables the introduction of products or processes into countries in which they were previously unknown.

However, from the governmental point of view, the concept 'science and technology' does not consist of production of goods and services as such, which as far as government policies are concerned is taken care of by industry, agriculture, health transport, etc.

A close examination of what happens in highly developed, as well as in a cross-section of developing countries, reveals that modern science and technology policy deals with many functions : planning, budgeting, co-ordination, administration and promoting of science and technology and the effective implementation of activities in the areas of research and scientific services; it thus assists in the definition of the nature and the orientation of the overall national development policy. It also plays an important role in the advocacy and suport for science and technology in the society. These various functions are briefly described below.

(i) *The planning and budgeting function*

The first aspect of this function is to look ahead; it is, therefore, long term in character. It consists mainly in defining S&T objectives and in deciding between options and results in periodic statements determining the ranges of resource allocation for national scientific and technological activities.

The second aspect of the function is short term, and therefore more tangible. It focuses on problems such as budget allocations, the share of the national R&D effort to be dedicated to competing requirements and the preparation of decisions on major R&D programmes. Both aspects rely heavily on complete and accurate information, particularly in regard to national scientific and technological potential.

(ii) *The co-ordination function*

This function aims at coherence and consistency among the activities undertaken by government institutions (and the private sector, if any) which have operational responsibility for R&D programmes and the related scientific and technological services.

(iii) *The management and promotion function*

The management function is concerned with the practical execution of the objectives of the programme. At this stage, the main concern is the optimization of the resources and the efficiency of execution.

(iv) *The execution function*

The practical implementation of programme objectives is related to this function, the main problem being bench-level optimization of resources and effectiveness of operations.

(vi) *The function of general policy advice*

This function includes participation in the preparation of the national development plan, advice on crucial issues like the use of the sea and the natural environment, the creation of alternative civilization blueprints to reduce societal or international tensions, the use of science and technology for national security purposes and the shaping of national ethics and laws on the use of scientific discoveries and inventions.

(v) *The function of advocacy for science and technology*

This function comprises organized support for scientific and technological activities as such, and especially for fundamental research which, because it is long-term, tends to suffer by comparison with applied research with regard to the allocation of funds to R&D at the national level. It also includes the protection of the legitimate interests of the scientific community, and of the responsibilities and rights of its individual members. It is obvious that science and technology in themselves are rather weak competitors in the race for budgetary allocations. They therefore need authorized spokesmen close to the corridors of power to present their case and take steps to ensure that their discoveries and innovations, whether from within or without, are understood and applied.

Governmental structures and mechanisms for policy-making in science and technology

In a number of developed and developing countries, several new ministries have been created in recent years in fields such as energy, environment and culture. Among them, one often finds a ministry of Science and Technology, or an equivalent governmental body directly responsible to the Prime Minister, as the case may be. In countries where science and technology and daily politics are separate, the governmental policy-making body is not headed by a cabinet ranking minister. Instead, matters in this field are referred to a special statutory body, a system thought to encourage continuity in policy when frequent changes in personnel occur at top political level.

There are many reasons for creating such horizontally integrated policy-making bodies in the field of science and technology, some of which are mentioned below:

The first is the obvious inability of 'vertical' ministries responsible for a well-defined sector of the economy such as agriculture, health or industry, to deal adequately with the application of science and technology to development either *across the board*, or in terms of *objectives* assigned and *resources* devoted to research, experimental development and scientific and technological services. One major drawback of such a purely sectoral approach is that no single governmental office is responsible for 'inter-sectoral' questions, or for developing new fields which are not the concern of traditional ministries. Under these circumstances, research and innovation are bound to generate 'more of the same' instead of pioneering in fields like space, nuclear energy or oceanography; only marginal attention is paid to urgent problems like the degradation of the environment, the quality of life, urban decay, rural development and unemployment. Another frequent inadequacy is the absence of any governmental authority responsible for the post-graduate training, status, working conditions and employment of scientific researchers and similar personnel in the governmental, higher education and private productive enterprise sectors. The resulting 'brain drain' or emigration of talent, now a well-known phenomenon, has crippled or at least impoverished the scientific communities of many developing countries in recent years.

A second reason for creating such horizontal bodies is the acute 'vulnerability' of research and scientific service budgets in all traditional ministries. These activities are of vital importance for the long-term future of any nation and for the development of human knowledge. However, they often undergo severe budgetary cuts or are badly hit by inflation if there is no one at top governmental level to support them, to ensure adequate promotion of science and technology through successive national development plans or state budgets, and to hold the key to a 'double lock' on budgets relating to science and technology (R&D and STS) in *all* ministries. It is well known that the

lead-time between the establishment of research teams and the yield of applicable results is, on average, seven years, throughout which continuous effort is required. Any discontinuity in budgetary support for these research units leads to their breakdown and total waste of initial investment.

Thirdly, the creation of horizontally-integrated policy-making bodies are a consequence of the administrative and financial autonomy of higher educational institutions in many countries. While these institutions of higher learning often account for most of the national research potential, it is difficult to harness this innovative force into activity oriented towards national requirements, because university-research remains exclusively 'discipline-oriented'. The results are published in international science journals, and primarily serve the advanced countries which can use them immediately, while the less developed countries foot the bill — paradoxical situation indeed! A governmental science and technology policy-making body, with a related budgeting or funding system for 'mission-oriented' research supporting long-term development policy enables considerable academic resources to be mobilized in order to solve national problems.

Fourthly, there is a universal and growing need to double-check and invigorate (by means of competitive research teams) the often inflexible and somewhat 'crystallized' autonomous organizations created by governments for the study of demographic, economic, economic, social and development or public health programmes.

Finally, one should not forget the various tasks to be carried out at national level in regard to technological transfer, commercialization, forecasting and assessment.

The above-mentioned considerations have lead to the distinguishing of a different functional levels at which these functions could be performed. Experience has shown that governmental bodies perform more efficiently when their functions, scope and powers are defined in unequivocal terms. In this way, unnecessary duplication, 'vicious circles' or obstructions within the process of the formulation, adoption and execution of the national science and technology policy can be avoided.

Comparative studies carried by Unesco have shown that it is useful to distinguish four functional levels in governmental science and technology policy-making:

Functional level 1:
general science and technology policy

It is at this level that decisions on the choice between various major options are taken by a Committee of Ministers charged to do so. These decisions determine the main orientation of the overall national policy as regards science and technology.

In practice, it is at this centralized level that is placed the inter-ministerial organ responsible for planning, budgeting, the formulation of decisions, ministerial co-ordination and for the overall evaluation of results achieved. It is worth noting that in countries with parliamentary type of government, the national plans and related budgets for science and technology need to be placed before parliament for approval.

Functional level 2:
management of the national science and technology system

It is at this level that detailed directives are prepared for the implementation of the national science and technology policy. This policy level is at times centralized as at the first functional level. On the other hand, functions at this level are performed by the Ministries and their sectoral science policy units. It is at this level that the sectoral programmes and the relevant budgets reflecting the objectives of the national science and technology policy, are prepared. Also indicated in the programmes and budget is the time-frame within which the activities must be executed.

Also at this level is created at times National Research Councils, advisory bodies on which the government calls for scientific advice from qualified scientists and engineers either in their own right or as representatives of academies or science associations etc. The role of these councils is to 'translate' the socio-economic development objectives into those of science and technology and farm them out to the R&D and the STS institutions. The functions performed at this level are closely related to 'inter-ministerial co-ordination'. They can be carried out either through 'programme-budget' procedures as applied in so-called 'management by objectives'.

Functional levels 3 & 4:
execution of R&D and STS programmes

These levels concern the actual performance of institutions, laboratories, research units (R&D) and scientific and technological services (STS).

In general, it may be said that the governmental structures and mechanisms belonging to the first and second functional levels are established in such a way as to:

(a) allow their adaptation to suit the administrative traditions as well as the socio-economic and cultural conditions of the country concerned;

(b) assign, unequivocally, responsibility for policy formulation to a centrally placed organisation at the highest level of Government and/or strongly linked with the highest planning authority for overall national development;

(c) make possible a constant review of the national science and technology policy and its adaptation to changing circumstances;

(d) ensure the active participation of the scientific community (without distinction of disciplines) during the national science and technology policy-formulating process.

(e) endow the organization in charge of policy formulation with an adequate budget to ensure the quality and continuity of its work and to offer it reasonable autonomy and stability to carry out its functions regardless of any political reorganization.

Part II

Integration of science and technology into the socio-economic development plans of the countries of the West African sub-region

The best index of a society's technological development is its ability to use its own endogenous technological capacity to produce, itself, the goods and services it needs. This ability shows itself in the way this society produces these goods and services, i.e. in the tools and instruments it uses and in how it applies its acquired knowledge to the production process.

In this Study, therefore, the authors set out to investigate the extent to which science and technology are integrated into the socio-economic development plans of the states concerned. In other words, the Study bears essentially on the way the countries of the sub-region use science and technology to solve their major development problems.

What emerges from it is that, as a general rule, the governments of the countries in West Africa are fully aware of the important role that science and technology must play in the socio-economic development of their countries. The need to promote technological development is felt by all the countries of the sub-region, but very few have a clearly defined national science and technology policy aimed at systematically integrating science and technology into the formulation of the objectives of the development plans and their execution.

Planners very often lay down the objectives of a plan without bothering to find out whether the basic scientific data needed to achieve them exist. Generally speaking, there was seldom found in the plan documents examined any systematically laid down strategy based on available scientific and technological data for achieving the objectives of the plan; rarely is provision for the acquisition of such data made in the plan documents.

However, certain countries such as Senegal, Ivory Coast, Nigeria and Ghana, which have relatively well-developed science and technology policy-making bodies, have made some effort to integrate science and technology into the major objectives of their plans.

In Senegal, for instance, clear-cut objectives were thus defined for a national scientific and technological system to support the developemnt objectives of the various economic sectors in the 1977-1981 Five-Year Plan, and financial resources (nearly 11,000 million CFA francs) were set aside to implement this science and technology policy.

In the Ivory Coast, scientific research represents one of the most important auxiliary measures laid down in the 1981-1985 Plan. Fields of research will be closely linked to the general objectives of development. Thus priority will be given to research aimed at expanding, diversifying and modernizing agriculture, stock-farming and forestry. In particular, considerable resources have been earmarked for scientific research in the agricultural sector, which has been declared a priority in this country.

In Nigeria, after years of hesitance, an objective of self-sufficiency has been set and the 1981-1985 Five-Year Plan document proposes definite measures to accelerate technological development in the various sectors. A look at the objectives and policies laid down in the Plans for the various sectors of the economy, such as agriculture, industry, mining, transport, energy and construction, show that the question of technological development is taken into account at this level as one of the problems arising from inadequate domestic implementation capability. Similarly, the problem of training qualified scientific and technological manpower to meet demand in the various sectors was taken into account in the process of planning education in the National Development Plan.

In Ghana, the importance of promoting and integrating science and technology and applying them to development problems was appreciated by the governmental authorities very early on. Notable efforts in this direction have been made since independence to organize, plan and promote the development of science and technology as an essential component of national socio-economic development. With the creation, less than a year after independence, of the National Research Council, science and technological activities got under way in Ghana on a national basis, and were planned, oriented and carried out in the context of a true national development. The frequent political changes in this country seriously affected the efforts undertaken since 1958 to integrate science and technology into national development objectives. These efforts have now been resumed and are being realized. For the first time since independence, a whole section in the 1975/1976-1979/1980 Five-Year Development Plan has been devoted to science and technology policy. It is significant that one of the fifteen specialized committees to draw up the Five-Year Plan was concerned with defining ways and means of developing a science and technology policy for Ghana. The science and technology committee in its report reaffirmed the political will to use existing knowledge and compile new scientific and technological data to solve the problems facing the country.

In Guinea (Revolutionary People's Republic), the science and technology planning body is one of the most long-standing in West Africa. Acute awareness of the role that science and technology can play in the socio-economic development of the country exists at the highest national policy level. The Central Committee of the government party in Guinea, is the supreme decision-making body where science and technology policy is concerned. The formulation of the policy is at present assigned to its Cultural Commission. All the conditions for the integration of science and technology into the objectives of socio-economic development seem, in theory, to have been met. Nevertheless, it has been observed that science and technology have still made little real impact in terms of improving domestic production capacity. All the efforts made for more than twenty years to develop science and technology in order to improve productivity and solve the major development problems facing the country seem to have had little result.

In other countries, viz. Benin, Guinea-Bissau, Upper Volta, Mali, Gambia, Mauritania, Liberia, Sierra Leone, Niger and Togo, although research activities exist, mainly in the agricultural sector, development plans do not include a policy for science

and technology which can be translated into a national scientific and technological budget. The research budgets which figure from time to time in certain plans (Upper Volta, Mali and Niger) are committed either by way of national counterpart for bilateral or multinational co-operation projects or else in aid of one-off agricultural development projects (Benin and Niger).

The absence of national options for science and technology in the development plans of most countries in the sub-region is due to the fact that most activities in these countries arise not from national initiatives but from operations undertaken by foreign and international bodies inherited by the host country. Despite their keenness to maintain and develop the research structures they have inherited, many West African countries have not yet created mechanisms for decision-making and planning in the field of science and technology. The integration of science and technology into the national development plan is one of the most important functions of the national science and technology policy-making body. This integration cannot be achieved in the absence of such a body. It is also worth noting that it is only in countries of the sub-region which have operational science and technology policy-making bodies, that there is to be found a distinct chapter in the national socio-economic development Plan devoted to the scientific and technological development programme together with the appropriate budgetary appropriation made for its implementation.

Part III

History and present structure of science and technology policy-making bodies in West Africa

Unesco periodically takes stock of research and experimental development (R & D) activities and science and technology policy-making bodies in Africa. The latest and most comprehensive documents on the subject are those which were compiled for the Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA) held in Dakar in January 1974 (see Nos. 31 and 35, of the Unesco series "Science and policy studies and documents").

The present Study, which deals only with the West African sub-region, confines itself to investigating and assessing the effectiveness of science and technology policy-making bodies.

Origins and development of R & D activities in the sub-region

(i) Colonial R & D institutions

Before the independence of the states in the sub-region, research activities in many countries were often carried out by research institutions in the mother country which had African research branches. In the French-speaking countries they were mainly French research bodies such as ORSTOM, IRAT, IRCT, IFCC, IRHO, etc.*

These institutes specialize mainly in research on agricultural produce which explains why agricultural research has developed more rapidly than other types of research in the sub-region.

In the English-speaking states of the sub-region, the former West African Research Organization (WARO) called on the services of Research Institutes, mostly founded in the 1930s and 1940s which operated in Gambia, Ghana, Nigeria and Sierra Leone via a number of stations for cocoa (WACRI), palm oil (WAIFOR), maize (WAMRU), rice (WARRS) the social sciences (WAISER) and health and medicine (WACMR).*

All these institutions played a decisive role in the emergence of scientific and technological activities in the sub-region, by facilitating meetings between scientists from the various countries covered by their network.

(ii) Role of the United Nations

But what especially aroused national awareness of science and technology were various events (meetings, symposia and conferences) organized by Unesco for African states, in particular:

— the International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilization of Natural Resources, held in Lagos (Nigeria) from 28 July to 6 August 1964;

— the Symposium on Science Policy and Research Administration in Africa, held in Yaoundé (Cameroun) from 10 to 21 July 1967;

— the Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA), held in Dakar from 21 to 30 January 1974.

The results of these conferences began to be apparent in 1965. As part of the implementation of the recommendations of the 1964 Lagos Conference, Senegal and Nigeria each submitted a separate request to Unesco to help them set up a national science and technology policy-making body. In 1966 a Unesco mission (N.R. Martin mission) was sent to Lagos to help the Nigerian government lay the foundations of a science and technology policy mechanism.

In Senegal also the Interministerial Council for Scientific and Technological Research and the Bureau for Scientific and Technological Affairs were set up by decree 66-13 of 26 October 1966 following an Unesco expert mission in 1965 and the recommendations for the setting up, at the highest governmental level, of an International Research Co-ordination Council and an Office of Scientific and Technological Affairs.

As part of the implementation of the recommendations of these various conferences, several states, between 1967 and 1970, set up National Scientific Research Councils (Mali and Niger), Ministries of Scientific Research (Ivory Coast, 1970), or General Delegations for Scientific and Technological Research (DGRST) (Senegal, 1974). Various activities and deliberations on science and technology resulted in the creation, in 1978, of a Ministry of Higher Education and Scientific Research, in Upper Volta.

The recent Vienna Conference on Science and Technology for Development (UNCSTD), held from 20-31 August 1979, reinforced this trend.

The recent setting up of a Federal Ministry of Science and Technology in Nigeria in October 1979 and a Ministry of Higher Education and Scientific Research in Benin in 1980 are in keeping with the new implementation of the Vienna Programme of Action, and are the beginning of a new trend qualitatively superior to that of the decade 1960-1970.

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* ORSTOM :Office de la Recherche Scientifique et Technique Outre-Mer
IRAT :Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres
IRCT :Institut de Recherches du Coton et de Textiles Exotiques
IFCC :Institut Français du Café, du Cacao et autres Plantes Stimulantes
IRHO :Institut de Recherches pour les Huiles Oléagineux.
WACRI :West African Cocoa Research Institute
WAIFOR :West African Institute for Oil-Palm Research
WAMRU :West African Maize Research Unit
WARRS :West African Rice Research Station
WAISER :West African Institute of Social and Economic Research
WACMR :West African Council for Medical Research

(iii) Role of the post-independence intergovernmental organizations in the sub-region

Towards the end of the first decade of independence (1960-1970), certain sub-regional organizations were set up to deal with the common problems of the States in the sub-region, viz. CILSS, OCLALAV, WARDA and most recently, CEAO and ECOWAS*. These organizations have scientific research departments which draw up programmes of community research. Their various joint activities demonstrate that the prerequisite for scientific and technological co-operation between Member States is the strengthening of national structures.

The strengthening of these structures is a policy that aims at strengthening the national science and technology capabilities of the States, without which no policy of co-operation is possible in this field.

Present situation

The present situation of science and technology at sub-regional level accurately reflects the political and socio-economic situation of the States. It is characterized by:

— Uneven development of science and technology policy bodies as between one State and another;

— Diversity of the experiments in progress as regards the organization of the science and technology policy mechanism. Some States (Benin, Liberia, Sierra Leone, Gambia, etc.) are still looking for the most suitable form of mechanism in the light of their socio-economic situation;

— Others are going backwards; thus in Mali, the National Council for Scientific and Technological Research, set up in 1967 under the Lagos recommendations, had to be disbanded in 1970 for lack of working funds. From Niger it is reported that the National Council for Scientific and Technological Research has not met since the Ministry of Higher Education and Scientific Research was created in 1978. There is at present no organ in the new Ministry that could replace this body or play its roles of joint consultation and co-ordination of science and technology activities assigned to this body.

— As in Guinea and Togo, a state of stagnation is observable in the science and technology policy body, whose organization status by no means reflects the length of its active life.

The only cases of gradual cumulative development of the science and technology policy-making bodies are those of Senegal, Nigeria, Ivory Coast and Ghana. Here, thanks to a sustained political will, the science and technology policy-making bodies developed through qualitative changes to reach a fully operational stage of development, which enables them to act as a source for the dissemination of science and technology, not only at national, but eventually also at sub-regional level, if a policy of sub-regional co-operation between states were to be introduced, as is the case with the CEAO.

Generally speaking, there is a positive political will in the sub-region to develop science and technology and make it an efficient tool in the service of socio-economic development. It remains to remove a certain number of political, administrative socio-cultural and economic obstacles before this will can be converted into reality.

These obstacles include:

— The absence of science and technology policy-making bodies in a great number of countries of the sub-region;

— The inadequacy of financial resources allocated to science and technology in the state budget;

— The dearth of scientific personnel (scientists, engineers and technicians) and misuse of the personnel available.

CILSS :Permanent Inter-State Commission for Drought Control in the Sahel
(Comité Inter-État de Lutte contre la Sécheresse dans le Sahel)
OCLALAV :Joint Antilocust and Antiavarian Organization
(Organisation Commune de Lutte Antiacridienne et de Lutte Antiaviaire)
WARDA :West African Rice Development Association
CEAO :West African Economic Community
(Communauté Économique de l'Afrique de l'Ouest)
ECOWAS :Economic Community of West African States

Part IV

Finance and operations

It is already difficult to discover from state budgetary structures how much of the national budget is devoted to science and technology as a whole. Now, the present Study is limited to investigating the effectiveness of science and technology policy-making bodies, which implies finding out what resources these bodies possess in order to carry out their missions. It is however, difficult to identify science and technology policy-making bodies' own resources in the countries of West Africa for several reasons:

1. In some cases, although scientific and technological research is carried out in the country, there is no science and technology policy-making body responsible for co-ordinating these activities. Hence it is difficult to speak of resources allocated specifically to this body.
2. In other cases the science and technology policy-making body has a legal existence but operates as a research unit, and often the budgets for the two functions are not separated.
3. In rare cases (Senegal, Ivory Coast, Ghana and Nigeria) a science and technology policy body exists and is functional and provisions for financial resources are made in the national development plan for science and technology. But the administration of these budgets is still subject to the classical financial regulations according to which funds are shown in the administrative appropriation budgets prepared ministry by ministry; it is often therefore not easy, if not impossible, administratively to obtain complete information on movement of funds, and the amounts explicitly allocated to national science and technology policy so as to be able to make an analysis of their distribution.

Several types of research institutes may be distinguished among the states of the sub-region:

(a) State institutions financed by government funds. This is at present the case in a majority of countries.
(b) Local units depending on the former mother country operating under bilateral agreements. In most countries in which they still operate, the tendency is in the direction of integrating them into national structures.
(c) University research units and polytechnic institutes concerned essentially with teaching science and technology. To this end they often carry out basic discipline-oriented research.
(d) Private research institutes. There are only a few of these, and they form part of multinational companies which are but branches of parent firms based in the former mother country. It is well known that it is in the laboratories of parent firms in the mother country that most of the research for the branches is undertaken. The impact of such research on the development of national science and technology is limited.
(e) Professional science and technology associations. There are not many of these left in the sub-region, apart from WASA (West African Science Association), whose impact is, however, relatively limited.

As a general rule, the financing of R &D in the sub-region falls within the purview of the State Budget. The odd research programme concealed here and there in development projects can only be regarded as auxiliary to certain specific national developmental efforts.

Governments are becoming increasingly aware of the need to allocate, explicitly, funds to national scientific and technological development activities as such.

The political will to do this exists, but *it remains to adopt proper procedures* to implement it rationally in budget planning, by devoting a specific chapter for science and technology in the national development plan, and by taking the appropriate parallel budgetary measures which will facilitate their administration and the evaluation of work accomplished.

Part V

Assessment and impact of science and technology on the economy of the sub-region

Development is regarded nowadays as the process by which a national society moves from its present cultural, political, economic and social stage to a more advanced one.

This change comes about through the implementation of a certain number of objectives which governments set themselves in their development plans. The role of science and technology as the driving force in achieving these objectives is widely recognized today. But science and technology cannot assist development if they are not the subject of an agreed, clearly defined national policy. This policy is defined as: "principles and methods, together with the legislative and executive provisions required to stimulate, mobilize and organize the country's scientific and technological potential".

Science and technology policy pertains to all research and experimental development (R&D) operations, including scientific and technological services (STS), as well as the transfer and innovation process which ensures effective use of discoveries and inventions in the productive sectors of the national economy.

In this sense, science and technology policy cannot have a real impact on development if research and experimental development activities are not geared to national socio-economic development objectives and do not contribute effectively to their achievement.

The assessment of the impact of science and technology policy then falls into two main parts:

(i) First the impact on development of scientific and technological potential itself.
During the last two decades the science and technology policy-making bodies of some countries in the sub-region have developed considerably. This development has stimulated the allocation of resources to science and technology in these countries (Senegal, Ivory Coast, Nigeria and Ghana) and has given a relatively sharp impetus to both human and material scientific potential. It is observed that the sector that has benefited the most from this development is that of agricultural research, which accounts for between 60 and 80 % of the resources allocated to scientific and technological research in these countries.

(ii) Secondly, the impact on the different sectors of the economy.

Agricultural production and rural technology

80-90 % of the people in the countries of the sub-region still work in the agricultural sector. The development of agricultural research is still given prime of position by governments, both as regards R & D activities and staff training programmes in educational systems (75% of secondary school leavers in the Revolutionary People's Republic of Guinea are directed into faculties of agriculture).

The impact of this deployment of effort on the rural population is by no means negligible. Thus new varieties of seed have been made available to farmers, while stock-breeders have seen new breeds of animals appearing in their herds, vaccines against the scourges that threatened them and so on.

In the rural areas new methods are being tested in the fields of energy (biogas), transportation (haulage), pumping out of well water and preservation of food. UNICEF is carrying out a massive rural technology programme in various countries.

Nevertheless, the fact remains that the real impact of all these activities on the well-being of the people is still limited judging from the continuance of poor living conditions. It would therefore be interesting to carry out a survey on this question, using polls and computerized questionnaires, to discover the degree of efficacy of these programmes and the reasons for their limited impact.

The difficulties the farmers have in correctly applying research results in this sector in fact stem from the very methods used to arrive at these results. The point is that agricultural research has so far adopted a thematic approach to produce innovations calculated to lead to the improvement of agricultural production. Thus there is a package of results for cotton, a separate one for groundnut, and another for maize and so on, all available to the farmers in separate packages.

Consequently, the combination of these results in a scientifically studied system of agriculture barely exists, if at all. The result of all this is that these packages of results, not tested in a study of a farming system combining all the production factors prevailing at the level of the farmer, remain pretty theoretical; and there is a large discrepancy between performance observed at research stations and the results the peasant obtains in his field.

Furthermore, if innovations are to be properly integrated into his farming system, they must be on the farmer's scale, ie. applicable by him in economic, social and cultural terms. They must be devised with the system used by the farmer in mind.

Industrial production

The impact of national science and technology on industrial production in the countries of the sub-region is still very limited. There is a complete contradiction here between the desire for economic independence and the industrial policy pursued, the latter being essentially based on imported advanced technology which one can say, neither takes account of the local situation nor of the skills of the domestic labour force. Factories in the sub-region are very often no more than branches of a big industry based in the European parent countries. The consequence of this industrial policy is that these West African States are technologically highly dependent in their industrial development process. Industrial production itself suffers as cruelly as a result, since in the absence of qualified maintenance technicians it takes only the most trivial mechanical failure to shut down production for two to six months. Furthermore lack of foreign exchange often makes it difficult to obtain spare parts.

This impact is relatively more noticeable in the agro-business sector. Thus in the sector of fruit and vegetable processing and

the use of local cereals to make bread, interesting results have been obtained. These results remain limited where village communities' knowledge of food preservation methods and processes is concerned.

Impact on house-building technology and building materials

Research agencies do exist in this field, but their activities are badly co-ordinated. Little research has been done on the use of local building materials. The big building material cartels seem to be a law unto themselves and constitute an obstacle to progress in this field.

Impact on energy

The energy crisis which the world has experienced for a number of years has had serious repercussions on the economy of the sub-region.

This can be seen in:

1. the deficit in the foreign balance of payment, the principal cause being the cost of oil, which in certain countries absorbs nearly 50% of receipts from the country's exports.
2. the phenomenon of desertification largely caused by the large-scale comsumption of wood for heating purposes which accounts for nearly 90% of all domestic energy in the rural areas of the sub-region.

This situation has led West African countries to seek other sources of energy to replace the traditional forms used hitherto, such as oil and coal. Important results have been obtained in certain fields of new or renewable energies:

(i) Solar energy

In the field of solar energy, satisfactory standards have been reached in the thermal and thermodynamical aspects of the problem.

Prototypes of solar water-heaters, cookers, dryers, and distillers have been developed by the "Office National de l'Énergie Solaire" (National Department for Solar Energy) - ONERSOL - in Niger and are now widely used throughout the sub-region. Prototypes of solar irrigation pumps are already in use in Senegal, Mali, Upper Volta, etc.

The Member States of the "Communauté Économique de l'Afrique de l'Ouest" (West African Economic Community - CEAO - are at present contemplating the setting up of a "Centre Régional d'Énergie Solaire" (Regional Solar Energy Centre) - CRES. The purpose of this project is to develop research into all types of use of solar energy and to establish a community research centre whose purpose will be:

— to formulate an overall energy strategy for all countries in the Community;
— to design and produce solar equipment suitable for their requirements;
— to develop applied research into solar or other forms of energy;
— to organize the training of personnel required in this field;
— to centralize information relating to energy problems, disseminate it and participate actively in the development of regional and international co-operation in the field of energy.

However, all the possibilities offered by solar energy, notably its conversion into electricity have not been fully explored. There is still the need to develop a technology in this field that will render the use of this source of energy (particularly through the use of photovoltaic cells) economical.

(ii) Biomass

The transformation of vegetable matter into a combustible gas by anaerobic fermentation of crop residues and agro-industrial waste is a form of energy production particularly well adapted to the rural areas of West Africa. Biogas has many uses (cooking of food, lighting, refrigeration, water pumping, etc.) and is a renewable and independent source of energy capable of satisfying many of the energy requirements in isolated rural areas. Further, the compost resulting from fermentation is a useful source of manure for tropical soils, which are particularly poor in organic matter.

Important results have been obtained in the use of biomass. But, here again, due to high cost of the digesting plant and accessory equipment, this sort of technology is at present beyond the reach of many farmers in the sub-region.

(iii) Energy from wood

Energy from firewood accounts for nearly 90% of the energy consumed in most of the West African rural areas. This situation, due to the absence of the availability of any other form of energy to the rural masses, has had the immediate result of reducing forest areas on a dramatic scale in certain parts of the Sahel where one has to travel more than 100 kilometres to find wood. The resultant ecological imbalance and even desertification in certain countries has led research institutes to seek means of economizing firewood. A number of prototypes of improved stoves have been developed and distributed in the sub-region, which can lead to a substantial saving of wood (in certain cases savings of nearly 40% in wood have been recorded).

Other sources of renewable energy

Very little research has been done into other forms of renewable energy such as wind, geothermal and tidal energy.

The national energy policy

A rapid survey of the sub-region's energy problems shows that, in spite of the low consumption of energy (on average less than 200 coal equivalent kilos per head) the energy problem will continue to be a major brake on its economic development.

It is therefore important that the States create a governmental mechanism for the formulation and implementation of an energy policy aimed at diversifying the sub-region's sources of energy, particularly through research into renewable energy sources.

Overall impact

Despite the results accumulated by research institutions in the sphere of agriculture, this sector is still characterized by low productivity. This means that research workers still have much to do to make their research beneficial to the farmers in the sub-region, 90% of whom it should be remembered, are illiterate.

In the industrial sphere the contradiction between the desire for economic independence and the policy of massive imports of technology is at the root of the weakness recorded. The application of science and technology to the problems of development that arise in the sphere implies the introduction of co-ordinated management of the scientific and technological and economic policies of the various countries. By and large, the wrong policy adopted, the content of research and the use of the results are such that, despite the efforts made by the various governments, countries continue to import food and ask for aid in the form of foodstuffs from outside. This situation, unfortunately, results in a high cost of living for the people. Finally, in the sphere of industrial production, the lack of co-ordination between the desire for economic independence and a rational industrial policy continually increases the technological dependence of the countries of the sub-region on the outside world.

Part VI

Problems and future prospects

Problems

Clearly, the economic, social and cultural situation of a country largely determines the objectives and resources of its policy regarding science and technology. Conversely, it is nowadays recognized that the latter has a profound influence on the "change" component of development (intensive growth) which in turn characterizes the upward movement of countries from the agricultural, pre-industrialized stage, to the stage of the so-called post-industrialized societies in which more than fifty per cent of the total labour force is employed in the service industries.

The majority of West African countries are still in the pre-industrialized stage of development where the national economy depends on the production and export of raw materials coming from the agricultural, forestry, fisheries and the mining sectors.

Most manufactured articles including equipment are imported. Higher education is not yet sufficiently developed in the sub-region. Apart from a few cases mentioned in this Study, the majority of the States in the sub-region have not yet established governmental bodies responsible for national science and technology policy.

As a result of this the countries of the sub-region are faced with a number of common difficulties in their efforts towards socio-economic development. These include:

1. The weak integration of science and technology into the national development plan.
2. The inadequacy of the financial resources (particularly the foreign exchange component) allocated to national science and technology*.
3. The dearth of scientific personnel at various levels and the lack of a balanced plan for training them.
4. The lack or inadequacy of a structure for information and for the dissemination of scientific and technological research results.
5. The high proportion of illiterates in the population, which poses a severe handicap in the application of available research results.
6. The bad general working conditions and poor remuneration of scientific workers (scientists, engineers and technicians).
7. The high degree of economic dependence of the sub-region.
8. The shortcomings in the national development planning caused by the lack of indigenous qualified personnel in this field.

Future prospects

Despite the many problems set out above, and the shortcomings observed here and there, there are nevertheless some very definite signs that most countries in the sub-region are giving special attention to the task of devising and setting up national science and technology policy-making bodies.

This trend is helped by the efforts of the United Nations system to promote scientific and technological development.

Many science and technology policy-making bodies have been set up in Africa as a result of the recommendations of the conferences on the organization of scientific and technological research, organized by Unesco in Africa (in particular the Lagos conference in 1964 and CASTAFRICA in 1974). More recently, the United Nations Conference on Science and Technology for Development (UNCSTD) held in Vienna in 1979 gave a fillip to the development of science and technology in the developing countries in the more general context of the establishment of a new international economic order.

All these international events were welcomed by governments, and resulted in widespread expressions of intent to set up national and sub-regional science and technology policy bodies where none existed and to reorganize and use them better where they already existed.

Furthermore, international initiatives need to be co-ordinated with those of governments so that the results may lead to a brisk and sustained "take off" of science and technology in the sub-region with a view to their being applied to socio-economic and cultural development. This means, the future development of science and technology in the sub-region must be viewed within the overall context of the major problems of development facing the sub-region.

Even though science and technology represent an important factor of development their impact on the development process can only be felt when they are judiciously used in conjuntion with all other factors of economic, social and cultural development of the society concerned. An inadequate dose of any of these factors inhibits the others. Thus in spite of their potentiality, science and technology alone cannot succeed in solving the complex developmental problems identified in the sub-region. The governments need to be made aware of these realities, so that, in implementing their national scientific and technological policies, care is taken that appropriate, complementary measures are also taken in other sectors.

* In 1974, the Conference of Ministers of African States responsible for the Application of Science and Technology for Development (CASTAFRICA) recommended (Recommendation, No. 1 (4)) "that Member States, taking into account national demand for R & D, increase their annual expenditure on R & D and supporting scientific and technological public services (STS) so as to attain, if possible before 1980, the target figure of a minimum of 1 percent of the Gross National Product..." It must now be admitted that, despite the efforts of certain States, this target still proves difficult to reach by any country in the sub-region.

Part VII

Conclusions

The main purpose of this Study is to make an inter-state evaluation of the way the national science and technology policy-making bodies in West Africa function, including the extent to which these bodies are able to contribute towards the solution of the major developmental problems facing the countries in the sub-region.

Many sub-regional and regional conferences have been organized in Africa by Unesco, with the co-operation of the Economic Commission for Africa and the Organization of African Unity at which have been adopted a number of important recommendations regarding the creation of science and technology policy-making bodies in Africa. One of the most important of these conferences is the Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASTAFRICA) held in Dakar from 21 to 30 January 1974.

The conclusions of CASTAFRICA had already reflected the situation as it was then in Africa, the main characteristics being:

— the weakness of the scientific and technological potential;
— the inadequacy or the lack of science and technology policy-making bodies;
— the inadequency of resources (human, financial, material and information) allocated to science and technology.

The Conference therefore made many recommendations, inviting Member States concerned to take the appropriate measures to remedy the situation. Similar recommendations were made by the recent United Nations Conference on Science and Technology for Development (UNCSTD) held in Vienna from 20 to 31 August 1979.

This Study, undertaken eight years after CASTAFRICA, is to review the efforts made by the countries in the sub-region since then, to implement these recommendations and estimate the amount of work left unaccomplished.

Using the results of the Study on the organization, functions and effectiveness of the science and technology policy-making bodies in the sub-region, one can divide the countries into three groups.

— The first group consists of countries that have made considerable efforts in setting up and developing national science and technology policy-making bodies; only a quarter of the States fall under this category.
— In the second group are countries which have been able to create national science and technology policy-making bodies, but which, due to lack of resources, have not become operational; such bodies either remain stagnant, or even show signs of negative development. There are more countries in this intermediate group than in the first one.
— Coming into the third group are the countries which have not yet set up a national science and technology policy-making body, although they are aware of the role science and technology can play in development and they, in fact, undertake a number of R & D activities.

The above analysis shows that the work that still remains to be done to boost the development of science and technology in the sub-region is enormous. To succeed in this endeavour, certain measures need to be considered at national, sub-regional as well as at international levels.

At the national level

(1) The creation and reinforcement of national science and technology policy-making bodies

Experience shows that the absence of a national body specifically responsible for the formulation and execution of national science and technology policy can be a great handicap in the formulation of a proper and coherent national scientific and technological development plan. Indeed, without such an organ, any plans for endogenous and self-reliant development often remain a dead letter. In as much as the realisation of development objectives depends on self application of scientific and technological know-how available in the world, it is hardly possible for a country without a body capable of formulating an explicit science and technology policy and of advising the governmental authorities on a rational choice and application of science and technology, to make use of the facilities available. It becomes possible to integrate a country's efforts in science and technology into the overall national development strategy, when there is such a body and which has close working links with the national body responsible for national economic planning, as well as with the different sectors of the national economy.

It is the national science and technology policy-making body, in co-operation with the other planning bodies, that is responsible for preparing the section of the national plan and budget, concerning the necessary resources (human, financial, material and information) which should be allocated to science and technology.

This body is also the government's special advisory organ on the choice of technology which involves either the transfer of technology from outside, or the use of local technology for executing projects in the national development plan.

Finally, the body assists the government in the shaping of national structures for industrial property and for scientific and technological information services.

In short, the main role of such a body is to assist the country concerned in reducing its scientific and technological dependence, thereby helping to promote a genuine endogenous development. It is therefore imperative for any state having such objectives in mind, to set up such a governmental body, or to strengthen it where it already exists.

(2) Development of human resources

Studies of the position of scientific and technical personnel show that the research institutions were not in the least concer-

ned, during the colonial period, to draw up any worthwhile programme for the training of local staff for the management and carrying out of scientific and technological research. The result is that, after independence, these research institutions were absorbed into the national governmental structures, without having the staff to manage these institutions and to work in research units and laboratories, or to formulate a national science and technology policy and put it in to practice effectively.

Twenty years after the attainment of independence by these States, the situation has still not been put right; it is characterized by:

— a general shortage and bad deployment of scientists, engineers and technicians;
— an imbalance between the number of science policy planners and the staff carrying out research.

(i) It is clear from this situation that the Governments' top priorities should include the drawing up and implementation of a national plan for the training and employment of scientific staff at all levels of R & D and STS, based on the real requirements of the countries for these different categories of personnel. In this task, special attention should be given to the training of planners and administrators of science and technology policy, as well as staff to manage research. Their training programmes should be designed to meet the following criteria:

— their subject matter must be adapted to the realities of the sub-region;
— they should be as efficient and as innovative as possible.

(ii) The implementation of such a training programme requires as an auxiliary service a scheme for bursaries for refresher courses.

(iii) Moreover, it is not sufficient to train large numbers of scientists, engineers and technicians; their working conditions and remuneration must be improved by adopting a special status for this type of personnel.

(iv) With regard to technicians and manual workers, it is even more important to raise their social status than it is to improve their remuneration.

All these objectives cannot be achieved unless the current education systems in the sub-region are thoroughly overhauled. It is necessary to introduce into the education system, starting with the elementary school, modern scientific concepts using curricula which stress the role of science and technology in society. Equipment and educational toys should also be employed with a view to arousing, early in the child's life, the spirit of creativity or at least making him dexterous.

(3) Development of financial resources

The implementation of a scientific and technological policy calls for the provision of the necessary means by the government. For the sake of efficiency, these means need to be integrated into the governmental mechanism. One of the difficulties at present encountered in integrating the funds for S & T into the traditional budgetary system is the fact that research budgets in vogue in these countries are "administrative" in nature evolved for the accounts of the expenditure of the State, ministry by ministry and of institutions enjoying administrative and financial autonomy. Such a budget is neither meant for the administration of a clear-cut S & T programme, nor is it suitable for management by objectives.

These countries, therefore, need to evolve budgetary measures that treat "science and technology" as a major heading of expenditure within the national budget in the same way as agriculture, health, education etc. are treated. In the same way, a specific chapter should be devoted to S &T in the national development plan.

(4) Popularization, dissemination and the application of the results of scientific and technological research

The limited impact of S & T on the economy of the sub-region is possibly due to the fact that many research results obtained in the field of agriculture, as well as in that of industry, have not been brought to the notice of the users, due to the absence of an appropriate mechanism for their popularization, dissemination and adaptation for use.

It is therefore essential that each state in the sub-region creates, within the reach of research results users, the appropriate mechanisms for this purpose. For example, in the field of agriculture, these mechanisms have to be integrated into the local agricultural system so that research results may benefit integrated agricultural production, by using packages of factors of production suitable for the conditions similar to those of the farmers involved.

Research in the industrial sector should be geared towards the application of local, as well as foreign technology, for processing local natural resources with a view to eventually manufacturing goods and equipment using local materials; this will help reduce the volume of imported goods.

At the sub-regional level

(5) Development of scientific and technological co-operation at sub-regional level

One of the major weaknesses noted is the lack of co-operation and of opportunities for communication among those in charge of science and technology policy in the sub-region.

The will for sub-regional scientific and technological co-operation exists and has been demonstrated at all intergovernmental sub-regional meetings. This attitude has been adopted for the following reasons:

— promotion of collective self-reliance through the pooling of scientific and technological potential of countries with limited resources;
— avoidance of duplication of certain major programmes which would be too much for one country alone to undertake due to the huge costs involved.

However, for scientific and technological co-operation at a sub-regional level to be viable, there is the need for a relevant administrative and juridical framework within which could be formulated and executed a concerted S & T policy for the sub-regional grouping concerned.

Thus, for example, the West African Economic Community (CEAO) consisting of six States* adopted in 1979 an additional protocol to its constitution concerning the promotion and application of community science and technology policy, thereby taking a step which is a turning point in the establishment of an operational structure for the co-operation of its Member States in this field.

Indeed, the first article of this protocol states that "in order to promote the economic and social development of the Member States, through scientific progress and technological innovation, the Secretary General of the Community will study and recommend to the Council of Ministers and the Conference of Heads of State, measures and activities which are likely to promote community policy for scientific and technological research".

The immediate objectives include:

(a) Promoting, up to operational stage, community intergovernmental scientific and technological co-operation, with a view to optimizing the scientific and technological potential of the community;

* The Member States of the CEAO are: Ivory Coast, Mali, Mauritania, Niger, Senegal, and Upper Volta

(b) Giving advice and assistance to Members States of the Community by assessing their scientific and technological potential and by planning and determining the priorities for their joint scientific and technological activities.

To this end, it has been decided to create a community mechanism responsible for:

(i) The preparation of the agenda for the meetings of the Council of Ministers of State of the Community, including draft proposals and decisions on scientific and technological matters (such as the acceleration of the process of transfer of science and technology for the economic development of the Member States), which are later submitted to the Conference of Heads of State, the supreme organ of the Community.

(ii) the creation, within the Secretariat of the Community, of a department for the co-ordination of the scientific and technological activities of the Community.

Such measures are sure to promote the development of scientific and technological co-operation within the Community, and may soon show results.

(6) Unesco's assistance to the Member States

The current situation of the organization of S & T shows that many of the countries in the sub-region need much assistance in the formulation of their science and technology policies.

Such assistance can be provided by experienced consultants who, at the request of Member States, can help these countries evolve the concept and methodology for planning their national S & T and integrating this into the national development plan. The countries that need such assistance most are Gambia, Guinea-Bissau, Liberia, Mauritania, Niger and Togo.

Finally, considering the present stage of development of science and technology policy-making bodies in the countries of West Africa, and the considerable distance between the sub-region and the Regional Office for S & T in Nairobi, it is desirable that measures should be taken to strengthen the West African Unit of the Unesco Regional Office for Science and Technology for Africa in Dakar.

Part VIII

Recommendations of the Symposium on the Functions and Effectiveness of National Science and Technology Policy-making Bodies in the Countries of West Africa, Lomé, Togo, 6-9 July, 1982

Recommendation No. 1:
National Science and Technology Policy-making Bodies

The Symposium,

Noting that certain countries of the sub-region have still not created national science and technology policy-making bodies and that those in existence are not as effective as they should be,

Recommends that countries in the sub-region consider the options that are open to them in this regard and take appropriate steps to form the type of bodies which suit their socio-cultural, political and administrative structures and regularly review them according to changing circumstances so as to make them effective in performing their various tasks which may include:

— Formulation of science and technology policy;
— Planning and budgeting for science and technology;
— Management, promotion and co-ordination of science and technology;
— Advice to national authorities on the use of science and technology for development;
— Advocacy for science and technology;
— Co-ordination of national participation in international scientific and technological co-operation.

Recommendation No. 2
Training and human resources development

The Symposium,

Mindful of the dearth of scientists, engineers and technicians, and the imbalance between planners and operational staff of research,

Recommends:
1. That the governments which have not yet done so, should draw up a plan for the training of scientific and technological personnel;
2. That such a plan caters equally for planners and executors of scientific operations;
3. That high priority be given to the training of planners and administrators in science and technology policy and to managers of research;
4. That, to this end, and with the assistance of Unesco, a focal point be established in West Africa for the training of research managers, using as base the Dakar Unit of the Unesco Regional Office of Science and Technology for Africa.

Recommendation No. 3
Sub-regional co-operation

The Symposium,

Aware of the weakness of the inter-country co-operation in science and technology in the sub-region,

Desirous that co-operation in the field be encouraged,

Recommends:
1. That the Member States take appropriate measures to strengthen co-operation among themselves with a view to developing their scientific and technological potential. Some interesting areas which lend themselves to such co-operation are:
   — The organization of scientific and technological policies;
   — The training of scientific and technological manpower;
   — Research and experimental development (R & D) on specific topics of common interest;
   — Transfer of technology.
2. That the Member States themselves should identify the topics and define the modalities of co-operation.
3. That sub-regional seminars and workshops be organized on the development of research infrastructure, with a view to assisting Member States start such a co-operation.

Recommendation No. 4:
Creating budgetary procedures for science and technology

The Symposium,

Realizing the deficiencies in the traditional budgetary procedures applied in the countries of the sub-region, and the specific requirements of scientific and technological activities,

Recommends:
1. That measures be taken in each country with a view to inserting in the State Budget a distinct chapter devoted to the financing of national science and technology, which may eventually take the form of a recapitulatory annex;
2. That measures be taken to give R & D institutions financial administrative autonomy in the operation of the budget allocated to them for Science and Technology, and to simplify complicated procedures which tend to stifle scientific and technological activities;
3. That the governmental authorities take the appropriate legislative measures to co-ordinate and approve – at the level of the National Science and Technology Policy-making Body – foreign resources meant for science and technology, in order to facilitate their evaluation and use within the framework of national programmes and priorities in this field;
4. That special funds be established at the national level and under the aegis of the national science and technology policy-making body, for the financing of science and technology.

Recommendation No. 5
Inventory of national scientific and technological potential.

The Symposium,

Considering the importance of information on national scientific

and technological potential for the formulation and the planning of scientific and technological policy and for operating sub-regional policies for co-operation in the field of science and technology,

Recommends:

1. That the States which have not yet undertaken such an inventory should make every attempt to do so, using the most appropriate methodology;
2. That an inventory of scientific and technological potential be undertaken at a sub-regional level within the framework of active co-operation among the scientific and technological institutions of sub-regional politico-economic groupings;
3. That Unesco assist the Member States and the inter-governmental organizations within the sub-region to implement this recommendation.

Recommendation No. 6

The role of the National Commissions in the Member States in implementing national science and technology policies

The Symposium,

Bearing in mind the ever increasing role of science and technology policy within governmental activities,

Recommends that the Unesco National Commissions within the Member States should collaborate closely with the national science and technology policy-making bodies in bringing home to the public the role which science and technology plays in socio-economic development.

Recommendation No.7

Scientific and Technological Information

The Symposium,

Considering that scientific and technological information is an invaluable component of the national S & T potential,

Recommends:

1. That each national science and technology policy-making body should therefore encourage the creation and the strengthening of a national science and technology information system which should, for effectiveness, be linked with similar international systems;
2. That each government should make adequate resources available for the development of such information system;
3. That Unesco assist Member States, at their request, in training personnel for operating such a system;
4. That the National Commissions of Unesco play an active role in the dissemination of scientific and technological information which is provided to them by Unesco.

Recommendation No. 8:

Review of national education in science and technology in the countries of the sub-region

The Symposium,

In view of the shortage of relevant scientific/engineering and technical staff in all institutions, and the evidence that the current form of education has not succeeded in producing the types of personnel needed by the production sector,

Recommends to Member States the following measures:

1. Intensify training in science and technology subjects in the curricula for primary, secondary and higher education institutions in the countries of the sub-region;
2. Introduce science and technology subjects in all teacher training institutions to ensure that competent science teachers are produced;
3. Establish a balanced scientific and technical manpower development by reviewing the existing institutions and establishing an institutional match for the training of scientific and technological staff in the required numbers and orientation;
4. Guide the subject matter of science and technology and its orientation to emphasize innovation and their relevance to employment opportunities in the society;
5. Introduce instrument design and science equipment manufacture as part of the education process and in relation to the curriculum dynamics in science and technology subjects, and
6. Guide the local production of science and technology texts to reflect the circumstances and the realities of the countries in the sub-region.

Recommendation No. 9:

Popularization of science and technology

The Symposium,

Realising that science and technology must be used as a tool for development and that research is done because of the use and application of its results;

Noting the weak link between research and development in the states of West Africa;

Noting the attitude of entrepreneurs who prefer to use imported technologies rather than those perfected by their national institutions;

Noting the conflict between the scientific rationality of the researcher and the empirical rationality of the peasant is an obstacle to the dialogue that must exist between research and agricultural development,

Recommends to the Member States:

1. To step up the propagation of results of science and technology using all appropriate means, especially the construction of pilot-plants, prototypes, and popularization by means of the mass media;
2. To ensure the provision of scientific and technological education and information for the masses, particularly for the rural population, in local languages. To this end, it is imperative to form inter-disciplinary research groups consisting of scientists and linguists to define scientific and technological terminologies in the national languages of the different countries; Unesco can sponsor such a project and cause its Exact and Natural Sciences, and Social Science Sectors to be associated with it;
3. To form integrated teams of researchers from the fields of social sciences and humanities to identify the psycho-sociological obstacles in the way of the use of the results of science and technology;
4. To take all necessary measures to encourage entrepreneurs to use more of the results produced by the research institutions of their country including the use of appropriate fiscal facilities in the investment system.

Recommendation No. 10:

Professional associations and non-governmental organizations (NGOs)

The Symposium,

Confirming the important role that professional associations and non-governmental organizations can play in the development of science and technology in the sub-region,

Recommends:

1. That the professional associations and other non-governmental science and technology organizations (e.g. West African Science Association–WASA) in West Africa should review their role in the context of the active promotion and advancement of the totality of S & T in the sub-region.
2. That, in this regard, the government of each Member State should encourage and use the expertise available in these associations and organizations in the furtherance and realization of national and regional S & T objectives.

Recommendation No. 11:
Transfer and acquisition of technology

The Symposium,

Noting the lack of options and national policy for the acquisition and transfer of technology in the countries of the sub-region,

Recommends to Member States:

1. To adopt a policy for the acquisition and transfer of technology that suits the options available and the level of the socio-economic development of the country concerned;
2. To be prudent in, and associate national experts with, the negociations related to the acquisition of foreign technology;
3. To choose the technologies whose maintenance could be managed by national personnel and that the operations of the transfer include a manpower training component;
4. To promote and develop local technologies.

Recommendation No. 12:
Transnational corporations and national science and technology policy

The Symposium,

Aware of the effect of the activities of transnational corporations on the development of the economies of the sub-region,

Recommends that each country should study carefully the operational strategies and activities of the Transnational corporations (TNCs) in its economy with a view to:

— ascertaining what obstacles to the development of national S & T potential of the host countries, if any, are inherent in such activities and strategies;
— devising, in the short term, specific measures and procedures aimed at minimizing the harmful effects of the operational strategies and activities of TNCs and at maximizing their contributions towards the pursuit and achievement of national S & T development objectives and targets of the host countries;
— devising strategic solutions to ensure that, in the long term, such obstacles and harmful effects are eliminated altogether.

Recommendation No. 13:
Industrialization and self-reliance

The Symposium,

Realizing the yawning gap between the desire for independence and the industrial policy by the States,

Desirous that national efforts in S & T research and development be channelled into the industrial process,

Recommends that each government should:

1. Reaffirm its commitment to industrialization;
2. Adopt concrete measures to promote the expansion of the industrial sector of its national economy;
3. Identify **at least ONE** industry which will serve as the basis of the country's industrialization;
4. Take appropriate steps and intensify efforts aimed at promoting the accelerated development of that industry through the intensive application of the results of relevant R & D activities to the production processes; and
5. Provide leadership in the application of the results of national scientific and technological activities to the local production processes, thus encouraging growth of the country's confidence in its own national S & T effort and capability.

Recommendation No. 14:
Social sciences and the humanities in the national science and technology policies

The Symposium,

Appreciating the role played by the Social Sciences and the Humanities in the development of national science and technology,

Recommends that national science and technology policy-making bodies pay more attention:

1. To the support of the development of the social sciences and the humanities as such;
2. To using the methodologies and techniques developed by the social sciences and humanities in the formulation of policy, in the orientation of research programmes, and in the application of their results.

List of participants

PRINCIPAL PARTICIPANTS

— Mr. Honorat AGUESSY (Benin)
Directeur de la recherche scientifique et technique,
Ministère de l'enseignement supérieur et de la recherche scientifique
B.P. 03-1665
COTONOU,
Bénin.

— Prof. Daniel CHAYTOR (Sierra Leone)
University of Sierra Leone
Fourah Bay
P.O. Box 87
FREETOWN,
Sierra Leone.

— Mr. Dognenena COULIBALY (Ivory Coast)
Directeur de la recherche scientifique,
Ministère de la recherche scientifique
B.P. V.151
ABIDJAN,
Côte-d'Ivoire.

— Mr. N'Golo DIARRA (Mali)
Chef de la Division de la recherche scientifique,
Ministère de l'éducation nationale
BAMAKO,
Mali.

— Mr. Sidiki Kobélé KEITA (Guinea)
Directeur Général,
Institut central de coordination de la recherche et de documentation de Guinée
B.P. 561
CONAKRY,
Guinée.

— Mr. Jean-Baptiste KIETHEGA (Upper Volta)
Secrétaire Général,
Centre national de la recherche scientifique et technologique
B.P. 7047
OUAGADOUGOU,
Haute-Volta.

— Dr. J. Nognwulo KOLLEH (Liberia)
Professional Specialist for Vocational and Technical Education,
Ministry of Education
P.O. Box 9012
MONROVIA,
Liberia.

— Mr. Amadou Tidiane LY (Mauritania)
c/o Chef du Service des études
Ministère de la Planification
B.P. 238
NOUAKCHOTT,
Mauritanie.

— Dr. M.A. ODEI (Ghana)
Ag. Director-General
Council for Scientific and Industrial Research
P.O. Box M.32
ACCRA,
Ghana.

— Dr. F.N.C. ORAGWU (Nigeria)
Director,
Science and Technology Planning Department
Federal Ministry of Science and Technology
P.M.B. 12793
Marina
LAGOS,
Nigeria.

— Mlle Rokhaya SENE (Senegal)
Directrice des recherches en sciences sociales et humaines,
Secrétariat d'état à la recherche scientifique et technique
61, Bd. Pinet Laprade
B.P. 3218
DAKAR,
Sénégal.

— Dr Kpablignon SIMTEKPEATI (Togo)
Institut national de recherche scientifique
B.P. 2240
LOME,
Togo.

— Mr José VIETIRA (Guinea Bissau)
Responsable du cabinet d'études et orientation pédagogique,
Ministère de l'éducation nationale
BISSAU,
Guinée-Bissau.

OTHER PARTICIPANTS FROM TOGO

— Prof. ADJAMBA,
Professeur de l'École des sciences,
Université du Bénin
LOME,
Togo.

— Mr AITHNARD
Directeur,
Direction de la recherche agronomique
LOME,
Togo.

— Mr BALOUKI
Attaché au Ministère des 3e, 4e degrés et de la recherche scientifique,
LOME,
Togo.

— Mr Amouzou ESSE
Chercheur,
Institut national de la recherche scientifique
B.P. 2240
LOME,
Togo.

— Mr Kounoutcho SOSSAH
Directeur Général,
Institut national de la recherche scientifique
B.P. 2240
LOME,
Togo.

REPRESENTATIVES

— CEAO
Mr Jean B. OUEDRAOGO
Chef de la Division de la recherche scientifique et technique,
Communauté économique de l'Afrique de l'Ouest (CEAO)
B.P. 643
OUAGADOUGOU,
Upper Volta.

OBSERVERS

— ECOWAS
Mr J.E.A. MANU
Director of Economic Studies and Statistics,
Economic Community of West African States (ECOWAS)
6, King George V Road
P.M.B. 12745
LAGOS,
Nigeria

CONSULTANT

— Prof. E.O. AKEREDOLU-ALE
Nigerian Institute of Social and Economic Research
(NISER)
P.M.B. 5 U.1 Post Office
University of Ibadan
IBADAN,
Nigeria.

UNESCO SECRETARIAT

— Mr Y. de HEMPTINNE
Director,
Division of Science and Technology Policies
Unesco
7, place de Fontenoy
75700 PARIS,
France.

— Mr S.N. DAZOGBO
c/o Représentant résident du PNUD,
B.P. 575
OUAGADOUGOU
Haute-Volta

— Mr K.M. SAPE
Division of Science and Technology Policies
Unesco
7, place de Fontenoy
75700 PARIS,
France.

— Mme D. PIUZZI
Division of Science and Technology Policies
Unesco
7, place de Fontenoy
75700 PARIS,
France.

ANNEXES

ANNEX I

Outline of a comparative study on the functions, performance and effectiveness of national S & T policy-making bodies in the countries of West Africa

Introduction

The purpose of the Study is to examine the development, performance and effectiveness of science and technology policy-making bodies in the states of West Africa, as related to the major problems facing the development of the sub-region in question.

The Study is being undertaken by two consultants, who will cover a selected number of countries independently. The political, socio-economic, cultural and scientific development strategies of the countries to be covered differ considerably. The present Study outline is therefore meant to ensure a high degree of uniformity in style, presentation and treatment of data collected. All concerned in this Study (both consultants and national personnel) are therefore requested kindly to adhere to the fullest extent possible to these guidelines, both as regards information coverage and concepts utilized. This will not only facilitate the work of the consultants when writing their joint report, but will also facilitate that of the Secretariat in carrying out subsequent analyses and inter-country comparisons.

The Study, after due discussion at a subsequent sub-regional seminar foreseen for 1982, will be published in the Unesco series "Science Policy Studies and Documents", for wide distribution, particularly in Africa.

Methodology

The consultants will visit all the States in the West African sub-region* and collaborate with the local personalities involved in national science and technology policy formulation, while collecting the basic data for the Study. In addition, the consultants will collect legislative texts and other relevant documents on the national science and technology policy. Particular attention will be paid to available information relating to the major development problems of each country and especially to the relation between overall S & T policies for the major productive sectors of the national economy.

Much of the factual information needed for the Study is likely to be available in the countries visited-e.g. national papers prepared for UNCSTD, statistical surveys of scientific and technological activities conducted periodically in Member States by Unesco, etc. The factual information contained therein should however be put in a form suitable to the needs of this Study. Other useful documents would be annual reports of national R & D institutions, pertinent statistical data produced by the national bureau of statistics or other institutions on demography, trade, finance, etc.

* The states involved are: Benin, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

OUTLINE OF THE STUDY

PART I
COUNTRY MONOGRAPHS

A. Political and socio-economic setting:

Briefly (in not more than 3 or 4 standard pages), describe the major socio-economic features of the country, factor endowments, and major exports. State whether the country is predominantly resource-products based, or whether it has already developed some manufacturing industries.* Briefly describe major problems hindering the socio-economic development process stating whether these problems are transient or endemic; mention any major assets or favourable conditions.

Describe the form of government stating whether it is federal or unitary. This information is essential since national science and technology policy and the institutional machinery for it are dependent to a large extent on the governmental structure.

B. National Development Plan—place of S & T therein

(a) Describe briefly the current global and sectoral objectives that are of priority importance for the country's development, and outline major programmes foreseen in those areas for the next 5-10 years.

(b) Describe briefly the present state of development of the national science and technology policy** highlighting the relationship between the overall development policy of the country and its current policy in the field of science and technology.***

Indicate the degree of interdependence between the two policy formation processes.

Specify on what basis, in what way and by whom scientific and technological activities carried out in the country are being made consonant with national development objectives.

C. National science and technology policy structures†

— Short outline of the historical development of the main national S & T policy-making body, highlighting reasons for the changes that have occurred over the years (if any) in the legislative texts governing its activities;

— Mention the other governmental bodies which play a role in the formulation of national science and technology policy, describing briefly their salient features (e.g. the government authority to which they relate and the role they play).

* Use typology and itemization appearing in *Introduction to Policy Analysis in S & T*, Unesco SPSD series No. 46, pp. 12-13.

** Refer to SPSD No. 46, *op. cit.* pp. 14-17.

*** Focus attention on Section 4, p. 14 of SPSD No. 46.

† This description may conveniently be supported by an organizational chart showing the internal structure of this body and its connections with the institutional environment.

— Briefly describe, wherever applicable, the role played in science and technology policy-making by the private sector, the academic community, professional associations of scientists and engineers (learned societies, academies of science, etc.).

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body

(i) Official name of the organization, indicating current acronym used.

(ii) Postal address of the organization, cable address, telephone and telex.

(iii) Juridical status and administrative characteristics of the Organization.

(iv) State briefly the *aims* of the organization with respect to national science policy,* in particular as regards the following *functions*:

— the planning, programming and budgeting for S & T;
— co-ordinating and promoting S & T activities (including role as adhering body to international organizations);
— execution of S & T activities in own laboratories (or elsewhere);
— advisory services, e.g. to Government;
— advocacy for science and technology, etc.

(v) Describe briefly the working methods of the organization —in other words, its principal modes of operation in relation to its stated functions.

(vi) Describe the modes of co-operation of the organization with research establishments, scientific and technological services, and institutions of higher education which do not come under its direct jurisdiction (e.g. universities, professional associations of scientists and technologists, academies of science, etc.). This description may conveniently be supported by an organizational chart.

(vii) Describe the role of the organization as concerns international S & T co-operation.

E. Own resources of the main national S & T policy-making body**

(a) *Financial resources*

Which are the main sources of finance of the organization (indicate percentages)?

What was the evolution over the last 5 years of the organization's *own* operating budget (at constant prices), *excluding* funds used for the performance of S & T activities in its own laboratories or in other institutions?

(b) *Human resources*

Indicate the total number of the organization's staff and specify (i) professional staff, (ii) technical and service staff. Restrict figures to personnel employed by the organization for its *own* work as explained above.

(c) *Informational resources*

(i) Surveying of S & T potential.
Which are the existing arrangements for collecting, processing and analyzing numerical and other factual data on the national scientific and technological efforts?

(ii) Bibliographic information for S & T policy-making—same question as above.

(iii) Other types of information.

(d) *Equipment/facilities* (material base)

Describe briefly the buildings and facilities the organization has for the proper performance of its *own* work.

F. Linkages of the national science and technology policy-making body with its counterpart organs in sectoral ministries or government departments

(a) Describe the linkages of the organization with its counterpart organs of the sectoral ministries or government departments (such as education, agriculture, health, transport and communications, etc.).

(b) Do the links ensure free flow of information and feedback?

G. Dynamic assessment of the performance of the national S & T policy-making body

This is the hard-core of the Study; it is to assess:

(1) The real impact of the national science and technology policy-making body (or bodies) on the country's overall development, through the application of science and technology. Attention should be focussed on major developments that have occurred in the country over the past ten years, which have been initiated by, or have benefited from, activities of the main national science and technology policy-making body.

(2) The degree to which activities of the science and technology policy-making body have influenced the growth of the national S & T potential.

(3) Obstacles and difficulties which have been encountered by the national S & T policy-making body—remedial action suggested by the various actors and interested parties.

(4) Future prospects.

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* Focus on points appearing in Section 5, pp. 15-18 of SPSD No. 46.

** What is meant here are the organization's resources utilized for its *own* work (*Not* the subventions, contracts, budgetary funds or staff it allocates to its own laboratories or other institutions to perform S & T activities).

PART II
CROSS COUNTRY ASSESSMENT OF THE PERFORMANCE OF THE S & T POLICY-MAKING BODIES IN THE SUB-REGION

(1) Discussion of the major strengths and weaknesses of the main S & T policy-making bodies observed in the sub-region. What can these be attributed to? Prospects for the future.

(2) Attempts currently undertaken (or suggested) to harmonize the S & T policies of countries in the sub-region. Possible areas of inter-country co-operation—in the field of R & D, in the field of scientific/technological services, in postgraduate training of qualified scientific researchers, in the field of international transfer of science and technology.

Bibliography

List of reference material referred to in the text, indicating:
1. the exact title of the work or text;
2. the place of publication and name of publishers;
3. the year of publication.

The works listed in the bibliography should be numbered and referred to by their number in the text.

ANNEX II

Country reports

BENIN

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Peoples' Republic of Benin is situated on the Gulf of Benin. It is bordered in the south by the Atlantic Ocean, in the east by Nigeria on the west by Togo and in the north by Upper Volta and Niger.
2. *Area:* 112,622 sq. km.
3. *Population:* 3,340,000 (March 1979)
4. *Average annual rate of population growth,* 1970-1979: 2.9%*
5. *Date of independence: 30 November 1960.*

The population distribution is very uneven. Whereas 29% of the population inhabit the two largest provinces (Atakora and Borgou) which between them have 70% of the country, 54% of the population live in the three southern provinces (Atlantique, Ouéme and Mono) which cover only 10% of the area of the country. The urban population is concentrated in the south; three-quarters living in Porto-Novo and Cotonou.

II. ECONOMIC INDICATORS

1. Economically active population: 1,520,000
2. GDP at factor cost: 152,669 million F.CFA (1978)
3. GDP at market price: 168,560 million F.CFA (1978)
4. External Trade:
   Imports: 60,212 million F. CFA (1978)
   Exports: 39,611 million F. CFA (1978)
   Cover: 65%
5. Literacy rate: 47% (1978)

III. NATURAL RESOURCES

1. Relief and drainage Benin has 125 km of coastline on the Atlantic ocean. With the exception of the old precambrian massifs in the centre and the north, the country is fairly flat. The highest points are in the Atakora ranges (500 to 800 metres).

The rivers Ouéme, Zou, and Mono, flow north-south while the other rivers Mekrou and Alibori are tributaries of the river Niger. There are three large surface waters which form a lagoon area in the south. They are the Mokoué (138 sq. km), the Achémé (78 sq. km) and the Porto-Novo lagoons.

2. Mineral resources Explorations are going on to find out more about the mineral resources of the country. There are indications that the following minerals exist in the country: phosphate, iron ore, kaolin, calcium, etc., but none of these mineral deposits has yet been commercially exploited.

3. Agricultural resources The economy of the country is predominantly agricultural. Over 60% of the economically active population is engaged in agricultural production; employment in the modern sector (including public administration) accounts for just over 5% while the rest are engaged in trading, handicraft and in other small-scale service enterprises.

Agriculture's role in GNP has tended to fluctuate depending on the climatic conditions—declining from 45.9% during the period 1970-1972 to 40.9% during the period 1973-1975 only to rise again to 45% in the course of the period 1976-1978.

The main food crops are: maize, beans, sorghum, millet, cassava, yam, vegetables, etc.

The cash crops include: oil palm, coconut, cotton, groundnut, coffee and cocoa.

The subsistence system of farming is still dominant with the majority of the farmers cultivating not more than one hectare each.

Keeping of large farm animals is common among the nomadic people of the north while small farm animals like goats and pigs are kept in the south around the urban areas and on state farms.

IV. INDUSTRIALIZATION AND PROBLEMS OF DEVELOPMENT

1. Industrial enterprises Between 1970 and 1978, industrial production accounted for about 7% of GPD, on the average. The state controls about 75% of the large-scale enterprise sector while some 12 firms dominate the private sector dealing in metalwork, leather, flour mills, parfumery and animal foods.

The main industries in Benin are agro-based (oil palm, palmetto, cotton). The following industrial areas: textiles, leather and beverages form the backbone of the industrial sector, making between them about 80% of the value added.

There are two building materials factories namely a 400-ton clinker factory and the Benin Ceramic Factory (CIB).

Nearly everywhere there is under-utilization of installed industrial capacity (estimated at 50%) due largely to the unavailability of raw materials.** It would appear that the only highly successful industry has been the brewery, "La Beninoise", whose capacity has grown from 150,000 hectolitres in 1975 to 350,000 hl in 1979, with a plan to reach 500,000 hl in the near future.

As regards energy, Benin imports all the petroleum and a great part of the electricity it needs.

2. The major obstacles to development The major constraints to development have been identified as, among others:
— inadequate development administration;
— shortage of qualified manpower;

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* World Bank: Accelerated Development in Subsaharan Africa: an Agenda for Action, Washington DC, 1980, Table 33 of the Statistical Annex.

** Republic of Benin: Programme National de Développement économique et social pour la décennie 1980-1990, Ministère du Plan de la statistique et d'analyse économique, Cotonou, 1980, especially, p. 22.

— inadequate infrastructure (roads, electricity, telecommunications, etc.);
— shortage of financial resources;
— acute balance of trade problems;
— rapid increase in the material needs of the population, and
— smallness of the domestic market.

V. POLITICAL INSTITUTIONS

The government in power in the People's Republic of Benin since the adoption of the 1977 Constitution has been a one-party presidential system. Legislative power resides in the Revolutionary National Assembly, the members of which come from all sections of the population.

The country is divided into six provinces each headed by a Prefect.

The provinces are sub-divided into districts and these in turn into communes. At the provincial level political power is vested in the Provincial Administrative Committee (Comité d'État d'Administration de la Province (CEAP)).

At the district level the administrative power is vested in the Revolutionary District Committee (Comité révolutionnaire du District (CRD)).

Similarly at the commune level administrative power is vested in the Local Revolutionary Committees (Comités révolutionnaires locaux (CRL)).

B. The place of science and technology in the national development plan

I. MAIN OBJECTIVES OF THE PLAN

The last three-year, socio-economic development plan of Benin (1977-1980) came to an end in December 1980. It was the first development plan of the socialist government. The main aim of this development plan was to achieve a self-reliant development, based on the rational exploitation of the natural resources of the country. The Plan regarded "agriculture as the foundation and industry as the motor of development". A new five-year plan is being prepared as a follow-up of the three-year plan which has expired. The document entitled "National socio-economic development plan for the decade 1980-1990", prepared by Benin for the United Nations Conference on the Least Developed Countries, contains useful elements for future five-year development plans.

The priority areas identified in this document include the following:
— satisfaction of the material and socio-cultural needs of the population;
— attainment of self-sufficiency in food production;
— exploitation and valorization of the country's natural resources;
— creation of a virile industrial sector;
— creation of an autonomous basis for capital formation and accumulation through effective utilization and management of the country's natural resources;
— establishment of a technological basis appropriate to the needs of the country.

II. THE PLACE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PLAN

There is no doubt that a carefully worked out S & T development policy is required if these objectives are to be achieved. In the 1980-1990 Plan, there is specific provision for a Directorate of Scientific Research. But it cannot be said that even that document contains any definite S & T policy or plan as such. In fact, it would appear that the need to articulate such a policy as an integral part of the national economic and social development policy is just beginning to receive serious official attention.

The emerging strategy for the development of the country's science and technology potential emphasizes the use of S & T to diversify the economy, the improvement of traditional technology and knowledge through adaptation and the establishment of new production structures (e.g. co-operatives, state farms, etc.) within which technology can be more effectively applied. The institutional framework for translating such strategy into concrete policies and programmes in the context of national planning is still to be determined and established.*

C. The science and technology policy structure

I. EVOLUTION

Until very recently, the history of public policy on science and technology in Benin has been virtually coterminous with that of agronomic research in the country. The beginnings of agronomic research in Benin can be traced to the activities of the Technical Services of Rural Development especially during World War II (for example, the work on new varieties of oil-palm, cotton, coffee, cocoa and ground nuts and the experimental farms at Pobe, Niaouli and Ina) and in the activities of ORSTOM.**

Post-independence efforts which began to give a national character and orientation to agronomic research in the country date back to the establishment in 1963 (Decree No. 63-3/PR/MAC of 14 January 1963) of the National Committee of Agronomic Research (CNRA), located in the Ministry of Agriculture and Co-operatives.

The CNRA was set up to be the national organ for the administration, orientation and co-ordination of agronomic research. The CNRA was set up to:
— "define the overall national orientation in agronomic research;
— consider and approve the research programmes and related budgets of agronomic research;
— advise the authorities responsible for economic policy, the executive as well as the legislative arms of the government of Benin, on the improvement of research programmes with a view to the development of the economy of the country..."

By Decree No. 74-86 of 1 April, 1974, agronomic research was later reorganized and the relationship between the research units and the Directorate of Agronomic Research (at the ministry) was clarified. Agronomic research remained under the Ministry of Rural Development (MDRAC).

By the same Decree, CNRA was to be the specialized committee for agronomic research and the rural sector within the proposed S & T Council which has not yet been created.

The term 'scientific research' was clearly noted in the name of a ministry for the first time only in February 1980 when the Ministry of Technical and Higher Education became the Ministry of Higher Education and Scientific Research.

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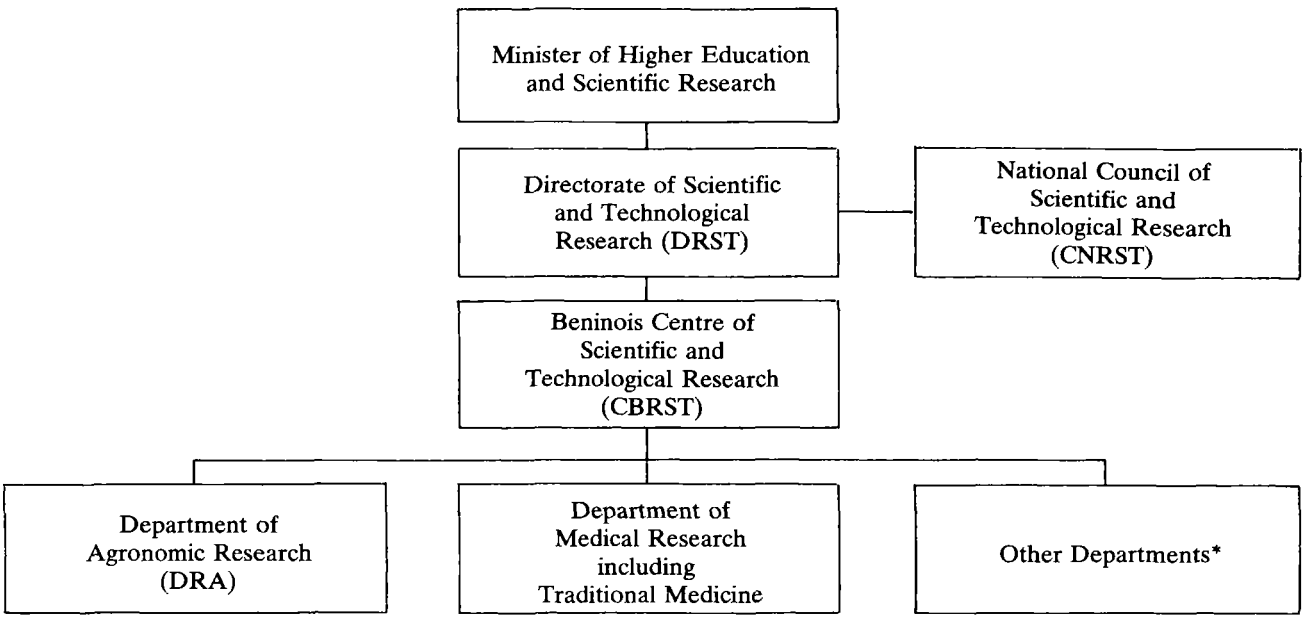
* The paper which the Republic of Benin prepared for the UN Conference on Science and Technology for Development, Vienna (August 1979) still carried proposals as to possible institutional arrangements.

** ORSTOM—Office National de Recherche scientifique et technique Outre-Mer, (French research organization).

It is worth noting that there has existed since 1976 in the Ministry of Higher Education and Scientific Research a Directorate for scientific and technological research responsible for science and technology policy. In the same year the Department of Agronomic Research came under the Directorate as a research department. These developments, especially Decree No. 81-84, reflected the new importance which the government wanted to give to the subject as well as the government's determination to evolve and implement the Vienna Plan of Action on scientific policy. For the first time, scientific research became recognised as a sector deserving serious attention in the country's overall scheme for comprehensive national economic and social planning and development.

II. THE CURRENT POSITION

This structure had not yet been officially adopted by the Government when this study was completed. In accordance with Decree 81-84, the functions and organization of the Directorate of Scientific and Technological Research have been explicitly spelt out in Decree No. 150/MESRS/DGM/DRST of 4 June 1982.



D. Aims and functions of the national science and technology policy-making body

Legally, the official body responsible for the formulation and implementation of science and technology policy in Benin, is the Directorate of Scientific and Technological Research (of the Ministry of Higher Education and Scientific Research). However, since its creation in 1976 this Directorate has not been given the appropriate structures to enable it to perform its functions.**

Neither has it been given the human and financial resources necessary for carrying out these functions.

This explains why the Ministry has relied up until now on the Department of Agronomic Research for the formulation of elements of science and technology policy pending the creation of an appropriate structure for the purpose.

The Department of Agronomic Research is one of the oldest research institutions of Benin. It has a science and technology committee, the National Committee for Agronomic Research (Comité National de la recherche agronomique (CNRA)), created in 1983. The Department at present has thirteen research units including large research stations (the largest research station with an area of 900 hectares is for oil palm research) and laboratories. The agricultural soil research laboratory is the most active. It has 7 qualified researchers, 10 middle-level staff, and 40 auxiliary staff.

The senior members of staff undertaking agronomic research are about thirty. The Department has at its disposal for its duties and research activities, in all, about 600 employees (overseers, research workers).

The average annual budget for the Department of Agronomic Research was 250 million F. CFA between 1968 and 1977 for the then existing 5 research units. It rose to 390 million F. CFA thereafter for 6 research units. At present it is around 500 million F. CFA for the 13 research units that have been in existence since 1978.

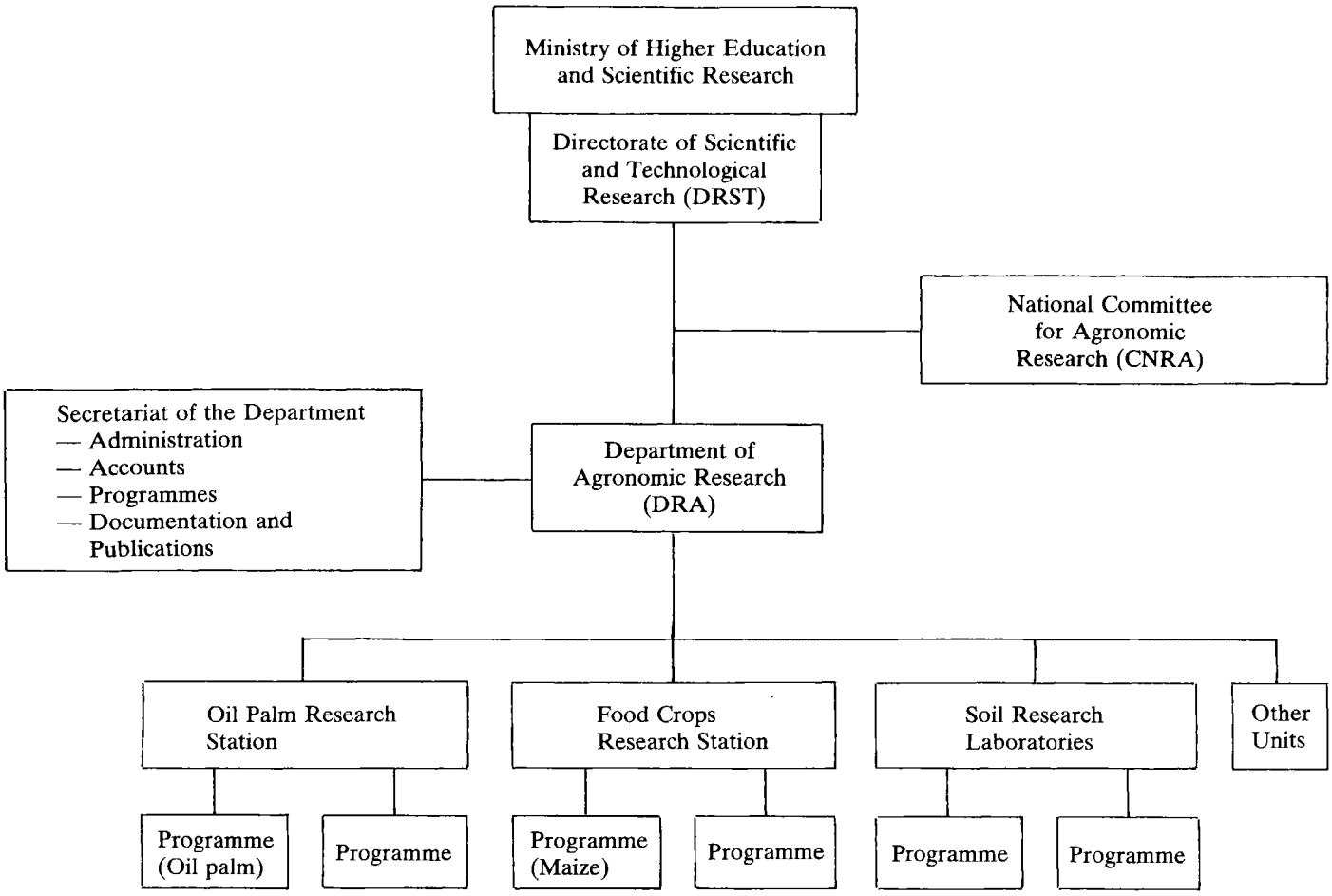
The organizational structure of the Department of Agronomic Research (as in 1981) appears overleaf.

However, since the issuance of the Decree No. 150/MESRS/DGM/DRST of 4 June 1982, all scientific and technological research bodies that had hitherto not had a juridico-political status have been put under four new departments. Thus, there are now five research departments, namely:

- Department of Agronomic Research
- Department of Human and Social Sciences Research
- Department of Industrial, Technological, Physico-chemical and Mathematical Research
- Department of Research in Life Sciences (Health, pharmacology, biology, veterinary medicine)
- Department of Earth and Environmental Sciences Research

* Other Departments such as university research, information and documentation publication units, etc.

** For the current situation (1983) see the penultimate paragraph on page 36.



Each of these departments has grouped the research laboratories and centres related to its fields of research. The above organizational chart showing the organization of the Department clearly illustrates the complexity of the organization of research in Benin. This accounts for the composition of the National Committee for Agronomic Research.

As at 1981, the membership of the National Committee for Agronomic Research is as follows:

Chairman: The Minister of Higher Education and Scientific Research

Members: The Minister of Rural Development and Co-operatives
The Minister of State Farms, Fisheries and Animal Husbandry.
The Minister of Economic Planning, Statistics and Economic Analysis.
The Minister of Finance.
The Minister of Commerce.
A representative of the National Revolutionary Assembly.
The Director of Agriculture.
The Director-General of the National Agricultural Credit Bank.
A representative of the proposed National Council of Science and Technology.
The Dean of the Faculty of Agriculture (University of Benin).
A representative each of the 6 Regional Centres for Rural Development.
Two representatives of each Society for Animal or Vegetable Production.
Two representatives of professional scientific organizations.

The two principal organs, at the national level, namely, the CNRST and the CBRST, have not yet been created by the Government. The Department of Agronomic Research has remained the only operational institution within the science and technology system. Administratively and financially, the Department is relatively autonomous. It reports to the Directorate of Scientific and Technological Research (of the Ministry). Its research programmes are studied by the National Committee of Agronomic Research, and are then submitted to the Ministry of Economic Planning, Statistics and Economic Analysis, by the Ministry of Higher Education and Scientific Research.

The national machinery for science and technology policy is not yet fully established and it cannot be said that a complete or effective institutional framework now exists for integrating science and technology policies in all sectors into the national development policy, for ensuring the relevance of S & T activities to development priorities or for deliberately promoting the growth of the science and technology sector as a critical and distinct sphere of development activity. Meanwhile, the Department of Agronomic Research, continues to play a leadership role (*role d'avant-garde*) in the definition of overall scientific and technological policy just as agriculture remains the pivot around which all national development efforts are organized.

Therefore, even though Decree No. 81-84 envisages a more comprehensive structure for S & T policy, what is actually on the ground relates meaningfully only to the formulation, development and application of agronomic research.

E. Critical assessment of the performance of the science and technology policy-making body

As indicated above, the science and technology policy-making body is still to evolve fully to be able to adequately play its role of formulating science policy and co-ordinating scientific research activities in the country. It has, understandably, therefore had only limited impact on the development of the country's scientific and technological potential.

At the level of implementation, the Department of Agronomic Research is still the only operational structure with the necessary financial and human resources, as well as the necessary infrastructure vital for the execution of national research programmes.

Agronomic research is thus the one area in which research activities have made noticeable impact on national development.

The indicative national plan for agronomic research (1980-1983) before proposing the research programmes for the future, lists the research results obtained in Benin during the last twenty years in the field of agronomic research. This list constitutes a basic asset of the Department and represents an important source of scientific information required by the various development agencies in realising their development objectives. The stage of development reached by some of the agronomic research units, notably the soil research laboratory, is such as to enable the Department to respond to the needs of users of research results by supplying them with services such as soil surveys, advice on the use of fertilizers, the preparation of soil use maps for the various crops of Benin, training of University students etc.

However, the future of the Department and the whole system of scientific and technological research depends on the creation of a scientific and technological policy-making body capable of co-ordinating the priority research needs of all sectors of the economy.*

There are many proposals in the country concerning the planning of the next step. Perhaps the report of the Unesco mission by Professor P. Piganiol to Benin in 1979 could be of use in this regard.

Gambia

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. Position: The Republic of the Gambia is one of the smallest independent countries in Africa. It is bordered on all sides, except on the Atlantic coast, by the Republic of Senegal. It is a small tongue of territory extending 300 km along the River Gambia and it is less than 50 km wide on each side of the river from which the country has its name.

2. *Area:* 10,400 sq. km.

3. *Population (1979):* 600,000. It is expected that this population will rise to 1,080,000 by the turn of the century.**

4. *Rate of population growth per annum:* 3% (1970-1979)**

II. ECONOMIC INDICATORS

1. *GNP per capita:* 440 dalasis***

2. *External trade:*

Exports: 110 million dalasis (1977)***
Imports: 177 million dalasis (1977)
Deficit: 67 million dalasis

3. *Percentage of children attending school:* 28%

III. NATURAL RESOURCES

1. Relief and drainage: The Gambia is a non-mountainous country. Both banks of the river that make up the country are covered by sand or by mangrove-swamps. The River Gambia which is navigable forms the main commercial artery of the country.

2. Mineral resources: The Gambia's main resources are its land, its river and its people. No mineral deposits have as yet been discovered.

3. Agricultural resources: Groundnut is the main cash crop and its production and processing account for some 90% of total exports, by value. The most important food crops are millet, sorghum and rice. The Gambia River is, potentially, an important natural resource for agricultural development. But, unless some way can be found to control the salt intrusion which occurs seasonally as far as 240 kilometres inland, vast areas of fertile agricultural land will remain uncultivated for much of the year.

Also, the country lies in the Sahel region and suffers acutely from insufficient and irregular rainfall. There is population pressure on the cultivable land and the soil potential has declined much over the years. The Gambian economy is predominantly agricultural. The sector (which includes livestock raising) provides employment for some 85% of the economically active population. The economy is dominated by groundnut production which is the country's main source of foreign exchange and the basis for its major industrial activity—groundnut oil milling.

Cotton was introduced in the Gambia long ago but still accounts for only a very small proportion of agricultural production.

Steps are being taken to expand the government's participation in the commercial fishing industry, hitherto firmly in the hands of non-Gambian companies.

IV. MANUFACTURING INDUSTRIES AND THE PROBLEMS OF DEVELOPMENT

Industrial development according to the Gambian national paper for the 1979 Vienna Conference, "will not be a major employer for the foreseeable future except for...labour-intensive industries (and)...industries which process local produce".†

At present, industrial activity in the country is limited to two groundnut oil mills, a soft-drinks factory and a shoe factory, all located in the capital, Banjul.

Since 1975, some deliberate effort has been made to promote the country's economic growth through planning.

Over the 1975/1976-1979/1980 Plan period, the annual investment rate increased from 10 per cent of GDP to 27 per cent but GDP itself only grew at a rate of 1.0 per cent per annum at constant prices and, with a population growth rate of about 3 per cent per annum, the average living standard actually fell. All the way, since 1965, the Gambia has been very heavily dependent on foreign capital for its public investment programmes, (the three programmes during 1965-1975 and the programmes of the 1975/76-1979/80 Development Plan). This has given rise to external debt which increased sixfold from D40 million in 1974 to D251 million in 1979.

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* With the promulgation of the legal instrument of incorporation of a new national science and technology policy-making body (Decree No. 150/MESRS/DGM/DRST of 4 June 1982) the next step should be to give to the new body the resources (financial and human) which are indispensable for the performance of the functions assigned to it.

** World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington D.C. 1981, Tables 22 and 33 of the Statistical Annex.

*** 1 Dalasis = 2.29 F. CFA. (1977)

† United Nations, National Paper submitted by the Gambia to the UN Conference on Science and Technology for Development, Vienna, August 1979. Document No. A/CONF.81/NP.101, July 1979, p. 28.

The main factors retarding economic growth and social development have included:
— low agricultural productivity,
— adverse price developments with respect to export and essential imports,
— limited natural endowment and inadequate financial resources for development,
— inadequate official concern with the planning and development of national productive capacity, even of agriculture,
— natural hindrances, e.g. drought.

The limited resource endowment of the Gambia and the country's small size had rendered it more difficult to undertake critical development projects. The move to bring the country into a Federation with Senegal will most probably affect its economic fortune within the new formation.

B. The place of science and technology within the national development plan

I. MAIN OBJECTIVES OF THE PLAN

During the period 1965 to 1975, the Gambia undertook three development programmes, 1963/64-1967/68, 1967/68-1970/71 and 1970/71-1974/75. Each of them had a limited objective. In 1975, the country then launched its "first attempt at a national plan", the 1975/76-1979/80 Development Plan, alias "Te Sito".*

The first of the 1965-1975 programmes was limited to administrative and social expenditures, the second was mainly concerned with improving communications in the Provinces and raising groundnut yields, while the third was intended to broaden the agricultural base, reorganise the public utilities and increase public-sector capacity for development planning and execution.

The 1975/76-1979/80 Plan was, therefore, the country's first attempt at more comprehensive (intersectoral) national planning for economic and social development.

The main objective of that Plan was to achieve self-sufficiency in food production and higher incomes for the average farmer. The measures proposed in the Plan were also intended among other things:
— to improve nutritional standards in the rural areas,
— to diversify rural cash crop incomes,
— to achieve a 35% rate of growth in domestically consumed foodstuffs and a 45% rate of growth in marketed export cash crops by 1980,
— to ensure that promising industrial projects are implemented as quickly as possible,
— to promote the establishment of labour-intensive export industries,
— to restructure the educational system in such a way that technical and managerial manpower needs are satisfied,
— to increase the use of locally manufactured building materials,
— to protect the entire population from preventable diseases, and provide adequate treatment facilities for common diseases.*

The high-capital-investment barrage/bridge project to permit year-round irrigation of some 24 000 hectares (which is scheduled to start in 1982/83 within the Second Plan Period, 1981/82-1985/86) remains the main hope for achieving the major agricultural transformation objective.

II. THE PLACE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PLAN

The various specific objectives already adopted in the expiring Plan required enormous S & T input but such inputs were not considered in any detail in the Plan nor did it contain any S & T policy as such. Also, as the country's national paper for the 1979 Vienna Conference puts it, "there is no long-term, detailed policy on science and technology necessary for Gambian development".**

It is clear that the need to work out a S & T policy as an integral part of national economic and social development policy is just beginning to be recognised and addressed in the Gambia.

The possibility of establishing a National Committee for Science and Technology is already being considered, as a result of the growing official concern with issues of appropriate technology for agriculture and other sectors. But the establishment of the Committee is still a matter for the future.

C. National science and technology system: structure and organization

As already indicated, the Gambia does not, as yet, have any national S & T policy-making machinery as such. But some agencies have been responsible for matters which fall within the S & T policy sector. Their activities have remained largely unco-ordinated at the national level but they have, nevertheless, acquired some resources and undertaken some operations which have had a measure of impact on the country's S & T capacity and on its production processes.

By far the most important national objective has been agricultural and rural development. Consequently, most S & T development activities have concentrated on this sector. In particular, although the government has not excluded or discouraged the use of tractors, its policy has been: "to emphasize the use of animal-drawn machinery as the technology most relevant to the needs and technological capacity of the majority of Gambian farmers".**

Apart from the efforts to expand draught-animal agricultural technology, some attention was also paid to the development of high-yield seeds and of fertilizers and to the strengthening of the institutional structure for agricultural extension work. The following agencies are relevant in this regard:
— The Ministry of Agriculture and Natural Resources (its Departments of Agriculture, Fisheries, Animal Health, Co-operatives, and Forestry and its rural Development Project Co-ordination Unit). The Ministry has provided agricultural and livestock services to farmers: crop extension, training and research, veterinary services and animal husbandry extension.
— The Yundum Experimental Station (for crop research).
— The Ministry of Education, Youth, Sports and Culture (especially Department of Education; Curriculum Development Unit).
— The Medical Research Council.

The Ministry of Agriculture and Natural Resources, in particular, has initiated and undertaken a number of significant projects relevant to S & T capacity development. Examples are:
— The Rural Development Project (especially, the Mixed Farming Centres, (MFCs), and other measures intended to disseminate new farming technology, particularly, ox-ploughing);
— The tractor-ploughing service originally started in the 1950s;

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* Republic of Gambia, Five-Year Plan for Economic and Social Development, 1975/76-1979/80, Ministry of Economic Planning and Industrial Development, Banjul, July 1975.

** Gambia's National Paper submitted to UNCSTD, *op. cit.*

— The Groundnut Seed Multiplication Scheme at Sapu;
— Various initiatives addressed to seed storage, and crop protection and storage technology.

In general, the activities of the Ministry of Agriculture and other agencies were aimed at production—in agriculture mostly—but also in the development of physical infrastructure and in the social services sector, notably, education and health. But their impact has been very modest indeed.

Traditional methods of cultivation are still dominant. For example, with regard to rice cultivation, the Gambian National Paper to the Vienna Conference observes that: "the greater part of rice production still comes from women's traditional rainfed rice swamps in low-lying land near the coast (tandako), in natural valleys which trap runoff (Bantafaro), in basins near the river that fill up with water in the wet season (bafaro), and in saline swamps in which rice can be planted when the rains have washed out the salt".*

A lot of research needs to be done on imported varieties of existing crops and on possible new crops to end the undesirable mono-crop character of the Gambian economy.

Other areas requiring urgent research attention include the standard of living of the people, e.g. housing and household technologies, local varieties of drought-resistant legumes for possible use and propagation as pastures, the milking potential of the N'Dama cattle, fishing technology, fish preservation and processing, solar energy, traditional herbal medicine, and so on.

Also, the Gambia has made very little progress in the training of its S & T personnel, with the result that most of the physicists, engineers, architects, doctors, etc., working in the country are non-Gambians.

Many problems have retarded the development of S & T potential in the Gambia and limited the impact of the S & T activities on the country's economic and social development. Of these, the following seem major:
— The absence of a national policy on science and technology development and of a national machinery to co-ordinate S & T policy and activities for development;
— Serious shortage of trained S & T personnel and of field-research facilities;
— Inadequacies of the educational system, with particular reference to its S & T component (curriculum, teachers, other resources, planning and organisation);
— General shortage of entrepreneurial skills;
— Inadequate research and extension work even in agriculture on which emphasis was placed;
— High cost of importing technology and the reluctance of foreign firms to part with technological know-how;
— Deep-seated subsistence orientation of the farming population; and
— Limitations imposed by national financial resources.

However, it is encouraging to observe that, despite these difficulties, some significant steps are already being initiated towards technological innovation. Examples are:
— The proposed construction of a barrage across the Gambia River some 110 miles from Banjul, to open up vast land for rice cultivation;
— The Rural Development Project of the Ministry of Agriculture and Natural Resources (MANR) whose scope can be expanded considerably;
— The Extension Aids Unit of MANR which will provide many back-up communication —technology services for the agricultural sector;
— The Literacy Campaign concentrated on the rural sector;
— The Indigenous Enterprises Advisory Scheme, under the Ministry of Economic Planning and Industrial Development, addressed mainly to "traditional indigenous manufacturing and commerce";
— The National Investment Board proposed in the 1975/76-1979/80 Plan;
— The Technical Institute scheduled to start in 1982;
— The current move to create a Research Department and an Extension Department within the Ministry of Agriculture (in fact, the Research Laboratory at Abuko is now operational though very scantily staffed); and
— The move to work out a more appropriate science curriculum for the educational system.

All these initiatives will contribute to the development of the S & T potential of the Gambia. But they need to be co-ordinated. It is important that a permanent national machinery be established to co-ordinate such existing S & T activities in all sectors and others that may be added and to formulate and develop and even more adequate long-term national S & T policy for the country.

GHANA

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. Position: The Republic of Ghana is bordered on the west by the Ivory Coast, on the east by Togo, on the north by Upper Volta and on the south by the Atlantic Ocean. Ghana became independent from the British colonial rule on 6 March 1957, the first inter-tropical African country to attain that status.
2. *Area:* 238,539 sq. km.
3. *Population in 1979 (estimated):* 11.3 million**
4. *Average yearly population growth (1970-79):* 3.0**

The urban population was estimated at about 30% of the total population in 1974.***

II. ECONOMIC INDICATORS

1. *GNP per capita:* 1739 cedis (1977)†
2. *External Trade:*
   — Exports: 924 million cedis (1976)
   — Imports: 971 million cedis (1976)

III. NATURAL RESOURCES

1. Mineral resources: The country is well endowed with natural resources. Her mineral resources include large quantities of gold, bauxite and diamond, some manganese, iron ore, limestone, columbite-tantalite and, according to recent official indications, crude petroleum both off-shore and inland. The large hydro-electric plant on the Volta Dam supplies the country's ample energy resources.

2. Agricultural resources: Ghana was, for a long time, the world's largest exporter of cocoa and she has some of the finest timber in the world. However, despite these enormous resources and potential and despite the country's notable industrialization effort in the immediate post-independence years, Ghana's economy remains predominantly agricultural and rural and is still basically mono-crop, being very highly dependent on cocoa.

Agriculture (including livestock, fisheries and forestry) accounts for more than 40% of GDP, employs 60% of the labour

* Gambia's National Paper to the Vienna Conference, *op. cit.*
** World Bank: "Accelerated Development in Sub-Saharan Africa -Agenda for Action, Washington D.C., 1981, Tables 22 and 33 of the statistical Annex.
*** United Nations: "World Statistics in Brief", United Nations, New York, 1978.
† 1 U.S. Dollar = 2.75 cedis (1977).

force and provides at least 70% of total foreign exchange earnings. Some 75% of the latter comes from cocoa alone.

The agricultural sector remains mostly in the hands of small farming units, characterised by low productivity, output and income. It is estimated that, until the early 1970s, they accounted for about 90% of the country's crop harvest. More recently, commercial farming has been started and is growing, though slowly. The whole sector remains mostly dependent on imports for essential inputs such as fertilizers, insecticides, machinery, etc. Agricultural output has fallen far short of the food and industrial-inputs requirements of the economy.

IV. INDUSTRIALIZATION AND THE PROBLEMS OF DEVELOPMENT

The linkages between the agricultural and manufacturing sectors have remained weak and local industries are heavily dependent on imported inputs, especially raw materials.

As a result of this dependence and the shortage of foreign exchange to finance the importation of industrial inputs, the manufacturing sector is characterised by under-utilization of installed capacity.

The import-substitution strategy has recorded some achievement, e.g., in the local manufacture of consumer goods such as tobacco, beverages, flour, aluminium ware, furniture, paints, textiles, household enamelware, cement, roofing sheets, and so on. But, curiously enough, the strategy has also led to greater overall economic dependence.

At present, Ghana is going through a grave economic crisis characterised by acute internal shortages, spiralling inflation, urban unemployment estimated at over 70% of the urban labour force, an unhealthy balance of payments position and a very substantial external debt burden which, by 1978, had almost reached the $1.0 billion mark. The Ghanaian President, Dr Limann, spoke appropriately of the "unenviable state" of his country's "prostrate economy".*

The present economic situation seems to have been caused by five main factors, namely,

— Low and declining production of cocoa and gold. From its former position as the world's leading exporter of cocoa, Ghana now produces and exports less than Ivory Coast and Brazil. Ghana's output of gold had declined from 900,000 fine ounces (from 10 viable mines) in 1960 to 380,000 fine ounces (from 4 viable mines) in 1978.
— The falling world price of cocoa, from its peak of about $6,000 per tonne in 1976-77 to its present low-level of just about $2,000 per tonne.
— The high and rising price of oil and of manufactured imports from the industrialized countries.
— The general world economic recession.
— Prolonged political instability, mismanagament of national resources and general maladministration.

The present administration assumed office only in September 1979 and, since then, has been addressing itself seriously to the country's current economic problems, mostly through its moves to stimulate the interest of foreign investors in the economy, to rehabilitate the agricultural sector and stimulate manufacturing, and to diversify the sources of an increase in the country's foreign exchange earnings by expanding the gold-mining industry and exploiting mineral resources more effectively.

V. THE INSTITUTIONS

The civilian government which came into power after the 1979 elections was a presidential type with a multiparty system. The main parties included the People's National Party (PNP), the Popular Front Party (PFP) and the United National Convention (UNC).**

B. National Plan for the Development of Science and Technology

I. MAIN OBJECTIVES OF THE NATIONAL DEVELOPMENT PLAN

The main objectives of the five-year development plan which the government of the ex-President Limann was preparing were:

— the rehabilitaton of the agricultural sector of the economy, by boosting the production of cocoa as well as of food stuffs,
— the development of manufacturing industries by inviting capital from different external sources,
— rational exploitation of gold mines and of other mineral resources,
— the production of agro-based industrial raw materials.

II. THE ROLE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PLAN

There seems to have been a long-standing realization on the part of Ghana's decision-makers that it would be impossible to implement most of these measures without a correlative review and development of the country's S & T policy within the context of the new economic and social development objectives and targets.

Some noteworthy attempts have therefore been made, especially since independence, to organize, plan, and pursue science and technology development as a major instrumental component of overall national economic and social development. With the creation of the National Research Council less than one year after independence and under the chairmanship of the inaugural President, Dr Kwame Nkrumah, research in the country started off with a national orientation and was conceived and executed "in the context of total national development".***

Under the inspiration of President Nkrumah, national development policy and planning assumed a comprehensive and systematic character and the need was fully recognized to explore the S & T aspects of and provide a scientific basis for development programmes, to provide adequate resources for scientific activities and to co-ordinate such activities for national development.

Frequent changes of political leadership in the period since 1966 had, however, severely affected the support for the efforts which began in 1958 to co-ordinate S & T policy with national development objectives. However, the strong support for the role which science and technology must play seems to have come to the fore once more under the third civilian Republic. Well recognized are the inadequacies of the existing national S & T infrastructure which have been clearly reflected in the problems and S & T bottlenecks being encountered in the implementation of the country's agricultural, industrial and other socio-economic development programmes.

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* In "Ghana's Gold Endowment" Dr Limann's Opening Address to the International Seminar on Ghana's Gold Endowment, African Review, April 1981, p. 6.

** After the completion of this Study another coup d'état took place (1 December 1981) and a new government is in power. This government has already indicated its intention to ensure effective linkage between research and all sectors of production.

*** Office of the President of Ghana: *National Research Council of Ghana*, Government Printing Deparment, Accra, 1962.

Thus in the national effort to evolve a well integrated S & T policy for national development, a whole section of the 1975/76-1979/80 Five-Year Development Plan was devoted to science policy and the concerns there embrace both science and technology. And within the context of the present administration's moves to rehabilitate Ghana's ailing economy, due attention is being given to the review of the country's S & T policy and programmes, the existing S & T institutional structures and the integration of all these with national development planning.

Worthy of note is the recent initiative by the National Development Commission in committing one of its 15 specialized committees set up to assist it in drawing up a Five-Year National Development Plan to the task of working out ways of evolving an adequate S & T policy for Ghana, in the context of the next plan period and priorities.*

The S & T Sector Committee, in its report to the Development Commission, re-affirmed the need for "the political will and commitment to use existing knowledge and new knowledge from research and development to tackle the country's problems", stressed the importance of making adequate fiscal appropriation for the sector (not to be less than 2% of GNP), identified the practical short-comings of the existing S & T policy-making machinery and proposed that a serious and detailed review of the "institutional framework of the sector" be included as a project during the plan period in order "to ensure that definite linkages are established to enhance the effective performance of the sector".**

C. Evolution of the national science and technology policy-making body

Before the creation of the National Research Council (NRC), there was research activity in Ghana, for example, by the various Government Services such as Agriculture, Veterinary, Geology and Meteorology, by some Departments and staff of the two universities at Legon and Kumasi, and by inter-territorial agencies such as the West African Cocoa Research Institute (WACRI), the West African Institute for Oil-Palm Research (WAIFOR), the West African Council for Medical Research (WACMR), the West African Institute for Trypanosomiasis Research (WAITR), the West African Building Research Institute (WABRI), the West African Rice Research Station (WARRS) and the West African Timber Borer Research Unit (WATBRU). There was also the West African Institute of Social and Economic Research (WAISER).

The West African Research Office, which administered all these research organizations, was situated in Accra. However, despite the country's participation in this early sub-regional research network, the idea of planning and pursuing research in Ghana with deliberate reference to a co-ordinated national programme only began with the creation of NRC in 1958. Thus, it can be said that the attempt to institutionalise and co-ordinate S & T policy and activities in Ghana dates back to the promulgation of the Research Act of 1958 and to the actual establishment of NRC in February 1959. The original NRC was created under the Research Act of 1958 (No. 21) and came into being on the 14th of February 1959. Shortly after, under Legislative Instrument Number 72 of 1960, a Research (Repeal) Act was brought into force simultaneously as Executive Instrument 214 of 10th October, 1960, rescinding the 1958 Research Act and abolishing the original Council.

The statutory responsibilities of NRC included, broadly, the promotion and co-ordination of "research in all its aspects in Ghana" and of the application of "the results of research". It also included the disbursement and administration of funds made available to it in support of these objectives.*** Membership of NRC, as at 1962, included the President, the Minister responsible to the President for research and the Executive Secretary of NRC (as "statutory" members). There were, in addition, seven "nominated" members, namely, the Minister of Agriculture, the Minister of Education and Social Welfare, the Vice-Chancellor of the University of Ghana, the Vice-Chancellor of the Kwame Nkrumah University of Science and Technology,† the Secretary to the Cabinet, the Secretary to the National Council for Higher Education and the Executive Secretary of the State Control Commission.

In January 1963, NRC ceased to exist as such. It was merged with the Ghana Academy of Learning (which had been incorporated in 1959).†† The NRC became, in effect, the Research Division of the Ghana Academy of Sciences. The Academy combined the usual functions of a learned society with that of a central national organisation, overseeing the conduct, promotion and co-ordination of scientific research and its application.

In 1966, after the overthrow of the First Republic of Ghana, a review body, the Cockroft Committee, was appointed by the government of Ghana "to advise on the future of the Ghana Academy of Sciences". Following the recommendations of the Cockcroft Committee,††† the Ghana Academy of Sciences was reconstituted into the present Council for Scientific and Industrial Research (CSIR) and the Ghana Academy of Arts and Sciences. The former is to advise government on science and technology policy while the latter continues the functions of a learned society.

CSIR became firmly established on 12 October 1968, through NLC Decree 293, which was later amended by CSIR (Amendment) Decree on 7 February 1969. In effect, these separation orders simply restored the *status quo ante* January 1963.

The Council for Scientific and Industrial Research (CSIR) has remained the central agency charged with the promotion and co-ordination of scientific and technological research and for the development of S & T policy in Ghana since October 1968. As at the time of this study (mid-1981), there was an on-going review of the country's existing arrangements in this sector of policy and planning and a new overall structure (perhaps a National Commission for Science and Technology) seems to be in the pipeline. It is quite possible, therefore, that the existing CSIR-based machinery, whose evolution has just been traced and whose structure, operations and impact are examined in the next two sections, will very soon undergo major modifications.

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body.

Official name of the organization

Council for Scientific and Industrial Research (CSIR)

Postal address

P.O. Box M.32
Accra, Ghana
Telephone: 77651 (five lines)
Cables: SCIENCES, ACCRA

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* Republic of Ghana: *Five-Year Development Plan*, 1975/76-1979/80, Accra, Ghana Publishing Corporation, 1977, p. 55

** National Development Commission, *Science and Technology Policy Proposals*, Draft Report of the Science and Technology Sector Committee of the National Development Commission, Accra, February, 1981.

*** For details, see Research Act of 1958 (No. 21 of 1958) or National Research Council of Ghana, *op. cit.*

† Currently known as the Kumasi University of Science and Technology

†† The merger became known as the Ghana Academy of Sciences.

††† *Report of the Committee of Experts to advise on the Future of the Ghana Academy of Sciences:* Accra, Ghana Information Services, 1966.

Juridical status and administrative characteristics of the organization

Originally, the CSIR reported to the Ministry of Economic Planning but now it reports to the new Ministry of Industries, Science and Technology which has overall responsibility for the formulation and implementation of the country's industrial policy, for the development of science and technology policy and for the application of science and technology to industry and agriculture. Thus, it can be said that the CSIR is the principal organ through which the ministry attempts to execute these S & T development and co-ordinating functions. The Ghana Standards Board also comes under the Ministry of Industries, Science and Technology.

Aims and functions of the organization

The main functions of the Council for Scientific and Industrial Research are:

— to advise the government on scientific and technological advances likely to be of importance to national development;
— to encourage scientific and industrial research of importance to the development in the national interest, of industry, technology, agriculture and medicine;
— to co-ordinate research in all its aspects in the country;
— to establish, where necessary, research institutes, units and projects under its direct administrative control.* The CSIR was expected to be "...a central research organization which would serve as the focal point for the various national research activities, co-ordinate the various national research programmes and ensure the maximum use of scarce resources of manpower and research facilities" towards ensuring effective "utilisation and conservation of the natural resources of Ghana".**

The Council has always had a much broader membership base than its predecessor, the National Research Council. As at 30 June 1969, membership of the CSIR stood at 26, made up as follows:

— Chairman
— Two persons appointed by the Government
— Six persons appointed by Government, after consultations with the Ghana Academy of Arts and Sciences
— Two Representatives of the Directors of Research Institutes of CSIR
— Secretary of the Ghana Academy of Arts & Sciences
— Representative of the Atomic Energy Commission
— Six Representatives of relevant Ministries
— Three Representatives of the Universities
— One Representative of the Ghana Chamber of Commerce
— One Representative of the Ghana Manufacturers' Association
— Director of the National Standards Board
— Representative of the National Council for Higher Education

The CSIR functions largely through the committee system. The specialized Standing Committees are:

(1) Executive Committee —which is the principal committee of the Council, acts in urgent and emergency situations for and on behalf of the Council; proposals from the other Committees to the Council may be routed through it.
(2) Finance and Development Committee,
(3) Personnel and Establishment Committee,
(4) Standing Technical Committee (which replaced the erstwhile Research Co-ordinating Committee),
(5) Management Boards of the Institutes.***

The CSIR has had co-ordinating functions from the start. A Co-ordination Office, was, however, started only in 1979, when a Planning and Analysis Group (PAG) was established at the Council's Secretariat. It is expected that PAG will, among other things, analyse and recommend projects to institutes of the CSIR, other research organizations, the universities or most suitable private institutions. Whether one considers the research institutes directly under it or the other agencies whose activities have been relevant to S & T development in Ghana since 1964, the CSIR's capacity and influence as a co-ordinating body have been very limited.

E. Resources of the main national S & T policy-making body

I. FINANCIAL RESOURCES

Unfortunately, it was not possible to obtain any meaningful figures, indicating the specific budgetary allocations to NRC/CSIR during the period under review or to determine how much of such allocations was actually meant for the S & T policy-making and co-ordination functions which these bodies were expected to perform.

II. HUMAN RESOURCES

It would appear that inadequacy of resources, including manpower, but also other facilities, has been one of the most important causes of the shortfall in CSIR's influence. The *senior staff* position at the CSIR Secretariat for the selected year is as follows:

CATEGORIES	1969	1972	1980/81
Executive Chairman	1	1	1
Secretary	1	1	1
Deputy Secretary	–	–	1
Senior Assistant Secretary	1	1	4
Assistant Secretary	4	5	1
Scientific Co-ordinator	–	1	1†
Scientific Editor	–	1	1
Scientific Information Officer	2	1	6
Library Staff	2	3	4
Research Staff	2	2	3
Technical Staff	4	2	9
Accounting Staff	3	4	7
Administrative Staff	7	5	9
Internal Audit Staff	1	1	4
	28	34	52

* Ghana's National Paper to the United Nations Conference on Science and Technology of Development, Vienna, August 1979, Draft copy, p. 15. Also, Decree No. 293 of 1968.

** Council for Scientific and Industrial Research, *CSIR First Annual Report, 1968/69*. Accra, 1971, p. 11.

*** The institutes are semi-autonomous organizations but are answerable to the Council, in respect of their respect of their programmes, budgets etc. through their Boards.

† Seven other posts in this category were vacant: for a Deputy Scientific Research Co-ordinator, an Industrial Engineer/Technologist, an Economist/Statistician, a Systems Analyst, a Social Scientist and two others, all meant for the newly created Planning, Analysis and Science Administration Division.

What these senior staff figures show clearly is that the manpower position of CSIR has been quite tight in relation to the functions of the Secretariat. Interviews with principal officers of the Council also confirmed what these figures would have led one to suspect, namely, that other facilities available to CSIR have been equally, if not more, inadequate.

F. Linkages of the national science and technology policy-making body with its counterpart organs in sectorial ministries or government departments

The membership of the CSIR includes six representatives of ministries concerned with science and technology, a representative of each of the three universities, one representative of the Chamber of Commerce, one from the Ghana Manufacturer's Association and a representative of the National Council for Higher Education. This membership enables the CSIR to forge links with the different counterpart bodies and ministries. These links are further strengthened by the existence of specialized committees dealing with sectors such as agriculture, industry, higher education, etc. The creation of the PAG at the Secretariat of the CSIR is aimed at further strengthening the links between the CSIR and the different research institutes, the institutions of higher learning and the production sector.

G. Dynamic assessment of the performance of the national S & T policy-making body

With the creation of the NRC in 1958, activities relevant to S & T in Ghana began to receive the serious attention of the government.

The NRC started establishing the necessary organisational structure for developing S & T policy. The Council recruited staff and embarked on the training of indigenous scientific personnel and the provision of a physical infrastructure. As a result of these early efforts, many indigenous scientists soon qualified and returned home and, until decline set in as a result of political instability, scientific research activities in the country expanded considerably.

Concrete schemes were initiated to establish and advance research in a number of critical areas and to create processes which link such research activities to the problems of Ghanian development. Included among such early research schemes were:

— the Radio-Isotope and Health Unit (the results of whose work could find extensive application in many other fields of research);
— the Biological Research Institute (redesignated as the Entomological Research Unit);
— the National Institute of Health and Medical Research;
— the Agricultural Meteorological Research Unit;
— the Native Herbs, Medicines and Alkaloids scheme;
— Sociological Research;
— Agricultural Research;
— Building and Roads: Building Research Unit[1]
Road Research Unit
— Forestry Products: Forest Products Research Unit[1]
— Mining and Metallurgy[2] (proposed only, but has not yet materialized)

These early efforts, plus subsequent measures to advance science education and scientific research and to develop the country's indigenous S & T capability and self-reliance, have led to notable achievements in the establishment of research institutions, in the training of scientists and in the beginning of certain S & T services. According to the 1979 *CSIR Recorder*, there were well over 200 Ghanian scientists on full time employment at the various research institutes alone. But then, the figure was about the same even in 1972.[3]

Research activities have influenced production to some extent, especially in the agricultural sector, e.g. the activities of the Soil Research Institute, the Crops Research Institute and the Institute of Aquatic Biology. Also, the Food Research Institute has made notable efforts in food processing and preservation; the Building and Road Research Institute has achieved new possibilities in the design of rural housing while the Forest Products Research Institute[4] has achieved some improvements in methods of charcoal production. But, given the enormous challenge with which S & T policy in Ghana must deal, especially at the level of production in agriculture and industry, these achievements are rather modest.

Moreover, when the impact of the existing S & T policy-making machinery in Ghana is assessed in terms of how far it has effectively explored the following "technological options",

— adaptation or evolution of traditional technologies
— new technology based on domestic research and development, and
— transfer of technology from abroad,

the conclusion must be that there has not been much overall impact. The Executive Chairman in his address to the 1st Annual General Meeting of the Research Staff Association, stated that "although the CSIR has been in existence for two decades, one could not easily point to a really significant impact which CSIR's research has made on the nation's economy.[5] It has to be conceded, however, that taking into consideration the numerous constraints, the CSIR has made some significant contributions to the economy.

According to Ghana's 1975/76-1979/80 Development Plan, the lack of appropriate technologies in all sectors of the economy continues to pose major constraints to national development.

The S & T policy system is now undertaking systematic investigation of the processes and techniques involved in all the important traditional economic activities in farming, processing of agricultural products, the repair and maintenance of machinery and equipment and how to translate its discoveries into appropriate technology. Most of the significant research results that have been accumulated by the CSIR have yet to be transformed into products, tools, etc., through appropriate experimental development activities. This means that both agriculture and industry (especially, indigenous public and private small-scale industries) are not fully receiving the kind of S & T which they need in order to increase their productivity and output.

The limited impact on development of the S & T policy-making machinery which has evolved since 1958 may be attributed to the following factors, among others:

(1) The inability of the CSIR, as it is set up in the context of the national political framework, to develop and champion a comprehensive and coherent S & T policy for Ghana as a framework for all S & T agencies in the country.
(2) Weak co-ordination by the CSIR of the research orientations, priorities and activities, more especially, of agencies other than the Research Institutes directly responsible to it.
(3) The apparent ineffectiveness of the existing machinery for linking research and user-agencies on a regular and continuing basis through their representation on management boards of the CSIR institutes.

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1. Developed later into the Building and Road Research Institute, and the Forest Product Research Institute, respectively.
2. For more details of these early schemes, see Office of the President, *National Research Council of Ghana, op. cit.*, pp. 7-35
3. CSIR Recorder, Vol. 8, No. 2, September 1979.
4. No longer an institute of the CSIR, but of the Forestry Commission.
5. CSIR Recorder, Volume 8, No. 1, April 1979.

(4) The apparent ineffectiveness of the established policy and institutional arrangements for exploring and effectively exploiting available S & T international co-operation systems.
(5) Resource inadequacy: manpower, research equipment and other working facilities, foreign exchange. (The CSIR itself has blamed the aforementioned inadequacies on its lack of resources.)
(6) The inadequacy of STS, especially in a situation of near-total dependence on foreign sources for scientific research equipment and other inputs and even for their maintenance and repair, in many cases.
(7) Organizational problems of the CSIR itself, especially in its role as the Co-ordinating Body, e.g. the questions regarding the autonomy, accountability and control of the CSIR's institutes; inter-agency conflicts such as those between the CSIR on the one hand and the Universities and the Ministries (re-control of research institutions), on the other, the sheer complexity of the S & T system whose activities the CSIR is expected to co-ordinate, in relation to the limited scope of the CSIR's powers to command compliance, and, of course, the conditions of service of S & T personnel in Ghana.
(8) Weak entrepreneurial response, which may point, in turn, to a low level of scientific, technological and entrepreneurial consciousness in the society at large.
(9) Political instability and the reverses which the national economy has suffered during the period, as these have affected the motivations and actions of scientists and technologists, science administrators, development planners and entrepreneurs.

It is very clear from the several sources already referred to, and especially from Ghana's national paper to the 1979 Vienna Conference, that these problems are already recognized officially and that steps are already being taken to tackle them even more systematically in the years ahead, beginning from the current plan period.

— Firstly, the national planning system itself is being reviewed to ensure that it gives due weight to the planning and development of the S & T sector.
— Secondly, there is a plan to increase resources available to the sector, so as to ensure an expansion and better co-ordination of research and development activities and to facilitate the transmission of S & T inputs into agriculture, and industry.
— Thirdly, the Ghana government is determined to build up rural infrastructure and promote the application of science and appropriate technology to agriculture and other rural-based activities. Projects relevant to this objective include the Ghana/Unicef project on "Appropriate Village/Home Improvement Technology", the Agricultural Research Centres for each region and the establishment of the Irrigation Development Authority.
— Fourthly, several measures are being introduced or contemplated to strengthen STS and extension service arrangements, e.g. the Ghana/UNDP Scientific Instrumentation Centre, the Technology Consultancy Centre at Kumasi U.S.T. and the move to establish a national scientific information system and the proposed National Technology Transfer Centre.
— Fifthly, conscious efforts are being made to streamline the machinery for international co-operation in the transfer and development of technology.

Perhaps, even more important than any of these measures are the efforts directed at reviewing the status of the CSIR itself and at both streamlining and strengthening the whole S & T policy-making machinery (however it may be reconstituted) to enable it to carry out more effectively its truly onerous responsibilities in the area of policy formulation and in co-ordination of scientific and technological development activities within the framework of the country's national development priorities and plans.

To sum up, the initiative which began with the passing of the Research Act (1958) and the setting up of the National Research Council may not have fully achieved its grand objectives. But it has led, over the years, to the gradual growth of an institutional framework for formulation of national S & T policy.* It has also led to the creation of considerable S & T physical infrastructure and to an increase in Ghana's trained scientific manpower.

Finally, it has created and institutionalized an awareness of the need to relate and harness S & T activities closely to the pursuit of national development.

It cannot be said, however, that all S & T activities in Ghana are invariably addressed specifically to the country's development problems, that they are all being determined strictly in line with definite national priorities and that they are subject to an effective central co-ordination at the national or even sectoral level. Yet, both the CSIR and its precursor, the NRC, had specific responsibility for "the organisation and co-ordination of scientific research in Ghana".

Despite the initial momentum and later developments, the capacities of the existing S & T sector including the national S & T policy-making and co-ordination machinery seem inadequate for implementing a well-co-ordinated national S & T policy or of effectively advancing the nation's technological capacity in the service of rapid and self-reliant economic and social development. This is why the on-going attempt to reorganise the S & T policy-making machinery itself is very appropriate.

Guinea

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* Situated on the West Coast of Africa, the Revolutionary People's Republic of Guinea lies between the 7th and 15th degree of latitude north and between the 8th and 15th degree of longitude west.

It is bordered to the west by the Republic of Guinea-Bissau and the Atlantic Ocean (with 300 km of coastline), to the south by the Republics of Sierra Leone and Liberia, to the east by the Republics of the Ivory Coast and Mali and to the north by the Republics of Mali and Senegal.

2. *Area:* 245,857 sq. km.
3. *Population:* 5,300,000 inhabitants (1979)**
4. *Density:* 30 inhabitants /sq. km except at Conakry where the density rises to 500 inhabitants/sq. km.
5. *Average annual growth rate of population* (1970-79): 2.9%**

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* *Research institutes and units under the CSIR in 1981*
Animal Research Institute, Achimota
Building and Road Research Institute, Kumasi
Crops Research Institute, Kumasi
Food Research Institute, Accra
Institute of Aquatic Biology, Accra
Institute of Industrial Research, Accra
Soil Research Institute, Kumasi
Water Resources Research Unit
Oil Palm Research Unit.

** World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington D.C., 1981 -Tables 22 and 33 of the Statistical Annex.

II. SOCIO-ECONOMIC INDICATORS

GNP (1974) in millions of US dollars: $ 630
GDP per capita (1977, source UNDP): $ 120
Composition of the GDP (1975):
Primary: 47%
Secondary: 21%
Tertiary: 32%
Imports c.i.f. (1975-1976): 4.2 billion sylis*
Exports f.o.b. (1975-1976): 6.1 billion sylis
of which bauxite: 61%; *alumina:* 33%;
External debt: 215 million US dollars
Budget (expenditure 1973): 2.4 billion sylis

III. NATURAL RESOURCES

1. Relief and drainage. The country has a varied and rugged surface. The highest peak in West Africa is found in Guinea: Mt. Nimba: 1,752 m high.

Guinea has 300 km of coastline.

There are two distinct seasons: the dry season lasting from December to May, and the wet season lasting from June to November.

The two biggest rivers in West Africa have their source in Guinea: the Niger with its big tributaries, the Tinkisso, the Milo and the Nianda; and the Senegal; whence its nickname "Africa's water tower".

2. Geological and mineral resources. Guinea is referred to as a "geological scandal" because of its enormous mineral wealth.

In 1975, Guinea was the third world producer of bauxite with 11 million tonnes estimated at 13% of world production. Its reserves of high-grade iron-ore amount to perhaps half the world reserves. There are no recent statistics regarding the production of iron-ore (1 or 2 million tonnes at the end of the 1960s).

But a project for the working of the deposits in Mts Nimba and Binandou was being studied: the production of more than 10 million tonnes per annum was forecast as from 1978. The production of diamonds (80,000 carats in 1973) has apparently been forbidden since then.**

3. Agricultural resources. Guinea has the potential for a varied range of production. No recent agricultural statistics are available.

The FAO statistics show the average increase in farm animal production as follows:
1960-1974: 1.7%
1970-1974: 0.1%
Food crop production (1975) in tonnes:
rice (450,000), manioc (450,000), maize (300,000).
Export crops in tonnes:
bananas (95,000), groundnuts (28,000), palm oil (35,000), palm kernel oil (35,000), green coffee (5,400).
Livestock (1975):
cattle: 1,500,000
sheep and goats: 775,000
fish: 200,000 tonnes (in 1974)

IV. MANUFACTURING INDUSTRIES AND THE PROBLEMS OF ECONOMIC DEVELOPMENT

Guinea attempts to diversify its industries despite the financial, technological and political difficulties with which it is confronted.

The aim of industrial development is the on-the-site valorization, by processing, of the country's natural resources. Amongst its industries, there are numerous foodstuff industries:
— At *Labé,* the SIPAR (Société industrielle des plantes aromatiques -Industrial Aromatic Plants Company) produces essence from oranges, grapefruits, and bitter oranges for the perfume industry.
— There are two oil factories: a groundnut oil factory at Dabola and a polyvalent oil factory at Kassa (groundnut oil).
— A sugar factory with a capacity of 600 to 700 tonnes/annum cannot meet the country's requirements. Another sugar project is being considered for Faranah.
— A project for the manufacture of gari is intended for Faranah.
— *The cannery at Mamou:* production of fruit juice (orange, grapefruit, bitter orange, mango, etc.), tomato concentrate, citrus fruit and mango jam.

Apart from food industries, there are:
— A national tobacco and match factory.
— Brick factories at Conakry and at Kankan.
— A textile complex at Sonava with a capacity of 24 million metres, of which 80% is cotton and 20% polyester.

The aluminium industry (650,000 tonnes of alumina in 1975) is highly developed.

Guinea produces 500 million kwh of electricity per annum, most of which is taken up by the manufacture of aluminium.

Despite its vast potential, Guinean industry is not prosperous. Most firms are either closed or function below capacity.

The next Plan has set up a list of about ten firms to be rehabilited during the Plan period. The following new projects are foreseen:
— A compost factory for the transformation of household refuse into compost for agriculture.
— An industrial pharmaceutical firm for the manufacture of injectable solutions.
— A fertilizer factory with a capacity of 350,000 tonnes/annum, etc.

Also foreseen is the creation of State as well as of mixed-economy enterprises.

B. National development plan and the place of science and technology therein

I. THE AIMS OF THE FIVE-YEAR PLAN (1981-1985)

The documents of the Five-Year Plan 1981-1985 were still in press when this monograph was being prepared. Nevertheless, a discussion with the persons responsible for planning enabled the author to grasp the main lines.

(a) Agricultural sector. The next Plan gives priority to the rural development sector aiming mainly at the country's self-sufficiency in foodstuffs, through food production. The present growth rate of the agricultural sector is only 1%. The next Plan aims at a growth rate of 3% per annum. To triple the growth rate of the primary sector, emphasis will be placed on the training of agronomists: 75% of 'bacheliers' (those who have taken school-leaving certificate) will, from now on be directed to an agropastoral type of course. At the level of the district agropastoral farms (FAPA), these agents will be charged with promoting modern agriculture using improved plant or animal material and modern production techniques.

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* 1 US $ = 18 sylis in 1978.
** Afrique économique INADES-FORMATION-PARIS

(b) Industrial sector. In the industrial sector, the Plan forecasts a growth rate of 8%. The emphasis will be on the development of the agro-industries with a view to on-the-site valorization of local agricultural products, in particular food products.

The mining industry will have the same growth rate. In this field, the Plan envisages the primary processing of raw materials prior to exportation. Thus bauxite would be exported after calcination, and alumina after processing.

In the field of energy production, two approaches are envisaged:

(1) The development of small dams for the production of electricity.
(2) The development of new sources of energy, in particular renewable forms of energy.

It thus appears that the Five-Year Plan in preparation is based on one hand, on extensive modernization of agriculture and on the other, on an increased development of the food, industrial and energy sectors.

With regard to the agro-pastoral and fish-farming sector, almost one third of the budget of the Plan is devoted to it and moreover two-thirds of the university-level staff being trained are intended for this sector in keeping with the 1975 charter which granted priority to animal husbandry training; for this sector, it is a question of moving the Guinean agriculture, livestock production and fish-farming during the five years of the Plan (1981-1985) from their precarious situation to a state of development of the infrastructure, the techniques and the technological methods which would change the sphere which they constitute into a powerful base for the socio-economic development of the whole nation and ensure the modernization of all the Guinean peasantry.

To this end, 300 agro-pastoral arrondissement farms (FAPA) have been created in the country which are the basis for the modernization of the agriculture and peasantry in Guinea.

As far as Mines, Industry and Energy are concerned, the extent of the actions foreseen in the Plan is reason to hope that there will be fresh initiatives in these fields during the Plan period.

II. THE PLACE OF SCIENCE AND TECHNOLOGY IN THE NATIONAL DEVELOPMENT PLAN

"Science and Technology are goods, —means of production among all the other means of production. It is through science and technology that men liberated themselves from their initial situation of beings, subject to the whims of hostile nature, to achieve the status of man dominating nature" (President Ahmed Sekou Touré).

These words emphasize the extent of the importance which the Guinean authorities attach to science and technology in the country's ongoing development programme. Science and Technology are considered as direct productive forces which must take part in the production of material and immediate goods essential to satisfy the needs of the people.

The Guinean conception of the application of science and technology stated by the Guinean authorities is based on the principle that, given that the whole population is concerned by the problems of development, everybody must be equally concerned with science and technology and with their application.

The very structure of the national agency for science and technology policy in Guinea is a good reflection of the popular conception in Guinea of scientific and technological research based on the Guinean cultural revolution which states that everything comes from the people and ends with the people.

The volume of investment intended for education and scientific research amounts to about 400 million sylis.* This sum represents 1% of the global volume of investment in the Five-Year Plan.

In the preceding Plan, the investment intended for science and technology appeared by sector as follows (1973-1978) (in sylis):

(1) Science and technology for rural development (stock-breeding, water and forestry):
Agricultural research: 448,211,000 or 25% of the budget (of 1,804,546,000 sylis) for equipment of the Ministry Rural Development.
(2) Science and Technology for geology and the mining industry:
267,000,000 or 0.8% of the budget of (34,330,030,000 sylis) for equipment of the Ministry of Mines and Geology
(3) In the public works sector, the percentage devoted to science and technology is 1.2%.

It appears from these figures that it is in the field of Rural Development** that the biggest efforts are being made for integrating Science and Technology into the realisation of the aims of the Development Plan. This is fully in keeping with the priority assigned to this sector in the Plan, especially as far as food production is concerned.

In sum, a noteworthy effort is being made in Guinea to apply science and technology to development and to associate a large spectrum of the population with the scientific and technological activities.

To this end a title of "approved research worker" has been created to enable each militant—whatever his previous level of education—to present and defend his research findings at the University. The National Commission for theses and papers then ratifies them; the titles and degrees are then awarded. This original practice should permit an effective penetration of scientific and technological achievement into the daily productive activities of the masses.

C. Structure of science and technology policy development of scientific research in Guinea

First step: 1958-1969: Barely forty days after the declaration of national independence, Decree No. 74-PRG of 10 November 1958 created the *Institut National de Recherche et de Documentation de Guinée* (National Guinean Institute for Research and Documentation) thus marking a decisive step in the history of the country, that of being among the first independent states in Africa to set up a national agency for the co-ordination and planning of scientific research comprising all the spheres of knowledge in the service of the socio-economic and cultural development of the country.

One year after the declaration of the Cultural Socialist Revolution in 1968, and in order to confer on research activities all the importance which they deserve in the integral development of Guinea, a *Secrétariat d'État à la recherche scientifique* (State Secretariat for Scientific Research) was set up with the aim of elaborating, co-ordinating and controlling national science policy.

Second step: 1969-1972: this three-year period, although short, witnessed a decisive step in the development of scientific research in Guinea, confirmed by the holding of the first National Science Conference at Foulaya in February 1971, which had

* 1 US dollar = 18 sylis in 1978

** Grouped under Rural Development are:
— The Ministry of Agriculture and Agricultural management
— Ministry of District Farms (FAPA) and Agricultural Co-operatives and
— Ministry of Animal Husbandry and Fisheries

the credit for having decided upon a precise programme of scientific activity for each research unit, in keeping with the national development aims.

The fundamental aim of the Guinean one-party state being the rational and efficient control of science and technology by the people, the national science conference at Foulaya clearly demonstrated that Guinea would not be a "Laboratory for experiments where the people of Guinea were mere spectators".

Third step: 1972-1973: This period is characterized in the history of the Parti-Démocratique in Guinea (PDG) by the beginning of the party-state phase.

The Secrétariat d'État à la recherche scientifique (State Secretariat for Scientific Research) was set up at the Ministry for Scientific Research.

In his critical analysis of the scientific research sector in January 1972, the President of the Republic outlined the guidelines for research activities, the priority tasks being those on which research should be focussed, and emphasized the need for the adaptation of existing structures to suit these activities. He thus requested researchers to translate into action:

(1) The wishes of the masses which call for the mobilization of all sectors and of all those who can participate in research activities. This can be summed up in the phrase of the Head of State "Science at the crossroads of the People".

(2) The restructuring of research activities to give them an organisational base which is in keeping with realities in Guinea.

(3) The search for the means to implement the vast programmes in keeping with the tasks which have been chosen as priorities and which are the result of a rapid, harmonious and balanced development programme.

Fourth step: 1974-1981: Since this political aspect of the Scientific Research sector did not satisfy the aspirations of the Party, the Ministry for Scientific Research was abolished. A Ministry for Higher Education and Scientific Research was created.

Drawing the lessons from the previous step and from the numerous teachings of the Head of State, the Cultural Commission of the Central Committee held an extraordinary session on 22 October 1975, which examined the practical means for the implementation of these teachings while defining the structure of national scientific policy which was articulated around three agencies:

— The Central Committee: decision-making body (level I),
— the INRDG:* the agency for programming, co-ordination and control (level II),
— the scientific and technical units and collectivities executive agency (level III).

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body

Official name of the organization:
Institut Central de Co-ordination de la Recherche et de la Documentation de Guinée (ICCRDG)

Postal address:
Boîte postale 561
Conakry
République populaire révolutionnaire de Guinée

Telephone: 46-10-10 and 46-10-12
Telex: 631 MDEC.

Attached to the Ministry for Higher Education and Scientific Research, the ICCRDG is the central body for programming, co-ordination and controlling scientific research in Guinea; it ensures a specialized administration responsible for ensuring the scientific sponsorship of research agencies and for promoting research through its departments.

It is empowered to:

— undertake surveys of the national scientific and technological potential (PST);
— formulate, execute, and control national science policy;
— search for the means essential for achieving the objectives and, in particular, the financing of scientific activities;
— establish with the Ministries concerned the links considered necessary for applied research;
— make an inventory of feasible research activities and collect, with the collaboration of the General Management of the Plan, the elements essential for the short-, medium- and long-term programming of science policy;
— initiate and plan the training courses of research workers in all fields;
— carry out national research programmes connected with development;
— collect, use and diffuse research results and any information concerning national and international scientific progress;
— promote bilateral, regional and international scientific co-operation.

The links between the ICCRDG and scientific research establishments are institutional and financial.

The financing of scientific research in Guinea is mainly dependent on the state budget.

On the other hand, the directives contained in Decree No. 583/PRG indicate that each Unit must include in its activities two sections in close and constant co-operation:

(a) "A" Section referred to as a production section;
(b) "B" Section referred to as a research section.

Section "A" is under the authority of the Ministry which sponsors the Unit in question, while Section "B" is controlled by the ICCRDG which, being responsible for its creation, ensures its organization, follow-up and control.

— The ICCRDG is the national focal point as far as bilateral and international scientific and technological co-operation is concerned.

As part of its functions:

— It is responsible for the scientific secretariat of the national committees, constituting the basic structure of the international programmes: the Man and the Biosphere (MAB) programme and the Conseil africain de télédétection (African Council for Remote Sensing), etc.
— It identifies scientific and technical research projects in keeping with national aspirations and seeks the means for their implementation from International Organizations.
— It receives and gives orientation courses to foreign research workers and co-ordinates their programme at the level of the research departments and the technical services concerned.
— It encourages the participation of national administrators and researchers in international scientific meetings and judiciously uses the foreign fellowships granted by friendly countries and international agencies with a view to satisfying training and refresher course requirements.
— etc.

E. Resources specific to the main national science and technology policy-making body

(a) Financial resources
(according to the budget of the 1981-1985 Plan)
The State is the main source of the agency's financing:
— Equipment: 1,760,000 sylis/annum**
— Staff: 5,840,000 sylis/annum

* Was renamed ICCRDG (Institut Central de Coordination de la Recherche et de la Documentation de Guinée) in 1982.

** 1 US dollar = 18 sylis (1978)

Total operating budget: 7,600,000 sylis/annum.

(b) Human resources

— Professional staff: 40 professors —administrators and engineers, research workers.

— Technical and general service staff: 53 technicians.

(c) Information resources

The ICCRDG has adequate staff and structures for collecting, processing and analysing factual data concerning national scientific and technological effort.

Other types of information:

— MAB documents; Unesco

— Working reports from research units.— Resolutions adopted by scientific seminars, etc.

(d) Equipment and facilities

Description of the buildings:

(1) General administration of the ICCRDG: A one-storey building including 18 offices and a library with a reading room.

(2) The Directorate of the National Archives: comprises a single-storey building with 5 units.

(3) A complex which is made up of the Directorate of the Museums of Guinea with offices, exhibition and lecture rooms, a laboratory, 2 reserved rooms, a library, a cafeteria and a guest house for researchers.

F. Existing links between the national science and technology policy-making body and its counterpart organs in sectoral ministries or government departments

(a) Each sectoral Ministry has within it a research department which deals with the technical study of all the projects and development activities within its field of competence. This study co-operates in acquiring, guiding and adapting all the means and in harmonizing them, bearing in mind the objectives of the National Development Plan.

As mentioned above, the ICCRDG has the task of ensuring the co-ordination and control of the research activities of the departments concerned with scientific and technological research.

(b) These links are such that the free circulation of information and of their "feedback" is guaranteed.

G. Critical assessment of the performance of the national science and technology policy-making body

(1) The real impact of the ICCRDG in the country is that it has created the awareness amongst national communities, of the dominant role of science and technology in development.

(2) The ICCRDG has assisted in boosting research activities which have been diversified and intensified. It has made possible the formulation of a precise and coherent research programme.

(3) As regards the growth of the national potential of Science and Technology, the efforts of the ICCRDG have yielded a number of results:

(a) The creation of research centres in the fields of oceanography, solar physics and the study of materials at Conakry (Rogbane).

(b) The creation of a laboratory for virology and microbiology at the Institut de recherche de biologie appliquée Néné Kaly Condetto, IRBANC (Institute for Applied Biological Research), Kindia.

(c) The creation of a museographical complex at Conakry.

(d) The restoration of the Fortin-Museum at Boké.

(e) The creation of the Macenta Regional Museum.

(f) The construction (underway) of the Niany archaeological research centre (Mandiana).

(g) The creation of a research centre for medicinal plants and cash crops at Seredon Macenta.

(4) The obstacles and difficulties encountered are due *inter alia* to:

(a) inadequate material and financial resources.

(b) the inadequacy of the infrastructure as far as publishing and extension services are concerned in the fields of Education and Scientific Research.

(c) insufficient drive in scientific and technical information services.

(d) shortage of qualified scientific personnel.

(5) Future prospects:

(a) Reinforcement of the scientific and technological capacity of the ICCRDG.

(b) Development of international scientific co-operation, in particular with United Nations organizations for improving the national capacities for management and implementation of the results of science and technology in the service of economic and social progress.

(c)Development of sub-regional co-operation.

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Guinea-Bissau

A. The political and socio-economic setting

I. GEOPOLITICAL DATA

1. Position: The Republic of Guinea-Bissau lies between the Republic of Senegal to the north and the Revolutionary People's Republic of Guinea to the south-east and is made up of a mainland part and a series of islands.

2. *Area:* 36, 125 sq. km

3. *Population (1979 Census):* 800,000* inhabitants

4. *Density:* 22 inhabitants/sq. km

5. *Average annual growth rate of population (1970-1979):* 1.6% (for 1960-70 it was 2.6%)*

6. *Demographic structure:*

0-14 years..... 38%
15-59 years..... 58%
60 years and over 4%

7. *Economically active population:* 450,000 inhabitants

8. *Structure of the economically active population:*

Primary sector..... 87.8%
Secondary sector ... 3.2%
Tertiary sector..... 9.0%

* World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington DC 1981, Tables 22 and 33 of the Statistical Annex.

II. ECONOMIC INDICATORS

1. GDP (1977) in millions of dollars	130
2. Per capita GDP dollars	170
3. Exports (1979) in millions of F. CFA	480
4. Imports (1979) in millions of F. CFA	2,067
5. Trade deficit: (in millions of pesos)*	1,587
6. Operating budget (in millions of pesos):	

	1976	1977	1978	1979
Income	518,776	469,715	620,639	890,349
Expenditure	1,124,623	1,324,652	1,318,325	1,474,262
Deficit	605,847	854,937	697,686	583,913
Income/ expenditure ratio	0.46	0.35	0.47	0.60

The operating budget shows a large deficit. When capital expenditure is added to this operating deficit one arrives at a total deficit of, 2,350 million pesos in 1979.

This deficit was covered in 1978 by external financing amounting to 1,821 million pesos and by a monetary issue of 529 million.

It should be noted that the size of external resources is very significant. During the 1976/78 period these resources were as follows:

Multilateral sources: (EEC, UNDP, Unicef): $US 23,700, 000

Bilateral sources: (German Democratic Rep., Federal Rep. of Germany, China, Cuba, France, the Netherlands, Norway, Portugal, Sweden, USSR, USA): $US 85,641,000 making a grand total of $US 109,341,000

III. NATURAL RESOURCES

1. Coastal situation and hydrographic network. The main land part of Guinea-Bissau is made up of a coastal region of swampy plains (covered with shrubs and palm-trees), and an interior area including the hills around Boé and the plateaux at Bafata and at Gobu. The island part comprises the islands of Bolama, Pecime and Jeta and the Bijagos archipelago, consisting of fifteen small islands which lie near the coast.

The country is criss-crossed by innumerable streams and rivers of which the most important are: the Cacheu, the Geba and the Corubal. In some places (Sucujaque, Cacheu, Bissau, Cacine), the sea deeply indents the coast and boats with a tonnage of 2,000 tonnes can navigate on the water thus created for distances of 95 to 150 km.

2. Climate. The climate is tropical and humid. The annual mean temperature is 27°C. The average humidity is 80%. The average annual rainfall is 1,600 mm. However, the influence of the Sahel region is felt in the north-east with a consequent irregularity in the amount of rainfall, the drop in numbers of days with rainfall which affects agricultural production.

3. Mineral resources

Bauxite: There are deposits of approximately 200 million tonnes of roughly 48% ore situated 150 km from a deep-water port (Buba). The infrastructures to be constructed for working them (mining port, railway, etc.) make this project a long-term aim.

Phosphates: Prospecting in the Farim region has shown interesting results, but the boundaries of the deposit still need to be marked out.

Oil: Seismic surveys have given very interesting signs of offshore oil, and prospection is to begin very shortly within the framework of a loan approved by the World Bank.

4. Agricultural resources. The economy of Guinea-Bissau is predominantly agricultural. The rural population of the country is estimated at 85%. The main agricultural products are: rice, groundnuts, oilseeds, maize, tropical hardwoods, sugar-cane. The rural sector of Guinea-Bissau has remained fundamentally traditional at both the technical and the organizational level.

— The economically useful area of the country is 3,363,700 ha (minus the areas covered by water);
— The arable area (not including forests) amounts to 482,177 ha.
— The forest area amounts to 2,525,900 ha.

The area under cultivation is:

— Paddy rice	107,000 ha
— Groundnut	60,000 ha
— Manioc and tubers	15,000 ha
— Oil palm	135,000 ha
— Rain-fed cereals	105,000 ha

Production of main crops:

— Swamp rice	74,900 tonnes
— Groundnut	36,000 tonnes
— Manioc/tubers	51,500 tonnes
— Oil palm	162,000 tonnes
— Rain-fed cereals	63,000 tonnes

Animal husbandry:

— Cattle	153,500 head
— Sheep and goats	132,900 head
— Pigs	66,600 head
— Poultry	335,400 birds.

These data show the weakness of agriculture in Guinea-Bissau and its low productivity. It should be noted that the fact that the cultivation of a single crop for export was never established ensures a certain balance in the population's foodstuffs. The protein balance is particularly well ensured by the consumption of fish.

Source: Commissariat d'État au Développement Rural

IV. INDUSTRIALIZATION AND DEVELOPMENT PROBLEMS

Industry in Guinea-Bissau is still at an embryonic stage. It is mainly limited to a few sectors which meet essential demands such as drinks, edible oil, clothing and construction materials.

The production of beer by the CICER**, has been diversified. Today it satisfies the requirements of the local market and a considerable quantity is exported. An agro-industrial complex at Cuméré will allow an annual production of 20,000 tonnes of unrefined oil and 5,000 tonnes of refined oil.

In 1977, a fruit juice and jam factory was set up at Bolama. A naval shipyard is being re-equipped and will be capable of ensuring the maintenance of the sea and river transport fleet as well as that of the fishing fleet.

In the field of clothing and allied industries, a shirt factory has been in operation since 1960. Furthermore, the production of cloth is being undertaken, thanks to a factory for the processing of textile fibres.

A factory for plastic products is being set up which will facilitate the manufacture of sandals and other articles.

* 1 US$ = approximately 35 pesos.

** Compania industrial de cervejas refrigerantes.

In the villages a large number of semi-artisanal activities can be observed; these activities are encouraged by the lack of supplies from outside. Thus, blacksmiths and weavers can be found. In many places, the country has simple distilleries for sugarcane brandy.

The weakness in development of the industrial infrastructures forces Guinea-Bissau to import the most elementary products with a consequent deterioration of the balance of trade.

V. MAIN PRODUCTS EXPORTED FROM GUINEA-BISSAU IN 1979

Products	*Quantity* (in tonnes)	*Value* ('000 dollars)
Groundnuts	10,606	6,089
Palm kernel oil	6,370	2,757
Cashew nuts	400	173
Frozen shrimps	742	3,445
Fish	764	476
Timber	2,947	639

VI. OBSTACLES TO ECONOMIC DEVELOPMENT

One of the major obstacles to the take-off of the economy in Guinea-Bissau is the almost total lack of high-level professional staff. There is not a single institution of higher learning in the country. It is estimated that 100,000 persons are in secondary schools in the country. However, the classes are taught by teachers who have only two or three years more training than their students, and these "teacher-pupils" still have to face difficulties resulting from the absence of elementary educational infrastructures.

The second handicap results from the consequences of a long war of liberation which lasted more than twelve years, the effects of which are still acutely felt today.

The disorganization of the system of production has caused serious economic problems which are additional to the delay inherited from a very backward colonial structure.

The country's leaders are aware of the situation and consider that the medium— and long-term economic policy will have to consist of taking the necessary measures to accumulate capital in the agricultural sector which employs the highest percentage of the population and where the natural resources which could be developed rapidly are concentrated.

VII. POLITICAL AND ADMINISTRATIVE ORGANIZATION

After a long war of national liberation under the leadership of the nationalists who joined together within the Parti africain de l'Indépendance de la Guinée et du Cap Vert (PAIGC), Guinea-Bissau was declared independent on 24 September 1973, and became a member of the United Nations Organization on 17 September 1974.

On independence day, a constitution was promulgated which set out the organs of political power as follows:

— The Popular National Assembly (l'Assemblée nationale populaire)
— The State Council (le Conseil d'État)
— The Council of State Commissioners (le Conseil des commissaires d'État).

Administratively, the country is divided into thirty-six sectors, eight regions and an autonomous sector, that of the City of Bissau, with regional status.

The PAIGC is responsible for the orientation and the political management of all the country's economic and social activities and in particular of the machinery of State.

B. The national development plan and the place of science and technology therein

Having emerged from a long war of national liberation, the economy of Guinea-Bissau is still searching for the economic guidelines which are most adequate and appropriate to its situation as a small country with limited resources.

Nevertheless, a Four-Year Development Plan for the period 1982-1985 has been prepared. The short and medium-term aims of development, as defined by the Planning Board are as follows:

On the whole, the years which followed the country's full independence (1974) have given rise to isolated initiatives corresponding to the most pressing crises, to the elementary structuring requirements of the State administrations affected by the exodus of the professional staff, etc.

Gradually, however, the initiatives became more organized to give way to an overall policy which was in keeping with the fundamental guidelines of PAIGC, which consisted of the elementary requirements of the population.

The Third Congress of the PAIGC was also aware of the dilemma faced by other developing countries which had thrown themselves entirely into agriculture for export and the creation of enclaves of modern urban development but unrelated to the country as a whole and in particular to the rural workers who form the bulk of the population. The Congress defined, in November 1977, a policy whereby the fundamental task of agriculture was to ensure adequate food supply for the population while industry was to concentrate on invigorating and modernizing rural activities.

This orientation in terms of development strategy—agriculture as the basis and industry as the driving force of its development—is fundamental, and also affects the service sector which is expected to play the role of integrating rural and industrial development, and not of channeling rural resources towards the capital and abroad.

Guinea-Bissau is less distorted than other former colonies by the classic colonial production system which cares only for primary products. It therefore intends to launch an integrated development process in which the capital city acts as a driving force and a developmental motor.

The introduction of this development implies on the one hand a systematic search for technological solutions adapted to the requirements of a small market and relatively unskilled manpower, but which does not rule out resort to advanced technology where this proves necessary. On the other hand, this development implies a choice in favour of the regionalization of development with a view to achieving an integrated rural development in which the population will have an important role to play in the definition of village programmes and regional infrastructures.

Following an initial phase during which economic measures were mainly individual responses to crises, the country is organizing itself to programme its development rationally.

The development programmes of all Ministries are submitted to the Government and the National Assembly. The elected representatives can then democratically consider the investments to be made, postponed or cancelled before final decisions are taken. These investment programmes which have been set up since 1978, grouping several hundreds of the country's main undertakings each year (in 1980, there were about 400 investment projects) have been enlarged to give way, at present, to a 1980-1981 Biennial Development Programme.

The 1980-1981 Biennial Development Programme maintains the Government's priorities relating to balanced development and to meeting the most urgent needs of the population, but is marked by its concentration on the main infrastructures necessary for the chosen developmental activities. Thus, the present phase is defined as one of "pre-development", a situation characteristic of a country in which the minimal preliminary conditions for development must be created before it can take off. At the same time, the 1980-1981 Programme considers the three main structural problems, which are by and large inherited from colonialism:

— The relative backwardness of rural development when compared with the development of the capital city's modern activities. An increased effort is therefore required at the level of regional development and, in particular, at the village level with the view to making the village economy more dynamic;
— The relative backwardness in organisation, management and maintenance of the modern facitilities established in the country as compared with the speed at which they are set up; this means that greater attention needs to be paid to the infrastructures for the reception and absorption of external inputs;
— The alarming increase in recurrent foreign exchange burdens which result from the accumulation of operational costs, in foreign exchange of imported equipment (spare parts, fuel, technical assistance, maintenance) as compared with the increase in production or exports which the units bring about; this calls for both an improved choice of technologies, standardization of equipment and a more rigorous definition of priorities.

The preparation of the 1980-1981 Investment Programme and the Biennial Development Programme should result, as from 1982, in the launching of the first Development Plan, 1982-1985, thus gradually reinforcing planning activities as the effective capacity to apply them is developed.

Since the 1980-1981 Biennial Development Programme has placed emphasis on the infrastructures necessary for development, it is probable that the 1982-1985 Four-Year Plan will be in a position to launch the general lines of the main programmes for the development of production in the country, especially by mobilizing the mass of rural workers.

The planning services are also subject to the difficulties of a take-off from an exceptionally low initial level with a restricted administrative structure. Nevertheless, planning and research offices have been set up in the technical Ministries and regional planning committees are being created within the regional state committees. This will gradually result in a flexible and decentralized pyramid of economic co-ordination.

These major problems of development are compounded by the general backwardness of the economy, poverty of the population, the distortions inherited from colonialism, the cost of energy (wholly imported) and the unfavourable system of transfer of technology at present in force on the world market and which makes the establishment of a New International Economic Order essential.

The Government in Guinea-Bissau, emanating from a liberation movement, is non-aligned. It accepts foreign aid from any source, provided this aid does not interfere with the country's absolute control over the direction of its development.

C. Science and technology policy structures

There is no science and technology policy-making body in Guinea-Bissau, neither is there any research activity in the real sense of the word.

As in all the countries visited, the author of this report found remnants of a colonial research institute mainly concerned with human sciences, linguistics, archaeology and ethnography, lacking means and staff and which, as is the case in many former West African colonies, is misnamed National Science Research Institute, whereas it covers only a small number of scientific disciplines, not to talk about technology.

The National Scientific Research Institute of Guinea-Bissau includes three departments: human sciences, economics, and geology and archaeology.

The Institute benefitted from Unesco support in 1977 and received a tape-recorder and laboratory equipment.

But the persons in charge of the Institute experience difficulty in using this equipment for lack of materials (chemicals for the laboratories, cassettes and headphones for the tape-recorder).

The Institute has a large library with important documents concerning the country's history and a certain number of old reports.

The national authorities are considering converting this centre into a regional information and archival centre for Gambia, Senegal and Guinea-Bissau.

In the agricultural sector, there is a department for agricultural experiments whose research is mainly concentrated on the improvement of rice production, the country's staple food. This department, which works in close co-operation with the West African Rice Development Association (WARDA) has already popularized numerous varieties of high-yielding rice in the country. It is attempting to take an interest in other crops, in particular food crops, but the department has only one professional staff member and a few technicians.

The greatest handicap to the country's development is the lack of professionals. This situation is mainly due to the fact that no establishment in the country provides university-level education and that the type of teaching given in secondary schools does not allow direct access to foreign universities.

In secondary schools, the level of the majority of the teachers is scarcely one or two years ahead of the pupils'.

But what is remarkable in this country which has barely emerged from a long war of liberation is the determination by the authorities to establish the conditions favourable to the economic take-off of the country. The country is open to all forms of aid likely to hasten its economic development.

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Ivory Coast

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. Position: In physical aspect, the Republic of the Ivory Coast is a fairly regular quadrilateral situated in the Gulf of Guinea. It is bounded to the south by the Atlantic Ocean, to the west by Liberia and Guinea, to the east by Ghana and to the north by Mali and Upper Volta.
2. Area: 322,000 sq. km
3. Population: 8.2 million (1979)*
4. *Density:* 21 inhabitants/sq. km reaching almost 50 inhabitants/sq. km in the south of the country.
5. *Average annual growth rate (1970-79):* 5.5% (3.7% for 1960-1970)*

At the end of 1980, the Ivory Coast had 8,400,000 inhabitants, 1.4 million of whom lived in the capital: 22% of this population consisted of foreigners in 1975. This proportion of foreigners approaches 50% in the city of Abidjan, 29% in the towns of the interior and 17% in the rural areas. It is estimated that the migratory balance accounts for one third of the net population growth.

The most striking aspect of the population of the Ivory Coast is its extreme youthfulness: 54% of the citizens of the Ivory Coast are less than 20 years old.

In 1980, 38% of the population of the Ivory Coast lived in the towns. The urbanization rate is in the range of 7.7% per annum. This rate is 5.7% for the towns in the interior and reaches 10% per annum for the city of Abidjan.

II. ECONOMIC INDICATORS

	1977	1978	1979	1980
1. General operating budget (BGF) in billion of F. CFA	198.3	253	304.6	338.4
2. Percentage increase	29.0%	27.9%	20.1%	11.1%
3. GDP (in billion F.CFA)**	1415	1615	1790	1940
4. % increase	+ 40%	+14.1%	+ 10.8%	+ 8.4%
Ratio general operating budget/GDP	14.0%	15.7%	17.0%	17.4%
6. Exports (in billion F. CFA)	529	524	536	
7. Imports (in billion F. CFA)	429	522	529	
8. Balance (in billion F. CFA)	+ 100	+ 2	+ 6	
9. Rate of import-export coverage	123%	100%	101%	

In Africa, the Ivory Coast is one of the countries with the most regular and sustained growth rate. As from 1962 it opted for an original formula by creating alongside the traditional operating budget another fund aimed directly at the development of the country.

The State plays an active role in many spheres for which the Special Investment and Equipment Budget (Budget spécial d'investissement et d'équipement, BSIE) is the financial tool.

Resources for the BSIE come from the following three entirely different sources:
— Taxes, dues and specific payments (BSIE-Treasury),
— Income from the fund for the stabilization and support of prices of agricultural products (BSIE-CSSPA),
— External aid.

The two internal sources total 65.5% of the amount of the BSIE in 1980, the external sources representing the remaining portion.

III. THE NATURAL RESOURCES OF THE IVORY COAST

(1) The lagoon complex and the harbour situation. Early geological studies revealed that around Abidjan the lagoon was unusually deep. By piercing the promontory opposite the oceanic depression known as the bottomless hole (44 m) it was possible to create a harbour which is both well protected and accessible to large boats.

This geological accident has enabled Abidjan to enjoy one of the most flourishing ports on the West African coast (8.5 million tonnes per year).

The coastal strip includes in its Western part a succession of beaches more attractive than a tourist brochure can describe, whereas its eastern part is composed of lagoons constituting a water-way in an area where the most varied economic activities take place (fishing, farming, transportation of wood and trade).

There are four big rivers that water the country: the Comoé, the Bandama, the Sassandra and the Cavally.

(2) Geology and mineral resources. Knowledge of the sub-oil in the Ivory Coast leaves much to be desired. The Eburnean platform of the Ivory Coast, which gave its name to one of the geographical entities of the African continent, is formed, in the Eastern part of the country by the old insular shelf. To the West, there is throughout the Man massif a scatter of small outcrops of magnetite quartzite. A more consistent deposit forms the top of the Mount Nimba range. These insular shelves are rich in iron-ore and silica. In the metamorphic hills to the East gold, diamonds and manganese are sometimes found, but only on a small scale.

On the other hand, the soil in the Ivory Coast is well known and utilized. The family of ferralitic soils with average or weak desaturation accounts for 2/3 of the Ivory Coast. Soils in this family cover the forest zone to a large extent while the savanna zone is composed of tropical ferruginous soils.

(3) Agricultural and forestry resources. Agriculture in the Ivory Coast consists predominantly of products of forest origin. They are coffee, cocoa, bananas, rubber, palm oil, pineapples, wood, cotton, rice, soya, etc.

Coffee is planted on over 1,000,000 ha; the average production of coffee reaches 250,000 tonnes yielding about 65 billion F. CFA. It represents one quarter of all exports.

Cocoa: approximately 550,000 ha of cocoa allow an average production of 200,000 tonnes/year. In 1978 a record production of 300,000 tonnes placed the Ivory Coast at the head of the world producers of cocoa with a global income of 72 billion F. CFA.

Bananas: represent a production of 160,000 tonnes with a value of 3.6 billion F. CFA. Wood with more than 2.5 million tonnes yields more than 50 billion F. CFA per annum.

* World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington D.C. 1081, Tables 22 and 33 of the Statistical Annex.

** We refer to the trading GDP in the national accounts.

In addition to these resources should be mentioned palm kernels and palm oil, pineapple, citrus fruit, rubber, etc. which account for approximately 12 billion F. CFA.

At the world level, these productions place the Ivory Coast as the first exporter of fresh pineapple, first producer of cocoa, second producer of yams, third producer of coffee and palm oil, and sixth exporter of bananas.

The Ivory Coast is a country whose economy is based primarily on products of vegetable origin and more specifically on commercial crops of interest to the world market.

Food crops: Yam is the starch which has the highest production in the Ivory Coast (2,400,000 tonnes) along with cassava, plantain bananas (roughly 1,400,000 tonnes each) and taro (300,000 tonnes).

As far as cereals are concerned, only rice benefits from a government subsidy because of its popularity with consumers.

IV. THE MAIN IMPORTS AND THE BALANCE OF TRADE OF THE IVORY COAST

The growth of imports has continued at a rate which is almost as high as that of exports, and the balance of trade has always been positive since independence. Development implies the purchase of highly technical machines and equipment.

However, the analysis over five years by category of utilization shows that the imports of intermediary goods and services represent 65% of imports.

There is a relative decline in the importation of household goods (21.8% in 1975 as compared with 19.7% in 1980), thanks to the good performance of Ivorian industry.

The growth rate of the importation of semi-manufactured goods and services has increased mainly in the industrial sectors and in construction.

The classification of imports by country shows several changes from one year to the other and illustrates the diversity of the Ivory Coast's suppliers.

In 1976 and 1977 the trade balance of the Ivory Coast showed a surplus of 81 billion F. CFA and 100 billion F. CFA respectively. These record figures resulted in an appreciable reduction in the rate of the balance of payments deficit.

In 1978 and 1979, despite the fall in the prices of coffee and cocoa, the import-export coverage rate was maintained above 100%.

V. MANUFACTURING INDUSTRY AND THE PROBLEMS OF DEVELOPMENT

The main aim of industry in the Ivory Coast is the processing of local resources: 47 of the 110 industrial firms which existed in the Ivory Coast in 1960 were saw-mills. The diversification which has been introduced since then has borne its fruits: Ivorian industry covers at the present moment 18 types of activities. In the space of two decades the progress achieved can be described as follows:

Industrial enterprises employed 10,000 persons at the time of Independence (1960), in 1980 they employed more than 65,000 wage earners, while the work-force engaged in various handicraft industries approached some 70,000 persons). The overall turnover was 13 billion F. CFA in 1960, and 650 billion F. CFA in 1979 or fifty times more within two decades. The most developed industries are those which are agro-based, e.g. palm oil, coffee, cocoa, canned fruit and fish.

The highly developed diversification of the chemical industry ensures that the Ivory Coast has at its disposal most products (with the exception of raw plastics, explosives and pharmaceutical products). It is now self-sufficient in the production of matches, fertilizers, soap and detergents.

The firm, Ivory Coast Refineries (Société ivoirienne de raffinage— SIR) has raised its initial capacity of 700,000 tonnes to 4 million tonnes and at the moment exports refined oil. At present this firm produces all the chemical by-products of oil; two lubricant factories and an asphalt works complete the expanding oil industry.

The Ivory Coast exports insecticide and perfumery products.

It is in partnership with Togo and Ghana in the production of clinker. The production of cement has risen by 46% between 1975 and 1978 necessitating an increase in the factory's grinding capacity from 950,000 tonnes in 1975 to 1,800,000 tonnes in 1980.

There is only one steel factory, which produces coils for concrete from imported steel billets. Production reached the figure of 18,000 tonnes in 1978.

Over the past few years, the textile industry has developed considerably. In 1977, in respect of 34 active firms it represented a combined investment of 39 billion F. CFA from a capital of 14.5 billion F. CFA of which the State and Ivory Coast citizens own more than 38%.

The balance sheet of the 1976-1980 Five-Year Plan shows a steady growth of the gross domestic product (GDP) of an average rate of 7.9% per annum generated by the productive sectors of the economy aided by the favourable conditions for the marketing of the main export products until 1977-1978.

The Plan period in question witnessed:

— an increase in modern exployment opportunities at a rate of 4.5% in agriculture, 5.7% in industry, 6% in the tertiary sector and 6% in the traditional sector;
— an increase in income: of 9.6% per annum overall and 5.1% per annum and per capita.

The volume of public investment exceeded the level forecast in the Plan in 1975 by 41%; the volume of investments in energy exceeded the projections of the Plan by 60%.

The increase in the volume of investment devoted to training and education is indeed spectacular:

The projections have been exceeded by 154%. However, the investment expenditure in this sphere has remained modest at 8.6% of investment in relation to the recurrent budget for education which accounted for 40% of the general recurrent expenditure in 1980.

The main problems facing the Ivory Coast economy are:

— Excessive specialization of agriculture in exports crops at the expense of food crops. This policy makes the Ivory Coast economy dependent on the world prices for these products (particularly coffee and cocoa), prices which the Ivory Coast cannot control.
— The non-adaptation of the industrial policy to local realities, in particular by the importation of highly sophisticated technology which local manpower cannot deal with.
— The dearth of qualified national professionals for directing and managing the vital sectors of the national economy.

VI. GOVERNMENTAL INSTITUTIONS

The Republic of the Ivory Coast has a presidential type of government. The supreme authority is vested in the President of the Republic. The other bodies are: the National Assembly (unicameral). The political system is that of the single Party. The Parti démocratique de Côte d'Ivoire, PDCI (The Ivory Coast Democratic Party) is the supreme decision-making and guiding body of national policy. It has three types of consultative bodies: the Steering Committee, the Executive Committee and the Technical Commissions.

B. The national development plan and the place of science and technology therein

I. THE AIMS OF THE PLAN 1981-1985

"The overall purpose of the national development strategy is, as hitherto, that of transition from a growth economy to one of a society committed to self-fulfilment both individual and collective, the supreme aim of which is the well-being of all Ivorian citizens".*

This goal reveals the following three aims:
— The pursuit of rapid growth;
— Increase of the participation of nationals in economic activity, i.e. 'ivorianisation';
— Individual and collective self-fulfiment of Ivorian citizens in response to their aspirations.

To attain these aims the following options have been decided upon by the authorities in the Ivory Coast:
— maintaining the liberal way of life;
— maintaining an opening to the outside world;
— aiming at a more balanced development of the whole of the national territory;
— developing regional co-operation with neighbouring countries.

The main orientations given in the Five-Year Plan are the following:
— Priority to the modernization of agriculture,
— Increased activity of the economic development agencies,
— Promotion and modernization of traditional and handicraft activities,
— Development of national human resources by the introduction of young people into the economy, aid to the peasantry and education in the service of development.

II. GROWTH TARGETS OF EACH SECTOR

At the level of the main sectors of the national economy the global medium and long-term targets of the Five-Year Plan can be interpreted as below:

Sectors of activity	Period I 1981-85	Period II 1985-1990
Primary sector (1)	7.7%	6.4%
including agriculture	5.3%	5.3%
Secondary sector (2)	4.7%	8.1%
of which industry	7.2%	8.1%
Tertiary sector	5.0%	7.7%
Commercial GDP	5.7%	7.4%

(1) including mines and unrefined oil.
(2) including construction and public works.

III. THE PLACE OF SCIENTIFIC RESEARCH IN THE DEVELOPMENT PLAN

Scientific research is one of the most important background measures amongst those projected by the 1981-1985 Plan for the implementation of its aims.

The orientation of research is to be closely linked to the general aims of development. Priority will thus be given to research aimed at increasing, diversifying and modernizing agriculture, stock-breeding, fishing and forestry, and to improving the conservation, processing and the further development of the products resulting from these activities. More than half of the human resources for research and almost 80% of its financial resources will be devoted to it.

The considerable effort made with regard to cash and export crops over the preceding years will be continued to consolidate the priorities of the Ivory Coast. But emphasis will be placed on the reduction of foodstuff dependency. The production of vegetable and animal products will be given high priority and research on farming systems and techniques with particular stress on the perfecting of mechanized methods of cultivation using the appropriate tools will be encouraged.

The following lines of research will also be encouraged:
— Development of knowledge of the environment, and in particular, pollution in the Ebrié lagoon with a view to remedying this situation.
— Public Health and the development of medicinal plants and the traditional pharmacopeia.
— The development of renewable and non-conventional sources of energy.

The rapid evaluation and development of the practical applications of research results will be a preoccupation common to the various themes demanding a more active participation from the productive sector.

To attain these objectives it is proposed to make the Ivory Coast research potential as efficient as possible, even before appreciably increasing it. Research worthy of the name demands excellent teams of research workers. The growth of the financial resources is as important as its scope. This is why the main background axes to the research policy according to the projections in the Plan will be:
— The recruitment and training of research workers of high calibre.
— The conservation of knowledge and the management of scientific and technological activities.
— An increase in the extent and depth of international co-operation.
— The improvement of the co-ordination and management of research.

The integration of scientific research in the aims of development in the Ivory Coast has been achieved thanks to the programming mechanism perfected by the Ivorian Ministry for Scientific Research.

The Ivorian system of research programming is based on the principle of financing by programmes and no longer by organization which implies as a corollary the close linking of research with the main national aims in the economic, social and cultural fields and a strict assessment of the cost of scientific activities.

Thus, each year a selection is made of the programmes identified. Meetings between organizations and or groups of organizations belonging to several commissions and a Technical Committee enable joint-consultation, between development agents and research workers to elaborate the programmes. These joint-consultations take place at the following different levels:

(1) *A Programme Commission,* which brings together men of science, planners and public and private persons in charge of development operations with a view to discussing and sorting out the programmes more particularly on the basis of their scientific values and degree of their usefulness in national development.

* National Plan for Economic and Social Development in the Ivory Coast (1981-1985)

(2) *A Budget Commission,* at the level of which the balance sheet for the past year, the progress of on-going activities and the applications for financing in the future are studied in the presence of the financing agencies, public or otherwise.
(3) *A co-odinating Commission,* which, on the basis of the classification of the programmes prepared by the programme commission and of the new undertakings, decides on a general classification at national level.

C. Ivorian science and technology policy structures

I. HISTORICAL DEVELOPMENT OF THE PRINCIPAL ORGANIZATION DIRECTING SCIENTIFIC AND TECHNOLOGICAL POLICY

The national organization for scientific and technological policy in the Ivory Coast is the Ministry for Scientific Research.

The Ministry for Scientific Research was set up by Presidential Decree No. 71-480, of 23 September 1971. The Ministry is responsible for promoting, directing, co-ordinating and planning scientific research, in the light of the development of science and its application to the economic, technical and social development of the Ivory Coast.

Prior to the creation of the Ministry for Scientific Research the majority of fundamental or applied research organizations depended either on the Ministry of Education (for those dealing with fundamental research) or on the Ministry of Agriculture as far as the institutes specialized in agricultural research, essentially French, were concerned.

II. THE RESEARCH ORGANIZATIONS WHICH PLAY A RÔLE IN THE FORMULATION OF THE NATIONAL SCIENTIFIC AND TECHNOLOGICAL POLICY

Reference will be made here only to the organizations which the Ministry of Scientific Research really functionally sponsors at present, since it is only at their level that it has been possible to set up the information networks which will be discussed later. These organizations have been established within various legal frameworks which can be divided into four groups:

(1) The organizations for applied agricultural research belonging to the Groupement d'études et de recherches pour le développement de l'agronomie tropicale, GERDAT (Group for Study and Research in the Development of Tropical Agriculture), of which there are four, which function as French associations under the 1901 law: the Institut de recherches sur les huiles et oléagineux, IRHO (Institute for Research into Oils and Oilseeds), the Institut de recherches sur le coton et les textiles exotiques, IRCT (Institute for Research into Cotton and Exotic Textiles), the Institut de recherches sur les fruits et agrumes, IRFAT (Institute for Research into Fruit and Citrus Fruits), and the Institut de recherches sur le caoutchouc en Afrique, IRCA (Institute for Research into Rubber in Africa).

(2) The Office de la recherche scientifique et technique Outre-Mer ORSTOM (Overseas Department for Scientific and Technical Research). This is a French research organization with two centres in Abidjan (Adiopodoumé and Petit-Bassam) and branches at Man and at Bouaké.

(3) The Research Organizations belonging to the Ivory Coast State managed by ORSTOM or by one of the GERDAT research organizations: The Centre de recherches océanographiques, CRO (Centre for Oceanographic Research) managed by ORSTOM; the Centre de recherches zootechniques, CRZ (Centre for Zootechnical Research), managed by the Institut d'élevage et de médecine vétérinaire tropicale, IEMVT (Institute for Stock-breeding and Tropical Veterinary Medicine); the Institut français du café, du cacao et autres plantes stimulantes, IFCC (French Institute for Coffee and Cocoa). The Centre technique forestier tropical, CTFT (Technical Centre for Tropical Forestry), and the Institut de recherches agronomiques tropicales et de cultures vivrières, IRAT (Institute for Tropical Agricultural Research), and the Institute for Food Crops managed by the GERDAT organizations of the same name.

(4) The Ivory Coast Research Organizations managed by the State: This group includes three types of bodies:

(a) University research organizations: The Centre ivoirien de recherches économiques et sociales, CIRES (Ivory Coast Centre for Economic and Social Research), the Centre national de floristique, CNF (National Flora Centre,) the Institut d'Ethnosociologie, IES (Ethno-Sociology Institute), the Centre de recherches architecturales et urbaines, CRAU (Centre for Architectural and Urban Research), the Institut de géographie tropicale, IGT (Institute for Tropical Geography), the Institut universitaire d'écologie tropicale, IUET (University Institute for Tropical Ecology), the Centre ivoirien d'études et de recherches audio-visuelles, CERAV (Ivory Coast Centre for Audio-Visual Study and Research), the Centre ivoirien d'études et de recherches en physiologie appliquée, CIERPA (Ivory Coast Centre for Study and Research in Applied Physiology), the Institut de littérature et d'esthétique négro-africaines, ILENA (Negro-African Institute for Literature and Aesthetics), the Institut de linguistique appliquée, ILA (Institute of Applied Linguistics), the Institut d'histoire, d'art et d'archéologie africaine, IHAA (Institute for African History, Art and Archaeology). The Institut de recherches mathématiques, IRMA (Institute for Mathematical Research), the Laboratoire de geophysique de LAMTO, Groupe de recherches sur la tradition orale, GRTO (LAMTO Geophysical Laboratory, the Oral Tradition Research Group.

(b) A public institution, the Institut Pasteur de Côte d'Ivoire, IPCI (Ivory Coast Pasteur Institute). Set up on 4 July 1979, the Institut ivoirien de recherches sucrières, IIRS (Ivory Coast Institute for Sugar Research) is intended to provide technical back-stopping to sugar production. The structure of this research organization is expected to take the form of an administrative-type public establishment.

(c) *A State enterprise,* the Institut pour la technologie et l'industrialisation des produits agricoles tropicaux, ITIPAT (Institute for the Technology and Industrialization of Tropical Agricultural Products).

(d) *Two foreign research organizations* should be added to the above list: the Nestlé Foundation which operates according to a special agreement concluded with the Ivorian Government, and the Dutch Centre which is a branch of the Agricultural University at Wageningen, linked to the ORSTOM centre at Adiopodoumé.

The GERDAT group of institutes is specialized in a crop, or a group of crops; institutes in this group are active in the following areas: oils-seeds, rubber, coffee, cocoa, fruit crops, food crops, stock-breeding, cotton and forests.

ORSTOM is active in the Ivory Coast in three research centres specialized in the humanities, in oceanography and in the earth and natural sciences. In the latter centre, which is by far the most important, research is concentrated mainly in the following areas: pedology, agronomy, plant genetics, phytopathology, immunology, virology, botany, entomology, geology, physical geography, and climatology.

As far as *non-University research* is concerned, two Institutes deserve to be mentioned:

— ITIPAT, whose aims are research, study, documentation and experimentation with regard to the conservation and processing of tropical products of biological origin with a view to improving the nutrition of the population and of enlarging the market for these products;

— The IPCT, set up in 1972, whose aims are the study of the contagious and immunizable diseases of mankind and the means of understanding and preventing them. Its programmes make use of the following disciplines: immunology, entomology, virology, ecology, serology and herpetology.

D. Aims, scope, functions and responsibilities of the principal national science and technology policy-making body

(1) Official title of the organization: Ministère de la recherche scientifique

(2) *Postal address:*

Ministère de la recherche scientifique
B.P. V 151
Abidjan
République de la Côte d'Ivoire

(3) *Legal status and administrative characteristics:* The Ministry for Scientific Research comprises a *Cabinet* (to which are attached two autonomous departments, which have between them five technical advisers) and four Central Directorates. The responsibilities of the technical advisers cover, respectively, international scientific co-operation, research policy, legal and financial problems, planning of research activities, co-ordination, evaluation and identification of structures and research projects and programmes.

(a) The *Directorate of Administrative and Financial Affairs* is responsible for the standardized preparation and control of the research organizations' budgets; it manages the property and staff of the Ministry.

(b) The *Directorate for Research and Programmes* has the task of activating and following up the programming and ensuring the scientific co-ordination which is a prerequisite of programming. It ensures the maintenance, in the field, of direct contacts between the Research units and the development agents.

(c) The *Directorate of Training* is in charge of monitoring the scientific qualification aspects of training, the introduction of research workers into Research Units and for the administrative follow-up of all training activities.

(d) The *Information and Publications Directorate* is responsible for encouraging and co-ordinating all the activities which promote documentation, information and publications in the field of science and technology.

Finally, it is to be noted that a consultative body has been set up, attached to the Ministry for Scientific Research: the *Council for Scientific Research.* This Council, whose tasks include discussing the main directions of scientific policy, has as its members ten Ministers and 16 scientific personalities. It relies on the work of ad-hoc commissions (Consultative Research Committee, Interministerial Research Commissions).

(4) **Aims of the organization including its key functions as regards the national scientific policy**

The main aims of the national science and technology policy-making body, as set out in Decree 71-480 which created it, are to promote, direct, co-ordinate and plan scientific research, geared to the development of science and its application to economic, technical and social development in the Ivory Coast.

To efficiently assume the task entrusted to it, the Ministry for Scientific Research has perfected an appropriate programming methodology covering both, scientific activities and their financing, and enabling the aims of the national scientific policy to be attained, without affecting the efficiency of the existing research mechanisms and without limiting the desirable spread to the international scientific community.

(5) **The Ivorian System for Research Programming**

The Ivorian system for research programming (as already stated) is based on the principle of financing by programmes and no longer by organization.

This system may be considered from both a theoretical and practical point of view:

(a) *From a theoretical point of view:* This methodology of research programming is central to the Ivory Coast's policy in respect of scientific activity. It is an instrument which should be considered from the dual aspect, both scientific and financial.

(i) *At the scientific level:*

The first operation is *identification,* i.e. the standardized division of research activities into research *programmes* and *operations,* these notions correspond to very precise definitions thus, for

The *programme* is a combined entity of research operations, which have a defined time-limit, and the scientific products of which is clearly identifiable— a product which can be used by agents external to the system of production under consideration. These agents are classified in three categories (the *direct development agents* who are producers of goods and services, the *vocational training organizations* and the *scientific community,* whether it be national or international);

Thereafter, on the basis of the definition of these fundamental units of scientific research and with the idea of linking research to national development, a *procedure for classifying and selecting* programmes into national priorities has been established;

In the second phase, and to control subjectivity during concertations, a method of making the programme selection procedure more formal has been introduced by using the mathematical method of graphs of comparison (the graph here is the image in graph form of the path followed by the research programmes in reality); it means using this instrument to select the best programmes by making a comparison, weighted by precise criteria, of the extent of their contribution to the implementation of certain defined development projects, e.g. in the regional programmes.

(ii) At the financial level:

The methodology follows the stages of programming at the scientific level, in as much as the budget is a programme in estimated figures.

The last months of the year 1974 were marked by the setting-up in the research organizations of an analytical accounting system which will henceforth enable a closer *evaluation* of the cost of research and of the *performance* of the budgets.

In this way, it is possible to ascertain the fraction of the subsidy which really accrues to the research programmes *sensu, stricto* in relation to the activities known as research support activities and which, while not research, are nevertheless essential to the implementation of the former.

It is easy to see the impact which a budget analysis of this type can have on the improvement of the financial management of organizations, in particular as far as the planning of expenditure is concerned.

(b) *From a practical point of view:* The implementation of the methodological research into the manner of managing scientific research takes the form of an annual meeting for each organization or group of organizations, of several Commissions and of a *Technical Committee.*

(6) **International Technical Co-operation** Two types of co-operation are practiced in the Ivory Coast: the first type is with the developed countries and the other is with the developing countries.

(a) *Scientific co-operation with developed countries:*

The Ivorian co-operation policy with the developed countries can, at the moment, be grouped under four headings:

— *first:* a new definition with France of the terms of the General convention which links the Ivory Coast to that country, in particular in the light of the evolution of the structures of a certain number of the existing organizations;

— *second:* a search for new partners likely to co-operate in executing national scientific policy, either by participating in the running of existing structures, or by contributing to the creation of new ones.
— *third:* the setting-up of a network of scientific correspondents abroad able to contribute efficiently to the store of information in the methods and results of research carried out abroad, which could be useful to national research.
— *fourth:* the maintenance of ongoing relationships with International Organizations such as UNDP, Unesco, FAO, UNEP which are likely to contribute to the development of national research programmes.

(b) *Scientific co-operation with developing countries:*

As far as co-operation with developing countries is concerned, particularly in the field of biological and natural sciences, priority goes first of all to the African countries which have the same ecological zones as the Ivory Coast.

E. National resources of the principal national science and technology policy-making body

(1) Financial resources. The general operating budget of the Ministry for Scientific Research amounted to 523,710,000 F. CFA for the year 1981. This budget covers staff salaries as well as various office supplies, subscriptions, fuel and miscellaneous operating expenses.

(2) Human resources. The total number of staff attached to the Scientific Policy organization, allowing it to function, is 90, made up as follows:

— 20 Professional staff Class A
— 4 Staff Class B
— 18 Staff Class C
— 53 Staff Class D.

(3) Informational resources

Scientific information: the sources of scientific information which exist in the Ivory Coast are of three kinds:

The first consists of results from experiments which are reliable enough to be disseminated among the users;

The second source is represented by the content of scientific publications intended to inform the international scientific community not only of the results obtained but also of the methodology employed and the scientific significance which should be accorded to these findings;

The third source brings together information from the first two sources which is likely to be introduced at the level of teaching, in particular for the training of research workers and technicians.

These three types of information are disseminated on two circuits which can be identified as: (i) Dissemination by popularization, and (ii) Dissemination by publication.

(a) *Dissemination by popularization:* This type of dissemination is mainly found in agricultural activities. It enables the primary research results to be translated into techniques directly applicable by the user. Since the ultimate user is usually the peasant who remains attached to information transmission habits which are linked to oral traditions, two relays are generally set up between him and the research worker.

The first relay, *pre-popularization* links the research worker to the technicians in the development firms. This is usually taken in hand by persons who are detached from the research agencies and are attached to the development firms within which they form *experimental units* known as *attendant units* whose aim is the "development" of the products of research in the accepted sense of the concept "research and development". At this level, the back-up of scientific information is represented by Technical Information Newsletters, by ad-hoc support, and by illustrated cards with a synthesized presentation of the techniques to be applied. The transmission of this written information is accompanied by joint-consultations to present the results and to discuss the aims and the programmes to be used to ensure the success of the pre-popularization.

The second relay, *popularization,* is exclusively in the hands of the technicians from the development firms, assisted by extension specialists in close contact with the peasants. At this last level, the information becomes almost exclusively oral while it is also divested of all technicalities; it nevertheless constitutes a decisive phase for the effectiveness of research in the service of social and economic development.

(b) *Disemination-publication:* Most of the research agencies in the Ivory Coast have their own means of publication. In the case of foreign agencies, the range of these means is not limited to their activities in the Ivory Coast: these means include journals, whose periodicity varies according to the institutes.

The Ivory Coast agencies use the most varied means: periodicals and, often, occasional reports. At university level, two attempts at co-ordinating publications should be mentioned: on the one hand, the *University Annals,* with their various series grouped by field of study, enable a presentation of a coherent image of research of the university institutes and laboratories as a whole; on the other hand, the publication in three volumes of an *Ivory Coast bibliography* enables the Ivorian researchers to obtain, in a single work, a complete overview of research carried out in the Ivory Coast.

The Ministry for Scientific Research envisages two complementary approaches aimed at presenting, in a minimum number of publications, as homogenous a picture as possible of research carried out in the Ivory Coast. On the one hand, it is a question of creating, on the foundation of the existing *University Annals,* a series to be entitled *Ivory Coast Scientific Research Annals.* On the other hand, it is intended to create a biannual journal of general information on the scientific research activities in the country. In both cases, the aim is to ensure a better co-ordination of the dissemination of research results whatever the nationality of the agency under consideration.

(4) Equipment and facilities. The Ministry for Scientific Research in the Ivory Coast, as is the case of most of the Ministries in this country, is housed adequately and functionally. This Ministry occupies two floors of a luxurious eight-floor building and is in the same premises, or close to, the other Ministries with which it maintains daily working contacts.

The Ivorian policy concerning the grouping of Ministries into a single Administrative Centre is indeed advantageous; it ensures a rapid and efficient working relationship among the various Ministries.

F. Links between the national science and technology policy-making body and its counterpart organs in sectoral ministries or government departments

They exist:

(1) At the level of the Commissions for Programming of Scientific and Technological Research

The Programme Commissions in the Ivorian Scientific Research System bring together the sectorial Ministries responsible for areas such as Planning, Agriculture, Livestock Production, National Education, Public Health, etc.

It is at this level that the Ministries which are the users of research results intervene on the research programme concerning their ministries. But the corresponding Ministries are also associated with the formulation of the programmes at the level of the Technical Committees of the specialized Research Institutes. It is at this level that the main information and feed-back networks function for the orientation and readjustment of the

objectives of the research programmes with a view to making them tally with those of sectorial development.

(2) At the level of the classical contacts between Ministries.

G. Critical evaluation of the performance of the national science and technology policy-making body

(1) True impact of the science and technology policy-making body on the economic development of the Ivory Coast

As in most of the countries covered by this study, the sector which has benefitted the most from the scientific and technological progress made in the Ivory Coast is the agricultural one.

In this country, it has been possible to valorize the results of scientific research thanks to the existence in rural society of administrative bodies which have at their disposal sufficient means and a functional structure for the purpose. These development agencies which are based on a crop, or group of crops (coffee, cocoa, palm-oil, cotton, etc.) work in close collaboration with the specialized research institutes in the rural areas: Institut français du café, du cacao et autres plantes stimulantes, IFCC (French Institute for Cocoa and Coffee), Institut de recherches pour les huiles et oléagineux, IRHO (Research Institute for oil and oil-seeds), Institut de recherches sur les fruits et agrumes, IRFA (Institute for Research into Fruit and Citrus Fruits), etc., and are ready to disseminate fresh research results amongst peasants. The combination of the efforts of scientific and technological research and socio-economic development is at the basis of the current prosperity of the Ivorian economy, which, despite the collapse of the world prices of its products maintains a certain drive.

In the field of food crops, the valorization of research results has been less spectacular than that recorded for cash crops. However, considerable improvements have been made in food crops including tubers and maize, thanks to the introduction of new high-yielding varieties bred by the Institut des savanes, IDESA (Savanna Institute) which brings together the French Institutes of the GERDAT.*

Despite the numerous research programmes underway in the other sectors (health, industry, etc.) progress in these areas is less noticeable. But the future seems to be bright for research into traditional medicine and pharmacopeia and into renewable sources of energy.

(2) Impact of the science and technology policy-making body on the development of the scientific potential

The Ivory Coast is one of the few countries in West Africa to have, at an early date, promoted its scientific and technology policy-making body to the highest governmental level. The Ivorian Ministry for Scientific Research was ten years old in 1981.

Prior to 1971, none of the Scientific Policy agencies existing in West Africa had been raised to ministerial level. The majority of these agencies such as:

The Conseil interministériel de la recherche scientifique et technique (Interministerial Council for Scientific and Technological Research) and the Bureau des affaires scientifiques et technologiques du Sénégal (Office for Scientific and Technological Affairs in Senegal), the Ghanaian Academy of Sciences and the Nigerian Council for Science and Technology (NCST), etc., were either attached to the Ministry of Education, to the Ministry of Planning or to the Presidency of the Republic, concerned.

The creation of the Ivorian Ministry for Scientific Research in 1971 constituted an *avant-garde* initiative and a demonstration of the political will of the authorities in this country to give special importance to this sector.

In 1974, the Ivory Coast was the only State in West Africa to be endowed with a Ministry for Scientific Research prior to the CASTAFRICA meeting, held in Dakar in January of that year.

(3) Development of human and financial resources

At present, in the various centres and Institutes, research programmes are carried out by research workers whose total number was estimated in 1979 at 392, taking into account the status of the institutes and the part-time participation of some of the researchers. On the basis of this figure, the participation of national research workers is only 16.5% of the total.

Given the size of the research programmes to be carried out, the number of research workers active in the country remains insufficient.

The national authorities are aware of this fact and have decided to establish a policy for the training of Ivorian professional research workers.

To this end, two means have been decided on, namely:

— The formulation of a special status for research workers.
— The implementation of a coherent system for training and recruitment of national staff.

Financing is mainly ensured by means of subsidies granted to the Research Institutions.

(4) The progress made by the science and technology policy-making body

The most important task of the Ivorian Ministry for Scientific Research has been the early perfection of a system for programming scientific research which equally takes into account relevant financial and scientific considerations. The originality of the system lies in the fact that it is the research programme, identified and decided upon, which is the subject of financing and no longer the research agency as such.

The Ivorian authorities think that this system has the advantage of better harmonizing the aims of the research programmes with those of the development agencies and of discouraging the routine presentation of the budgets of certain research institutions.

The second big achievement which has stimulated the development of the Ivorian scientific potential is the adoption of a national status of scientific workers. This arrangement, by means of the material advantages which it confers on research workers is an important factor in encouraging young Ivorians to choose careers in the field of scientific research.

It is worth noting the break-down of the overall budget allocation (in million F. CFA), to research programmes in 1975:

State subsidy	5,490
Private subsidy	90
External aid	10,285
Grand total	15,865

These resources are distributed amongst the research institutions in the following manner:

Agricultural sciences	45%
Basic sciences	40%
Technological sciences	5%
Medical sciences	5%
Social and Human sciences	5%

(5) Difficulties encountered by the agency

One of the current weaknesses of Ivorian scientific and technological policy is the lack of recent statistics concerning the assessment of the national scientific potential to enable a more

* GERDAT: Groupement d'étude et de recherche en agronomie tropicale (Tropical Agriculture Study and Research Group)

rational use of this potential. The existence of this type of information would have enabled a better grasp of the difficulties encountered by the Ivorian scientific and technological policy-making body.

The main difficulty is the shortage of Ivorian professional staff in the Research Institutes. Apart from the teacher-researchers at the University of Abidjan, the proportion of Ivorian research workers in the Research Institutes, the majority of which are directed by the GERDAT Institutes, may not exceed 15%. This situation is harmful to the future of research which is mainly a process of accumulation and of capitalization of knowledge and 'know-how'. This process can only achieve its aims when it is perfectly controlled by national manpower. Otherwise, the departure of each expatriate at the end of his contract deprives the country of a scientific capital in which the country has invested.

The second difficulty of Ivorian research lies in the sources of financing. Despite the praiseworthy effort made by the Ivorian authorities, two-thirds of the financing of the research comes from abroad, principally from France. This situation of dependency makes the future of research precarious if no solution is found.

(6) Future prospects

The Ivorian authorities are well aware of the present weaknesses of the scientific and technological policy-making body and the means for the implementation of the vast programme which it encompasses.

This is why important provisions are being made for:

— a better definition of scientific and technological policy and a concentration of efforts on research activities needed for development;
— an improvement in the valorization of research results and a reduction in the delays of implementing these results;
— encouragement of the training and recruitment of Ivorian research workers;
— the broadening of the participation by the various existing institutions (universities, private enterprises, etc.) in research activities;
— a rise in the level of financing.

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Liberia

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Republic of Liberia is situated on the west coast of Africa. It is borded on the east by Ivory Coast, on the west by Sierra Leone and on the north by Guinea. The Atlantic Ocean forms the southern border.
2. *Area:* 111,369 sq. km
3. *Population:* 1.8 million (1979)*
4. *Average annual rate of population growth:* (1970-79):3.3%*
5. *Date of Independence:* 26 July 1847

II. ECONOMIC INDICATORS

1. *GNP per capita:* 500 US dollars (1979)
2. *GNP:* 386 million US dollars (1977)
3. *External trade:*
   Exports: 147 million US dollars (1977)
   Imports: 457 million US dollars (1977)

III. NATURAL RESOURCES

1. Mineral resources. The major mineral resources of the country are iron ore (18,000,000 tonnes) and diamonds (300,000 carats).

2. Agricultural resources. Liberia is essentially an agricultural country. It is endowed with abundant land, fertile soils and a large agricultural population. Agriculture employs directly or indirectly about 85% of the economically active population. During the period 1975-1979, for example, agriculture alone contributed about 55% of the GDP. Its chief agricultural exports include rubber, timber (logs and sawn), coffee, cocoa and palm products.

IV. MANUFACTURING INDUSTRIES AND PROBLEMS OF DEVELOPMENT

Manufacturing activity consists mostly of the operations of some 142 private firms and 21 public corporations, the private sector being dominant. The corporations include the Liberia Petroleum Refining Company, the Liberia Sugar Corporation (LIBSUCO), the Liberia Timber and Plywood Corporation (LTPC), the Liberia Rubber Processing Corporation (LRPC), the Liberia Rubber Articles Manufacturing Corporation (LIRAMCO), among others, while the activities of the private firms cover the local production of tobacco, beverages, flour, aluminium ware, furniture, paints, cement, baked foods, soap, rubber footwear, clothing, jewelry and handicrafts.

The contribution of manufacturing to GDP, in real terms (at constant 1971 prices) increased from about $8.0 million in 1964 through $23.1 million in 1975 to almost $31 million in 1978 (see Table 1 below). Even then, its share of GDP is still less than 10% and it employs less than 9 000 persons.

* World Bank: Accelerated Development in Sub-Saharan Africa for Action. Washington DC 1981, tables 22 and 23 of the Statistical Annex.

Table 1.: Sectoral origin of GDP at factor cost, 1975-79, constant (1971) prices (million US dollars)

Sector	1975	1976	1977	1978	1979
Agriculture	(50.1)	(55.3)	(59.9)	(61.2)	
Rubber	24.3	24.9	23.1	21.9	20.2
Forestry	12.5	16.4	16.4	21.2	23.3
Others	13.3	14.0	15.4	16.8	17.7
Mining and quarrying	(116.2)	(108.4)	(94.3)	(93.3)	(99.1)
Iron ore	110.3	103.9	89.7	88.3	94.2
Other	5.9	4.5	4.6	5.0	4.9
Manufacturing	(23.1)	(28.1)	(29.2)	(30.7)	(*)
Construction	(14.1)	(17.7)	(19.2)	(22.0)	(25.0)
Other	(140.0)	(149.8)	(156.6)	(162.3)	(39.6)±
Total GDP at 1971 Factor cost	(343.5)	(357.2)	(354.2)	(368.2)	(386.0)

Source: Republic of Liberia, Ministry of Planning and Economic Affairs, Economic Survey of Liberia, 1979, Monrovia, Liberia, September 1980. Figures derived from Table 2.

* Not available

± Includes 'Government Services' only.

Due mostly to good prices for iron ore, the Liberian economy grew at an impressive rate of 5.7% per annum during 1964-1974. But during the first plan period (1976-1980), the economy virtually stagnated, the overall rate of growth for the whole period being only 0.5% per annum.* In particular, the export earnings and import capacity of the country were undermined by the substantial fall in world demand for iron ore. Simultaneously, the import bill rose due to increasing prices of oil, food and manufactured goods. The country's external debt (public) stood at $ 520.4 million by June 1980, 330 per cent of what it was in 1973.

However, despite these difficulties, government development expenditure rose steadily from $ 20.0 million in 1974 to a peak of $ 210.8 million in 1979, though it then declined sharply to $ 120.0 million for 1980. Table 2 below shows clearly the high level of the country's dependence on imports not only for raw materials but also for a wide range of consumer goods, many of which could be produced locally. This also indicates generally the existing technological-development gap in the agricultural and manufacturing sectors.

Among the country's major development problems are excessive dependence on iron ore for foreign exchange, increasing energy prices, a declining agricultural sector and resulting food shortages and food insecurity, widespread unemployment, an environment which does not stimulate local entrepreneurship, inefficient management of public corporations, low-level participation of the masses in development action and, of course, the under-development of the science and technology sector.

B. The place of science and technology within the national development plan

I. MAIN OBJECTIVES OF THE PLAN

Liberia's first national development plan was launched only in 1976 (1976-1980) and a second one (1981-1985) in 1980. Thus, development planning in the country has a very short history. In the two plans already noted, the major objectives were to strengthen agricultural production and small-scale (import-substitution) manufacturing as a way of diversifying the productive base of economy, to stimulate "Liberian entrepreneurship" and reduce unemployment, to raise the level of productivity in the economy, to improve the provision of social services and to mobilise the community for development. There has been a strong concern with the agricultural sector in general and, more recently, a particular concern with food production.

II. PLACE OF SCIENCE AND TECHNOLOGY WITHIN THE PLAN

There was hardly any specific mention of S & T policy in the 1976-1980 plan, though the plan included several *ad hoc* programmes to intensify the application of S & T inputs to some particular areas of production, mostly through external technical aid. For example, both the International Fund for Agricultural Development (IFAD) and the Food and Agricultural Organization (FAO) were scheduled to assist in implementing the government's large-scale upland rice programme. The Chinese Technical Co-operation Agreement was to be involved in the seed-multiplication and vegetable production centres, in the planning of irrigation and drainage systems and in the study of the development potentials of three basins; while the World Bank was to help with forestry development and the pulpwood industrial plantation initiative. All these projects necessarily require significant technological inputs.

* Republic of Liberia, People's Redemption Council, Second National Socio-Economic Development Plan, July 1981 -June 1985, Monrovia, 1981 (Draft), p. 1.

Table 2: Import Value by Economic End-Use, 1973-1980 (million US dollars)

	1973	1974	1975	1976	1977	1978	1979	1980
Consumer goods	58.3	73.2	73.4	83.1	122.8	125.3	131.5	129.8
Investment goods	49.7	58.4	81.3	90.5	113.8	112.4	112.9	95.2
Raw materials (crude oil)	85.5	156.8	176.5	225.6	226.9	243.1	262.1	308.9
	(11.6)	(53.2)	(44.4)	(53.1)	(68.7)	(84.6)	(103.7)	(152.1)
Total imports (c.i.f.)	193.5	288.4	331.2	399.2	463.5	480.8	506.5	533.9

Source: Extracted from 1981-1985 Development Plan, Table 4, p. 12.

There was a definite reference in the 1981-1985 plan to necessary S & T inputs, as part of the "support systems" for the production sectors, especially for agriculture, within what the plan calls "a crash rural development programme".* Specifically, the plan envisaged greater efforts in extension services, research and training; more intensive production-bound research by the Central Agricultural Research Institute (CARI); extension and training programmes organised with special reference to the needs of the small farmer; and research and other support to small-scale industries tranforming local agricultural produce or supplying farm inputs.

But still, there was no S & T policy as such in the plan. In fact, at its launching, it was noted that Liberia did not have any national S &T policy. As a result, a conference to begin to consider the matter was planned for early 1981.

C. Structure of the national scientific and technological system evolution

Official concern with the question of a science policy for Liberia probably dates back to the establishment of the Bureau of Science and Technology in 1972. That may also be regarded as the first step, (although not a bold one), in the effort to create Liberia's S & T policy-making machinery. The Bureau has moved forth and back between the Ministry of Education and the Ministry of Planning and Economic Affairs but it does not seem to have achieved much in its role as a policy-making organ. In any case, it was meant to deal with science and technical education rather than with the promotion of science and technology as critical inputs in development.

Writing in December 1979, the Faculty of the Faulkner College of Science and Technology of the University of Liberia highlighted several important issues concerning the possible role of science and technology in national development, it noted "that there exists a vacuum for any sort of concerted effort, nationally, on science and technological matters (that) there is no leadership in the country in this regard", and urged that "some National Science Policy Agency" be established.**

The need for such a co-ordinating body was highlighted again at the launching of the 1981-1985 Development Plan and a Task Force was set up in January 1981 under the Honourable Minister of Planning and Economic Affairs: "to consider the possibility of establishing a National Research Council on Science and Technology for Development in Liberia.T***

Papers were duly prepared for the conference but, owing to certain adverse developments, the meeting was postponed indefinitely. At the time of this study, the papers and addresses of the conference were being put together by the Ministry of Planning and Economic affairs.

Thus, there is as yet no national S & T policy-making machinery as such in existence in Liberia though the need to create that machinery is already clearly recognized and the move to plan and establish such a body will, most probably, be revived in the near future.

D. Aims, scope, functions and responsibilities of the national science and technology policy-making machinery

Even though there is no national S & T policy-making machinery as such in Liberia, some objectives relevant to the development of the country's S & T potential have been pursued, with little or no co-ordination at inter-agency level, over the years. The following list of agencies gives some idea of the range of objectives and institutional resources:

- The University of Liberia Institute of Research which coodinates research activities in the university in pursuit of contribution to national devlopment and academic excellence (areas of research which the Institute has actively supported include agriculture, forestry, health and education).
- The Faulkner College of Science and Technology, University of Liberia, which has done some work on solar energy, local dyes, drug chemistry, etc. It also runs professional courses in engineering and is contemplating graduate studies. It has, on a few occasions, rendered consultancy service to ministries, at the latter's request.
- The Central Agricultural Experiment Station (now Central Agricultural Research Institute, CARI), which was established in 1951 at Suacoco but has been virtually dormant through the sixties and seventies. It has made some contribution to the development of improved upland and swamp rice varieties.
- W.V.S. Tubman College of Technology, in the field of technical education.
- Research Institutes, e.g. the Tropical Health Institute, the Biomedical Research Institute, the Botanical Research Centre, the Liberia Research Unit of the Tropical Institute, Hamburg (located in Monrovia).
- Ministries, especially Agriculture, Lands and Mines, Public Works, Education, and Planning and Economic Affairs.
- Professional S & T associations, e.g. Natural History Association, Medical Association, Traditional Herbalists Association, Association of Engineers, etc.

Generally, these various agencies have not been as active or as effective as they could be nor have they made any truly remarkable impact on the country's technological capacity or its production process. True enough, some of them made notable efforts. Examples are the University of Liberia Institute of Research and its College of Science and Technology, as already noted, CARI with its work on rice and the Tropical Health Institute and the Bio-medical Research Institute some of whose findings are providing a basis for the country's public health policy.

Liberia is still producing under 15% of its technical manpower needs. The impact of the activities of these agencies even on the agricultural sector has been minimal.

Productivity and output have in fact declined in the sector and Liberia is, at present, unable to feed its rapidly -increasing population without massive and rising dependence on food imports financed from the country's slim foreign exchange earnings and on food aid. More serious research needs to be done to develop crop varieties appropriate to local conditions, e.g. for sugarcane, various tree crops, selected tubers and vegetables, to bring plant diseases under effective control, to improve agricultural and village technology and to advance Liberia's production capacity in the area of food processing and preservation. Much more of such research needs to be done by Liberia's own scientists in the country's own research establishments or under collaborative arrangements with other countries with similar problems and needs.

The following six major problems seem to explain the present underdevelopment of Liberia's S & T potential:

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* Second National Socio-Economic Development Plan 1981-1985 (Draft) *op. cit.*, p. 86

** College of Science and Technology, University of Liberia, "Views on the Formation of National Policy for Science and Technology in Liberia", University of Liberia Science Magazine, No. 5, December 1979, pp. 4-17.

*** From the statement by Dr El Mohamed Sherif, Chairman of the National Conference on the Application of Science and Technology to Cultural and Socio-Economic Development in Liberia, Monrovia, 26-28 January, 1981.

— Foreign orientation of local S & T policy-makers with respect to technological advice and choice of technology;
— Inadequate consultation with and utilization of local/indigenous S & T personnel;
— Ineffective regulation of the process of transfer of technology in the limited industrialization programme already being undertaken in the country;
— The absence of a comprehensive national science-education policy to link that sector of education to development needs;
— Acute shortage of scientific and technological manpower; and
— Lack of a National Science and Technology Policy-Making and Co-ordinating Machinery.

There is an urgent need to continue the initiatives aimed at working out the operational details of an appropriate S & T policy-making machinery and at establishing and developing the requisite policy and institutional framework for the advancement of the country's S & T potential. And this need seems to be well-recognized by the Ministry which is handling the matter.

Mali

A. Political and economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Republic of Mali is situated in the Western Sahara and the Sudan-Sahel area. It is a landlocked State, borded by seven countries: Algeria to the north, Mauritania to the north-west, Upper-Volta, the Ivory Coast and Guinea to the south, Niger and Senegal to the south-east.
2. *Area:* 1,240,192 sq. km
3. *Population:* 6,800,000 (1979)*
4. *Average annual growth rate:* 2.6%*
5. *Rural population:* 83.2%

Growth rate of the rural population 3.2% as compared with 2.4% in urban areas.

Average life expectancy: 38 years

Demographic structure:

0 to 15 years:	44.3%
15 to 39 years:	36.5%
40 to 55 years:	11.0%
over 55 years:	8.2%

II. ECONOMIC INDICATORS

	1978	1979
GDP in billions of Mali francs	423.4	261.9

Budgetary expenditure in millions of Mali francs

Year	Income	Expenditure	Deficit
1970	20,277	21,921	1,644
1975	28,848	37,030	8,867
1979	54,913	72,489	17,576

Overall trend

Between 1970 and 1979, budgetary expenditure rose from 21,921 million Mali francs to 72,489 million Mali francs. Within this evolution expenditure on personnel rose from 59.3% in 1970 to 70% in 1979 whereas that on materials fell from 22% to 19.7%. The budgetary deficit increased.

In 1970, income covered 92.5% of expenditure. In 1975 the coverage was only 76.8%. In 1979, the rate of coverage had fallen to 75%.

III. MALI'S NATURAL RESOURCES

1. Relief, vegetation and drainage network. Mali is a land-locked country with no opening to the sea. The country is completely covered by savanna and steppe which become poorer and poorer as they approach the Sahara and the plateaux of laterite which rise in a series of terraces to 300-400 metres. While the desert part is characterized by an almost total absence of vegetation, the semi-arid part (the Sahel area), an area of about 200,000 square kilometres, which lies between the estuary of the River Niger and the Central Delta, has a low rainfall (300 to 500 mm of water per annum). This region is characterized by sparse vegetation, dominated by thorny bushes and is the main cattle-raising area.

The rest of the country is divided into the central or Sudanic area (dry savanna) with a rainfall of 600 to 1,000 mm per annum, and the southern or Guinean area (moist savanna) with an average rainfall in the range of 1,300 mm per annum. Both areas are suitable for cattle-raising. Millet, rice, maize and cotton and groundnut can be grown in the southern part. Those areas include 45,9 million hectares of land suitable for agriculture and grazing.

The drainage system is composed of two big rivers which flow across the country: they rise in the Fouta-Djallon mountains in the Republic of Guinea: the Senegal River which flows towards the Atlantic Ocean and the Niger which after flowing towards the North for a considerable distance returns to flow out into the Gulf of Guinea.

These rivers flow through vast alluvial plains, extending in the case of the Niger from the region of Segou to Timbuctoo, almost 100 km wide. The central Delta of the Niger extends over almost 4 million hectares.

The Senegal River, with its tributaries, also offers considerable possibilities for agro-pastoral land management in the Kayes area. Moreover, there are differences in level in these rivers which constitute a considerable potential for sources of electricity. The energy potential for the various hydro-electric schemes which are operational or being planned are estimated, dam by dam, as follows:

Selinke Dam	183 million kWh
Manantali Dam	800 million kWh
Tossaye Dam	63 million kWh
Labezanga Dam	140 million kWh
Gouina Dam	570 million kWh
Felou Dam	430 million kWh

Solar energy and other sources of renewable energy also offer considerable possibilities.

Moreover, the Niger and Senegal rivers are navigable during part of the year.

2. Agricultural resources. Agriculture remains the main source of income for more than 85% of the population of Mali. Cultivated land extended in 1978 over an area of more than two million hectares devoted mainly to the cultivation of millet, sorghum, rice, groundnut, and cotton, the two latter crops and their by-products accounting for more than 60% of the value of exports of the country. Despite the resources in surface water, this sector continues to be dependent on climatic conditions, in particular on rainfall. When the latter is normal, agricultural production gives good results.

* World Bank: Accelerated Development in Sub-Saharan Africa: an Agenda for Action, Washington DC, 1981, Tables 22 and 23 of the Statistical Annex.

Thus, during the years 1976 and 1977, satisfactory rainfall, supported by efforts for improvement in productivity and an increase in cultivated area resulted not only in satisfying the food requirements of the country and the raw material needs of manufacturing industries, but also in the creation of a surplus for export.

3. Mineral resources. Over the past decade, considerable efforts have been made in the field of geological and mineral research. A number of concrete results have been obtained concerning gold (Kalana), phosphates (Tilemsi) and gypsum (Tessalit). In these fields, prospecting have been followed by working. On the other hand, research has revealed the existence of considerable deposits:

— of bauxite, the total reserves of which have been estimated at almost 800 million tonnes, 40 to 45% of which is alumina, with less than 4% silicon;
— of iron, two important deposits having been listed in the regions of Safing-Makana and Djidian-Kéniéba. The reserves exceed one billion tonnes of mineral;
— of manganese, reserves being estimated at 3.5 billion tonnes.

As far as uranium is concerned, prospecting is being carried out in the Adrar des Iforas and in the Kéniéba areas. Considerable efforts at prospecting for petroleum are also being made.

IV. TRADE BALANCE

1. Exports During the past decade, exports rose from 12,296 million M. Fr. in 1970 to 47,100 million M. Fr. in 1979.

This overall increase conceals different periods:

1970-72 was a period of recovery
1973-75 was a period of recession
1976-77 was a period of recovery
1978-80 was a period of fall

1968:	52,496 tonnes	4,504 million M. Fr.
1972:	135,700 tonnes	21,000 million M. Fr.
1975:	105,600 tonnes	23,100 million M. Fr.
1977:	208,792 tonnes	61,218 million M. Fr.
1979:	105,000 tonnes	47,100 million M. Fr.

The period between 1968 and 1972 benefited from the direct and indirect consequences of devaluation. The years were entirely characterized by variations in production, due to bad climatic conditions, and by the evolution of world prices.

Thus, between 1972 and 1974 an exceptional drought caused the production of cotton to fall from 74,000 tonnes to 55,000 tonnes and the production of groundnut from 188,000 tonnes to 100,000 tonnes.

After having experienced favourable prices, cotton was sold in 1975 for 452,000 M. Fr. per tonne. On the other hand, in 1976 the price rose to 800,000 francs and in 1978 fell again to 655,000 francs.

The structural evolution was as follows (in percentages):

Year	Cotton products	Cattle	Fish	Groundnut products	Others	Total
1969	39.3	27.6	10.8	11.4	10.7	100
1979	56.6	16.4	1.0	7.6	19.4	100

Whereas in 1969 traditional exports represented 38.6% of the total, ten years later they accounted for no more than 17.4%.

As far as modern exports are concerned, they are characterized by a steep rise in cotton, which represented 56.6% of total exports in 1979 as compared with 39.3% in 1969. This rise compensated happily not only for the fall in fish, but above all for the fall in groundnuts, whose share dropped from 11.4% to 7.6%.

2. Imports Over the past decade, imports have risen from 28,682 million M. Fr. in 1970 to 111,100 million M. Fr. in 1979.

Bearing in mind the need to meet the implementation of two investment programmes, the Three-Year Plan and the second Five-Year Plan, the increase in imports does not appear to be excessive. The latter, however, increase considerably as a result of the effect of two factors which had not been such a source of anxiety during the previous period:

— The world inflation in costs, aggravated by the increase in petroleum prices which had a systematic effect not only on the "CIF African ports" prices of the important products, but also on the costs of transporting goods up to the Mali frontier.
— A series of droughts reduced the subsistence crops and forced the importation of very large quantities of food products.

Thus, in 1969 a special importation of 40,000 tonnes of cereals had to be made; in 1973 it was necessary to import 240,000 tonnes of cereals; in 1976 a further 80,000 tonnes of imported cereals had to be dealt with.

The structural evolution of imports is as follows(in percentages):

Year	Food products	Petroleum products	Capital goods	Other products	Total
1969	38.6	10.7	23.2	27.3	100
1972	55.3	10.4	28.2	36.0	100
1974	17.8	9.0	14.0	21.8	100
1976	27.6	14.3	29.5	38.3	100
1977	13.9	16.2	33.3	24.7	100
1979	13.9	20.7	38.5	26.9	100

The period was characterized by:

— high food imports during the years of drought;
— a very high increase in the share taken by petroleum products which, after having represented 10% of imports practically throughout the period, began to rise accounting for 14.3% in 1976, 16.2% in 1978 and 20% in 1979. This share was estimated at 23% in 1980;
— a heavy increase in imports of consumer goods for the implementation of the Three-Year Plan and the Five-Year Plan.

Evolution of the trade balance: between 1970 and 1980, the net trade balance was constantly negative. In fact, Mali never exported enough to balance its imports. On average, the country ensures the coverage of about 50% of its imports by its exports. This imbalance is mainly due to the various factors which cause imports to rise or to fall in both value and quantity. However, it should be pointed out that the history of the commercial shortfall of Mali's trade balance is dominated by two special factors:

— the need to import capital goods to carry out its development programmes;
— the constraint of importing food products to deal with the consequences of drought.

Exports and imports (in millions M. Fr.)

Year	Exports	Imports	Balance	% Coverage
1970	19,296	28,682	9,386	67.3
1972	21,000	39,615	18,615	53.0
1975	23,100	75,412	52,312	30.6
1976	41,124	71,510	30,386	57.5
1977	61,218	78,000	16,782	78.5
1978	42,500	105,000	62,500	40.5
1979	44.900	111.100	66.200	40.4

3. Global evolution. Generally speaking, it can be seen that the balances of trade and of services are usually negative and that those dealing with multilateral transfers and capital operations are normally positive and that, in the last resort, it is the latter two which reduce the short-falls in the balance of payment. The deficit of the former is due to the disequilibrium between the export and import of goods, and to the operations dealing with manual exchange rates, and to the costs of travel and pilgrimages. They are also due to the interest to be paid on the public debt and particularly to the interest relating to the debit balance of the operations account with France. Finally, mention should be made of the expenses related to the Embassies abroad.

This deficit has numerous causes, some of which cannot really be attributed to Mali:

— Mali's geographical situation which confers on it heavy approach costs;
— the requirements for manufactured goods to ensure its development, which are a heavy burden on the demand for imports;
— the requirements for food products to deal with shortages due to drought;
— the fall in exports also due to the effects of drought;
— the increased demand for petroleum products resulting in a sudden increase in imports and in transport costs.

On the other hand, other causes do exist for which Mali ought to be able to find remedies:

— the insufficiency of storage facilities which forces the country to sell at any price and does not allow it to wait for an improvement in prices. This shortage of storage facilities thus often implies material and financial losses;
— inflation of the internal credit. Effectively, one of the principal causes of the external deficit lies in the very structure of the State enterprises whose disequilibrium leads to an excessive use of bank loans. It is evident that loans taken for financing the losses of firms instead of increasing production are unhealthy. In a country like Mali, which is open to the outside world and where the national production of manufactured goods is insufficient to meet local demands all injections of new forms of payments encourage an increase in imports.

V. INDUSTRIAL DEVELOPMENT AND DEVELOPMENTAL PROBLEMS OF THE MALI ECONOMY

1. Industries in Mali. Industry in Mali is not as yet very developed and mainly concerns the processing of local products. From an overall point of view, it only plays a small part in Mali's economic activities. The contribution of the secondary sector, taken as a whole, to the formation of the GDP is barely 16% and that of food industries is about 2.5%

The most important enterprises are:

— the oil factories SEPOM (groundnut) at Koulikoeo and SEPAMA (groundnut) at Kita
— the sugar refineries at Dougabougou and at Seribala.

Mali produces approximately 16,000 tonnes of sugar, a quantity which is considered below the national demand.

— The SOCOMA cans fruit juices and tomatoes.
— Amongst the other food industries, mention may be made of the milk products industry (Mali-lait), and the animal products industry (there are modern slaughter houses at Bamako and Gao)

Amongst future projects, Mali intends to substitute millet and manioc flour for wheat flour. The recently created Centre d'Étude et de Promotion industrielles (CEPI -Centre for Industrial Study and Promotion) will have an important role to play in encouraging and promoting industrialization.

2. Factors restricting the development of Mali's economy

(a) The country's land-locked situation is the prime handicap to Mali's economy. The absence of direct access to the sea has two types of consequences:

— dependence on neighbouring countries forcing Mali to diversify its access routes.
— international transit costs which must be added to the maritime transport costs and which, like the latter, are mainly paid for in foreign exchange.

Approach costs to bring imported goods up to the frontier, represented 30.3% of imports in 1979.

(b) *The climate:* The aridity of the climate is another major handicap for agricultural production whose contribution to the Mali GNP is almost 80%.

Mali's severe climate takes the form of high temperatures and low and irregular rainfall. Almost 20% of the country situated in the semi-arid zone, (an area of 200,000 sq. km) receives only 300 to 500 mm of rain per year. The rest of the country is made up of dry savanna (600 to 1,000 mm of rain) and moist savanna (1,300 mm of rain per year).

(c) *Financial constraints:* Mali's growing national debt is a major constraint on the financing of economic development projects.

The uncertain situation of public enterprises is also responsible for this situation. It has been pointed out that the deficit will reach the record figure of 23 billion M. Fr. equivalent to 11.5 billion F. CFA in 1980. The Mali economy will thus find it difficult, if not impossible, in the short run, to proceed with large-scale new investments in developmental projects without massive resort to external sources.

The Three-Year Plan for recovery is therefore being implemented with a view to rehabilitating the economic, financial and administrative situation of these enterprises. Several of them are becoming mixed economy enterprises in which private capital has a majority holding, whereas for others the Mali authorities recommend that only the State enterprises which are economically profitable or of strategic character should be maintained.

B. The national plan for development and the place of science and technology therein

I. GLOBAL LONG-TERM OBJECTIVES

The aim set out by the Plan for the economic development of Mali is to enable the entire population to attain a standard, mode and conditions of living which guarantee the satisfaction of essential needs, both cultural and material, within the context of an independent national economy.

More concretely, the main long-term qualitative objectives are the following:

— the security, reliability and improvement of the income of the population as a whole;
— The construction of a planned, national economy based on endogenous factors of production, in particular on the increase of domestic demand.

In order to attain these aims, the objectives of the 1981-1985 Five-Year Plan are stages in the implementation of the long-term objectives.

In this respect, they aim in particular at:
— self-sufficiency in food products,
— the control of water,
— the struggle against desertification,
— the opening-up of the country, of its different regions and its main areas of agricultural and mineral production,
— the improvement in the social well-being of the population,
— the re-establishment of the fundamental equilibria.

Economists consider that, in order to attain these objectives the rehabilitation of the economic environment of Mali is a *sine qua non* condition.

The new strategy is based on:
— Basic integrated development,
— Consolidation of objectives reached in the preceding Plans,
— Correction of the economic and financial situation.

At sector level, this strategy takes the following shape:

(a) *The rural economy sector*

The guideline of the rural economy development policy is a strategy of development from the grassroots. The aim is not only to develop production but to develop all the activities or aspects of social life in an attempt to achieve an improvement in the "quality of life".

On the basis of this guideline, the objectives assigned to the rural economy sector are the following:
(1) satisfying the population's requirements for foodstuffs necessary for subsistence (cereals and essential products, as well as water, wood for heating and for construction);
(2) supplying the national industries with raw materials;
(3) processing exports into the most valorized form possible (agricultural and industrial products) so as to increase the national capacity of industrial plants.

There will be particular emphasis on:
(1) the zones of intensive cultivation along the river basins,
(2) the integration of cultivation and stock-breeding in the dry Sudanic areas with a good rainfall, with the Sahel areas specializing in stock-breeding,
(3) the projects for industrial re-afforestation around the big urban centres and the village plantation under the aegis of the communities concerned,
(4) agricultural research which should continue its efforts geared towards the improvement of varieties, yields and farming techniques.

(b) *Energy —mines —industries sector*

In the field of energy, the aims are:
— To achieve control of water resources, as regards both surface and underground water, with a view to satisfying the requirements in water of the rural and urban populations, the guarantee of the agro-forestry-pastoral production, the reduction of energy dependence, and the control of river waters for better protection against flooding and for improved navigability, thus contributing to the opening-up of the country.

The reduction of energy dependence will be reinforced by the implementation of projects in the field of renewable energies.

The programme will aim mainly at the development of solar energy by popularizing solar machines which have already been tested, the installing of solar pumps for providing water for human-beings and animals and for irrigation purposes.

The development of mineral resources will proceed in three main directions:
(1) Supplying the various branches of the economy with raw materials;
(2) contributing to the reduction of energy dependence by research and development into energy-bearing raw materials (oil, lignite, bituminous schist);
(3) research and development into exportable minerals (bauxite, manganese, iron, uranium, gold, etc.) with a view to contributing to the improvement of the balance of payment.

The guidelines of the programme for industrial development will be:
— satisfying the local demand for essential consumer goods;
— supplying "inputs" to the various sectors of the economy;
— contributing to the establishment of a better balance in the structure of external trade by production aimed both at promoting the exports of Mali and at substitution for imports;
— promoting the development of small and medium-size enterprises in the field of industry and local handicrafts.

The promotion of small and medium-size enterprises is of special interest to Mali in that they can contribute to the solution of the two most thorny problems in the economy. In effect, small and medium enterprises favour and mobilize internal credit and they generate employment.

C. Science and technology policy structures

In the context of the implementation of the Lagos Plan adopted at the International Conference on the Organization of Research and Training in Africa in relation to the Study, Conservation and Utilization of natural resources, 1964, Mali set up in 1967 the structures necessary for the organization of research, attached to the Presidency of the Republic. The National Council for Scientific and Technological Research (le Conseil national de la recherche scientifique et technique) was then created to replace the Conseil supérieur de la recherche (the Superior Research Council) created in 1962.

But in 1970, for budgetary reasons, the Conseil national de la recherche (National Council for Research) and the Secrétariat permanent du Conseil (the Permanent Secretariat of the Council) ceased to function. Fundamental research and applied research were then, in principle, sponsored by the ministries responsible for National Education, Youth and Sport, and for Rural Development.

At present, there is, within the Ministry for Education, a Directorate of Higher Education and Scientific Research which includes two divisions: the Higher Education Division and the Division for Scientific Research.

Three quarters of the activities of this Directorate are devoted to the problems of training, study grants and vocational guidance. In reality, there is therefore no agency responsible for co-ordination, programming and control of the implementation of research at the national level.

Each Research Institute is responsible to its user Ministry which defines the research policy to be followed. Research is thus undertaken in a certain number of Institutes.

Three sectors are especially concerned:
— rural economy
— health
— renewable energies.

To these three sectors could be added the national languages, arts and culture.

To give an idea of the existing national scientific potential, brief details concerning some of the research institutions are given:

(a) *The IERM:*

Set up in 1960, the Institut d'économie rural du Mali (the Institute for Rural Economy of Mali) is a public service placed under the direct authority of the Ministry for Agriculture, of which it is one of the national institutions.

The Institut d'économie rurale du Mali is a body which deals with research, evaluation, study and conception, and plays a role in co-ordinating and forging links between the services or authorities in charge of research, studies, and the organization and evaluation of the programmes for rural development.

Its particular tasks are to implement:

— national programmes for agricultural research,
— the study programmes of the Developmental and Agricultural Projects, and
— to exercise technical control on all activities aimed at the introduction and popularization of new crops including the related agronomic techniques.

The Institut d'économie rurale employs 267 national members of staff classified as follows at the end of 1980:

— Professional staff (PhD. or Master's level, engineers, research administrators, etc.) 109
— Middle-level staff (engineer level or technical assistants) 78
— Works foremen (overseers) 80

There were 384 auxiliary staff (secretaries, drivers, messengers, etc.) at the end of 1980.

The financial resources of the Institut d'économie rurale, not including the salaries of the national civil servants and the technical assistance staff for 1980 came from:

— the Mali national budget 37%
— foreign aid 58%
— sources specific to the Institut d'économie rurale malienne 5%

There is a National Committee for Agricultural Research, which meets each year to take decisions on the programme and budget of the Institut d'économie rurale malienne.

At the level of the Ministry of Agriculture, the Institut d'économie rurale malienne is a true sectoral scientific and technological policy-making body.

(b) *Health*

In the field of public health, there are two Institutes which are under the Organization for the Co-ordination and Co-operation of the Campaign against the main Endemic Diseases*: the Institute for Tropical Ophtalmology responsible for the main endemic eye diseases, bacteriology and the chemotherapeutical treatment of leprosy and the National Research Institute for Public Health (l'Institut national de recherche de santé publique). One should also mention the Mali Bureau of Pharmacy (Office malien de pharmacie).

(c) *Renewable energy sources*

In this field may be mentioned the Laboratory for Solar Energy which carries out experiments on the installation of solar water heaters and pumps.

(d) *IPR*

One should also mention the Institut polytechnique rural (Rural Polytechnic Institute) at Katibougou which supports the Institut d'économie rurale malienne. This Institute trains rural development engineers and technicians specializing in agriculture, stock-breeding, water and forestry.

Assistance from Unesco is provided to the IPR's section dealing with pedology. The main problem posed at this level is the equipment of the laboratory which could become a high-powered tool for training and research if the IPR were given adequate means for it.

As in most of the countries visited, the most appreciable impact of scientific and technological activities on the national economy was observed in the field of agricultural research. The national aim is to manage, with the aid of the combined efforts of research and experimental development and of production, to achieve national self-sufficiency in foodstuffs, and to increase the production of industrial crops to ensure the supply of raw materials to the factories. It is a question of persuading the peasant population to apply farming techniques which have been sufficiently tested and adapted to local conditions. The results of this policy have been spectacular. In 1978, more than 11,000 tonnes of sorghum, millet and maize and 128,000 tonnes of cotton seed were produced.

Systems of production have been introduced in which the subsistence crops, mainly cereals, benefit from the residual effects of the fertilizer put on the cash crops. This technique maximizes their economic profitability.

Groundnut production is also increasing significantly.

Thus, despite the lack of a central body for scientific and technological policy, the research institutes, thanks to their own dynamism manage as best they can to obtain results from research in fields which have a real impact on the economic development of the country.

However, it is more urgent than ever for the Mali authorities to consider the creation of a real national scientific and technological policy-making body, not only to safeguard the existing scientific potential, but to ensure its expansion, in order to increase, in a balanced fashion, the endogenous capacity as an activator and technical support to national development taken as a whole.

Mauritania

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Islamic Republic of Mauritania lies in West Africa between the 15th and 27th parallels North in the Sahel region. It is bounded to the west by the Atlantic, to the north by Algeria, to the east and south-east by Mali, and to the south by Senegal.

2. *Area:* 1,185,000 sq. km

3. *Population:* 1,600,000 inhabitants (1979)**

Average annual rate of population growth (1970-79): 2.7%**

The population includes 44% young people between the ages of 0 and 14 years, and is distributed as follows:

Sedentary population:	894,810
Nomadic population:	444,020

Of the total, the urban population accounts for 394,000 inhabitants, or 25%.

Capital	: Nouakchott
Main port	: Nouadhibou
Date of Independence	: 28 November 1960

* Organisation de coordination et de coopération pour la lutte contre les grandes endémies (OCCGE)

** World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington DC, 1981 Tables 22 and 33 of the Statistical Annex.

II. ECONOMIC INDICATORS

	(in billions F. CFA)
1. GDP at factor cost	155,809
2. GNP (at market prices)	168,158
3. GDP at per capita factor cost	108,565
4. Trade balance (in billions F. CFA)	
— Global value of exports	85.8547
— Global value of imports	109.6252
Net balance of the operations	-23.7705
(Conversion at the rate of 1 Mauritanian ouguiya (UM)	= 5.3 F.CFA) = 0.22 $

5. General State budget (1975-76)
Expenditure: 30 billion F. CFA, of which 92% is devoted to the recurrent budget and 8% to capital expenditure.
Projections: 1976-77: 35 billion F. CFA.

III. FORM OF GOVERNMENT

The Islamic Republic of Mauritania has been independent since 28 November 1960. Since 10 July 1978 the country has been governed by a Military Committee for National Recovery. The National Assembly has been dissolved. The return to a constitutional régime is being prepared.

1. Administrative structure: The whole country is divided into regions. Each region is divided into 'départements' within which the administrative districts are the 'arrondissements'.

The regions and the 'départements' are, respectively, under the authority of Governers and Prefects.

2. Education: Education is bilingual: Arabic and French.

The rate of school attendance is 17.3%.

IV. MAURITANIA'S NATURAL RESOURCES

1. Sea coast, lakes and rivers. Mauritania has approximately 800 km of coastline.

The lakes are not very large and are generally semi-permanent (the Lac d'Aleg, Mare de Kankossa and, the biggest, Lac de R'Miz which communicates with the River Senegal).

The rivers are Wadis in the north (Wadi Handar, Wadis Seguelil, Kett, Therthiat, etc.).

In the south, they are branch channels communicating with the River Senegal except for both the Gorgol and the Karakoro which are fed by waters from the Assaba and Tagant mountains.

Industrial sea fishing is an important resource in Mauritania which exports approximately 15,000 to 25,000 tonnes of fish per annum.

2. Agricultural resources. The long period of drought which prevailed over the Sahel region between 1969 and 1973 was particularly trying for stock-breeding and agriculture in Mauritania. One of the most important effects of the drought was the large fall in the numbers of animals for stock-breeding.

It is estimated that at the end of the drought (end of 1973) the livestock population in Mauritania had changed as follows:

1968	1973
2,500,000	1,115,000 head of cattle
6,700,000	5,850,000 head of sheep and goats
720,000	620,000 head of camel
300,000	250,000 head of horses and donkeys.

The livestock is being actively reconstituted.

Crop production does not seem to follow the same trend although it had also been affected by the drought (see Table 1).

Table1. Estimate of crop production (tonnes)

	1972	1973	1974	1975	1976	1977	1978	1979
FOODS CROPS								
Millet and sorghum	37,125	24,750	25,000	32,000	28,000	21,000	17,200	23,000
Maize	1,990	1,493	–	3,100	3,200	3,300	4,800	5,000
Niébé (small bean)	1,997	2,060	–	700	650	650	700	–
Béref (melon seeds)	1,000	700	700	1,000	800	700	400	
Potatoes	–	–	–	1,800	1,800	2,500	4,160	
Sweet potatoes	1,000	700	–	1,700	1,700	1,800	1,000	4,000
Rice (paddy)	2,487	2,985	300	3,843	3,960	3,600	3,500	
Wheat	260	150		170	200	150	180	
OTHER CROPS								
Dates		18,000	10,400	12,500	13,000	14,000	13,500	
Barley				170	180	200	250	
Fruits	1,230	1,280	1,350	1,500	1,560	1,610	1,660	
Vegetables	1,425	1,440	1,500	1,550	1,590	1,650	1,700	
Others	240	255	270	286	300	320	338	

3. Mineral resources. The iron-ore resources which are being worked at present (Kediet Ijill and Rouessa) are estimated at 76 million tonnes of rich ore and 45 million tonnes of poor ore which will be exhausted during the period 1980-85. The long-term perspectives are based on the possibility of working the iron ore at Guelbes, which is low grade (34% and 40%), after being enriched. The known reserves are 480 million tonnes.

The working of copper is to be carried out in two stages, the first of which was due to be completed in 1978 and concerned the oxide ore. The working of the sulphide ore is based on reserves of 16 million tonnes (8 million of which are at 2.7%); at the rate of working projected (40,000 T/yr.) the deposit would be exhausted in 1990.

Deposits of gypsum (4 billion tonnes) and salt (11 million tonnes) have been discovered as well as signs of rare earths. Research going on at present concerns petroleum, uranium and phosphates.

4. Other natural resources. Mauritania has a considerable asset in the exploitation of solar energy because of its geoclimatic situation. The national average of sunny periods exceeds 3,000 h/annum.

The main products exported by Mauritania are:
— Livestock on the hoof, the exact number of which is difficult to ascertain;
— Iron ore (7,434 tonnes worth 22,302 million F.CFA in 1978);
— Fish and shellfish (35,000 tonnes worth 6,243 million F. CFA);
— Copper ore (2.86 tonnes worth 1,440 million F. CFA)
— Gum arabic worth 93 million F.CFA.

The main imported products are (1978):
— Food products for 16,938 million F.CFA, or one third of imports;
— Non-food items: beverages, tobacco, cigarettes, textiles, clothes and accessories, shoes, paper products for 4,653 million F.CFA in 1979.
— Construction materials for 2,427 million F. CFA.
— Machinery and equipment for 7,907 million F. CFA

Thanks to the mineral resources (86% of exports), the Mauritanian balance of trade has long remained mainly positive.

It has recently undergone some fluctuations due to the drought and to the effects of the war which caused a fall in certain exports (cattle, gum arabic) and increased import of foodstuffs.

V. MANUFACTURING INDUSTRIES AND DEVELOPMENT PROBLEMS IN MAURITANIA

Industrialization in Mauritania is very recent. Prior to independence, it would appear that no industrial employment existed in Mauritania. In 1972, this sector employed 2,000 people.

There are two fields which are relatively developed from the industrial point of view.

1. The fishing industry. The fishing industries represent both the main industrial sector and the area in wich development has been most rapid.

They comprise:
(1) Factories for drying and salting which produce annually more than 8,000 tonnes of dried and salted fish, or about 30,000 tonnes of fresh fish representing a value of more than a billion F. CFA. The enterprises responsible for this industry are: the 'Industrie Mauritanienne de Pêche' (IMAPEC), the 'Société industrielle de la Grande pêche' (SIGP) and the 'Entreprise générale atlantique' (EGA);
(2) The cold storage industry accounts for almost 100,000 tonnes/annum;
(3) The industries for manufacture of fish oil and flour (capacity of almost 250,000 fish/annum);
(4) The IMAPEC Canneries produce 2,500 tonnes of canned tuna/annum for a capacity of 3,500 tonnes.

2. The mining industries

The industrial town in the mining sector is Nouadhibou. It has an explosives factory which was opened in 1975. A steel works for the manufacture of iron for use in concrete has been constructed there. Similarly, steel works for 1 million tonnes of steel from the ore at Guelb and a copper refinery at Akjoujt using concentrated copper (30,000 tonnes of copper), are to be sited there.

The other industrial establishments are linked to the market for certain essential products:
— A refrigerated slaughter house at Kaedi;
— in Nouakchott are a match factory, a garments factory and a soft drinks factory; there is at Rosso a factory for spinning cotton and weaving. There is some private investment in these firms.

The industries based on fishing and mining are considerable. But there is very little transfer of income from the modern sector to the traditional sector, which employs more than 70% of the population.

The lack of technical and professional administrators and of skilled manpower creates a big gap between the reality of a pre-industrial economy and its transformation into a modern type of economy.

One solution for a real take-off of the economy as a whole would lie in more attention being paid to the rural sector, the control of water and the irrigation of pasture lands. These approaches which should be a priority in a country like Mauritania have been neglected for a very long time and it is only recently that they have begun to receive the attention of the Mauritanian Government. The huge project for the Foum-Gleita Dam on the Black Gorgol with a capacity of 500 million cubic metres capable of irrigating 6,000 ha is a real hope in this respect. There are also the pilot irrigation projects on the Gorgol at Kaedi, in the plain of Boghe and that at M'Pourie.

B. The national development plan and the place of science and technology therein

I. PLAN FOR ECONOMIC RECOVERY

On the assumption of power by a new group of leaders on 10 July 1978, a Plan for Economic Recovery was prepared in August 1978, the main lines of which were as follows:
— Re-orientation of investment towards directly productive activities.
— The re-organization of the State sector by means of a dynamic policy of austerity as regards public expenditure, including a strict selection in the recruitment of staff, cuts in operating expenses, re-organization of the management of public and parastatal firms in conjunction with an effort to improve the collection of taxes.
— The promulgation of a new investment code containing encouragement for both national and foreign entrepreneurs.

The Four-Year Plan being prepared for the period 1981-84 will be a Plan for consolidating the recovery policy which has been initiated.

The aims of this Plan are the following:

1. In the agricultural sector: The Plan aims at providing a concrete content to the priority given to the agricultural sector.

The aims assigned to this sector will be the following:
— Self-sufficiency in food;
— Stepping-up of the campaign against the rural exodus;
— Improvement of the natural environment.

A national firm for rural development (SONADER) will be responsible for carrying out major projects in the rural sector. There will be the combined projects of the OMVS- Organisation pour la mise en valeur du Fleuve Sénégal -(Senegal River Basin Development Organization), which foresees the construction of large dams on the River Senegal and its tributaries.

In addition to the combined projects, a huge development project for the Gorgol valley involves, apart from the dam, development within an area of 3,600 ha works for diversion and an irrigation canals network as well as the infrastructure required for the working of this area. This is the biggest agricultural project ever undertaken in Mauritania. It will enable an increase in food-crop production by the improvement of 3,600 ha, thus creating a new nucleus for development in south-east Mauritania.

2. In the industrial sector

The aims in this field are:

— The boosting of the mining sector by the implementation of the steel-works project at Guelb and reactivating of the copper sector.
— A re-organization of former projects, badly conceived, such as the oil and sugar refineries, by spreading the public debt resulting from these projects over a period of time.
— The re-organization of the fishing industry by granting fishing rights only to mixed firms involving public and private capital. This is a question of creating a real national fishing industry with processing plants.

II. PLACE OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT PLAN

It does not clearly appear that actions with a technological focus are being undertaken in support of the National Plan for Economic Development. It can, however, be noted that:

(1) **In the field of agriculture and stock-breeding,** research is undertaken:
(a) at the National Centre for Agronomic Research and Agricultural Development* at Kaédi either for the improvement of new varieties of seed or for testing the varieties which have been introduced. The Kaédi Research Centre is an autonomous department attached to the Ministry of Rural Development.
(b) In the field of animal breeding, research is being carried out at present at the National Veterinary Research Centre at Nouakchott; the programmes do not, however, appear to coincide exactly with the objectives of the Development Plan.

(2) In the industrial sector. Geological research and mining prospecting have been carried out by foreign centres and agencies. In this field, however, a National Geological Research Unit (Office mauritanien de recherches géologiques) was created in 1981.

To assist the Government with technological choices there is a Unit for Information and Technological Innovation at the Ministry for Industry and Commerce. This unit has just been reinforced by a UNIDO project entitled National Industrial Information Centre, the immediate aims of which are:

— to set up an efficient structure of industrial information for the Mauritanian economy;
— to improve industrial planning and to consolidate decision-making which demands the availability of reliable and regular industrial data.

For the time being, Mauritanian industry uses imported up-to-date technology. The least that can be said of it is that it has no relevance to the development of science and technology in this country.

C. National science and technology policy structures

Decree No. 71-256 of 28 August 1971 which defines the responsibilities of the Ministry of Planning and Research is expected, by its by-laws and regulations, to establish a link between the different research activities.

In 1973, a National Commission was created and entrusted with the duty of outlining the science and technology policy of the country. This Commission was chaired by the Director of the 'École normale supérieure' and had, as members, the Director of Planning, the Director of Public Health, the Director of Animal Husbandry, the Director of Mines, the Director of Industrialization, the Director of Technical Services at the Ministry for Equipment and the Director for Cultural Affairs. This interdepartmental Commission reports directly to the President of the Republic.

However the role of co-ordinating research was later entrusted to the Ministry for Economic Planning and Finance, whose Studies and Planning Directorate is entrusted with the co-ordination of scientific activities.

In fact, there is no national science and technology policy-making body as such in Mauritania. The various existing research institutions are entirely responsible to the sectorial ministry sponsoring them. There are:

— The National Centre for Agronomic Research and Agricultural Development at Kaédi.
— The National Centre for Veterinary Research at Nouakchott;
— The National Agency for the Promotion of Fisheries at Nouakchott;
— The National Centre for Oceanographic and Fisheries Research at Nouadhibou;
— The Centre for Humanities Research at Nouakchott.

Although the geographical distribution of the research units appears to make the task of co-ordination difficult, it nevertheless perfectly suits the ecological needs of the country.

The Planning Directorate is charged with the co-ordination of research but suffers from a tremendous shortage of material and human resources to do so.

It has four senior professional members of staff (a geographer, an administrative officer and two economists) and six supporting staff (typists, secretaries).

The operating budget of this Department amounts to 1.2 million Mauritanian ouguiya, or 6 millions F.CFA/annum.

The equipment available to the Department was supplied by a World Bank project entitled Planning Assistance, covering the period 1977-1981.

In 1978, another project (Rural Assessment and Man-Power Survey -RAMS), started and financed by the US-AID, had as its objective to assist the Mauritanian Government to develop information and decision-making capacity relating to alternative strategies and of translating these strategies into specific development projects.

The RAMS included:

A man-power survey and 19 policy documents related to the integrated development of the rural sector. The RAMS was carried out by an expert from US-AID in co-operation with two interministerial committees:

— A committee including the heads of the seven ministerial departments concerned: Planning, Mines, Rural Development, Basic Education, National Education, Manpower and Public Works, Health and Social Welfare and Finance. This committee was chaired by the Director of Planning.

* Centre national de recherche agronomique et du développement agricole.

— The other committee consisting of the Ministries corresponding to above-mentioned departments was chaired by the Minister of Planning. It plays an interministerial role.

Isolated actions and the dispersion of initiatives show that there is an urgent need in Mauritania for the organization of a national structure for the co-ordination of scientific and technological research in the country. All the administrators whom the author of this report met in the various Ministries, particularly at the Ministry of Mines and Industry, were unanimous in emphasizing this necessity.

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Niger

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Republic of Niger lies in the north of the West African subregion. It is bounded to the west by Upper Volta and Mali, to the north by Algeria and Libya, to the east by Chad and to the south by Benin and Nigeria.
2. *Area:* 1,200,000 sq. km
3. *Population:* 5,098,000 inhabitants according to the 1977 census. There were estimated to be 5,200,000 inhabitants at the end of 1979.
3. *Average population growth rate (1970-1979):* 2.8%* per annum. Almost all the inhabitants, approximately 97%, live in the zone which lies between 12.5 and 15 degrees of latitude north, i.e. in the extreme southern part of the country.

— The density of the population varies from one zone to another.

It is (in inhabitants/sq. km):

12.98 in Niamey
22.35 in Dosso
24.48 in Maradi
6.9 in Zinder
0.17 in Agadés.

— The urbanization rate was 11.6% in 1977.

It is estimated that 55% of the inhabitants are aged between 0 and 20 years, 40% are in the 21-60 years age group and 5% over 60 years old.

The rate of school enrolment at the time of independence (1960) stood at 2.8%. In 1977-78, it was 12.5%.

Higher education began in Niger only in 1971. There were 200 students from Niger being trained abroad in 1968-69. The University of Niamey had 239 students in 1976.

II. ECONOMIC INDICATORS

Evolution of the GDP at market prices (IMF)

		1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979
GDP in billion CFA francs		118.5	131.5	163.5	190	–	–
Per-capita GNP estimated at 49.000 F. CFA							
General budget in billions F: CFA	Estimated	15.22	20.18	26.66	35.98	48.49	56.75
	Realized	15	18.04	26.05	35.87	48.68	–

The growth of the budget between 1970 and 1978 is spectacular; the figures in current francs increased by 368% for the recurrent budget and by 1,222% for investment in relation to revenue. As from 1975-76 a sudden change in rhythm is observed whereas the opening years of the decade were marked by a long stagnation.

— *Structure of the GDP*

An examination of the structure of the GDP shows the following trends (1970-1976):

Primary sector	
Agriculture, stock-breeding, forestry, fisheries	49.2%
Secondary sector	
Industry, mines and public works	19.9%
Tertiary sector	
Trade, services, etc.	30.9%
	100.0%

— There is a considerable fall in the share of agricultural production which accounted for 60% of the GDP, in 1961 but represented no more than 47.2% in 1977.
— There is a considerable increase in the sectors of mining, energy, constructions and public works which rose from 10.7% in 1961 to 19.9% in 1977 and in the trade and transport sectors which rose from 8% in 1961 to 16% in 1977.

III. NATURAL RESOURCES

1. Drainage: The Republic of Niger has no outlet to the sea. The Niger is the only important waterway to cross the country. To the south, Lake Chad marks the frontier with Chad and Nigeria.

2. Mineral resources

(a) *Uranium*

Two deposits are being exploited at Arlit Somaik where the known reserves are 30,000 tonnes at a depth of 50-70 m.

At Akonta (COMINAR) there are private reserves: 44,000 tonnes at a depth of 250 m.

The exploitation of further deposits is intended and studies are continuing in the zones of Afasto-Ouest, Afasto-Est and Adar.

The production of uranium rose to 4,180 tonnes of the metal in 1980, or 10% of the world production.

(b) *Cassiterite*

Cassiterite is found in the form of highly dispersed pockets: the production is 90-100 tonnes per annum.

(c) *Coal:* there is a deposit at Anouareren, 50 km to the north-west of Agadés where there are known reserves of 6,300,000 tonnes.

* World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action, Washington DC, 1981, Tables 22 and 33 of the Statistical Annex.

(d) *Phosphates:* there are deposits in the Parc W 150 km to the south of Niamey. The reserves are estimated at 520 million tonnes of 23% P_2O_5. Another deposit to the north of Tahoua is at present being worked.
(e) *Limestone:* the zones of outcrops are huge but only one deposit is at present being worked at Malbaza; the reserves are estimated ar 3,500,000 tonnes.
(f) *Hydrocarbons:* current research has revealed numerous positive elements. Prospecting is continuing and six valid prospecting permits currently cover half of the country's area.
(g) *Various metallic minerals:* molybdenum and colombite are already being mined; iron-ore (650 million tonnes in the Say region) manganese (100,000 tonnes of 39% at Tera), lithium (350,000 tonnes of 1.6% near Tera), as well as copper, zinc, lead, silver and cobalt have been listed.

IV. AGRICULTURAL RESOURCES

Capital in land is one of Niger's most precious resources. Three-quarters of the country belongs to the Sahara desert. The land areas are broken down in hectares by the Deparment of Agriculture as follows:

Total area of the country: 126,700,000 ha
Useful agricultural land: 30,000,000 ha
Arable land: 15,000,000 ha
Cultivated land: 3,149,000 ha.

(a) *Agricultural production:* the agricultural part of Niger lies roughly between the 800 mm and the 350 mm isohyets.

Climatic, soil and human factors make this agricultural part particularly varied in its potentialities.

The growth of agricultural production shows considerable variations, the main problem being the big drought at the beginning of the period 1970-1973. Since 1974 agricultural production has improved thanks to a lessening of the drought.
(b) *Food crop production:* Niger's cereal production was estimated at 1,500,000 tonnes in 1978 with a production of Niébé (a variety of small white bean) distinctly increasing.
(c) *Cash crops:* on the other hand, a fall in the production of cash crops has been observed.

groundnuts: 74,000 tonnes in 1978 as compared with 207,000 in 1969.

cotton: 3,100 tonnes in 1978 as compared with 12,600 in 1969.

The share of agriculture in the national economy is distinctly falling.
(d) *Livestock production:* stock-breeding is more a way of life than an economic activity in Niger. This sector, as a result of pressure from internal and external demand has only recently been organized and its economic aspect is beginning to predominate over the traditional aspect.

Growth in numbers of livestock between 1975 and 1978
Compared to the reference year 1968 (in thousands)

Year	Cattle	Sheep	Goats
1975	2,508	2,136	5,395
1976	2,671	2,354	5,946
1977	2,850	2,556	6,540
1978	2,992	2,656	6,703
1968	4,450	2,800	6,430

It can be seen that it is cattle which suffered most from the drought. Ten years later the numbers have only been reconstituted by half. On the other hand, other species have reached or exceeded the 1968 level.

V. TRADE

1. Exports The structure of exports has changed considerably since the beginning of the 1970s with in particular:
— A marked fall in agricultural products which accounted for 52% of exports in 1971 and only represented 16% in 1976. The share of groundnuts was 32% in 1971 and 2% in 1976. The export of livestock products underwent a less spectacular fall (from 24% in 1970 to 18% in 1976).
— There was a sharp rise in the export of uranium which accounted for 64% of exports in 1976 and 71% in 1977.

2. Imports There was also an appreciable change in the structure of imports with a relative fall in current consumer goods and a rise in capital goods and hydrocarbons. The trade balance remains negative from one year to the next.

Evolution in billions of F.CFA

	1976	1977	1978
Exports f.o.b.	41.0	44.9	62.0
Imports c.i.f.	60.5	61.4	89.0
Balance	-19.5	-16.5	-27.0
% coverage	67.5	73.1	69.7

VI. MANUFACTURING INDUSTRIES AND PROBLEMS OF DEVELOPMENT

In 1977, fifty industrial firms employing 3,524 wage-earners, achieved a turnover of 12,163 million F. CFA (average growth rate: 10.1% per annum, since 1974, the year of publication of a new investment code creating conditions favourable to firms). The distribution of industries per branch of activity was as follows:

	%	Jobs
Food industry	30	781
Textile industry	26	1,150
Paper manufacture	5.6	247
Chemical industry	15.0	311
Wood and metal industries	9.3	458
Building materials	12.5	496
Total	100.0	3,524

The vulnerability of industry in Niger is a result of the over-emphasis on agro-industrial activities which have been considerably reduced following the drought.

To sum up, the main problems which the Niger economy faces in its development have been caused by:

— Climatic constraints, impoverishment and deterioration of soils which result in a fall in agricultural productivity and rural exodus.
— The small financial means at the disposal of the vital sectors of the economy (agriculture, stock-breeding, industry);
— Lack of access to the sea;
— Lack of skilled manpower.

But these problems are not endemic and numerous factors enable us to forecast a better future for the economy of Niger. In particular, the following may be mentioned:

— The wealth of the Niger sub-oil revealed by past and present surveys justifies transfers of funds towards, agriculture and stock-breeding the sectors which lack means.
— The definition of precise objectives and fundamental options for development backed up by a favourable investment code.
— a dynamic policy for training workers and qualified professional staff.

VII. THE GOVERNMENT

In Niger political power is vested in the Conseil militaire suprême—CMS (Supreme Military Council) and the Government. The President of the Supreme Military Council is the Head of State and President of the Council of Ministers. The suspension of the constitution entailed the supression of the legislative and political institutions.

The country is administratively divided into seven provinces (départements) and 35 administrative districts (arrondissements). The Heads of the provinces, the canton, the grouping and the village exercise customary powers. Consultative structures (Comité technique and Commission consultative provisoire, commonly known as COTEAC) assist the administrative authorities, particularly with regard to development.

B. The national development plan and the place of science and technology therein

1. The overall aims of the Five-Year Plan 1979-1983

The three fundamental orientations defined by the Comité militaire suprême (Supreme Military Committee) after the political changes which occured in Niger in 1974 have again been taken into account in the priority objectives of the Plan. They deal with:

— Self-sufficiency in foodstuffs;
— Setting-up a Development Society based on the participation of all citizens of Niger;
— Economic independence thanks to the control by Niger of its own development by relying, in the first instance, on its own ability.

Amongst the main strategic options and priorities of the Plan may be mentioned:

1st priority: rural development considered as a key sector in relation to the policy of self-sufficiency in foodstuffs.

2nd priority: economic growth and take-off.

3rd priority: the construction of the future. This deals in particular with:

— the construction of the vast infrastructure necessary to open up the country;
— land management;
— scientific and technological research;
— education and training.

The following are the main strategies which have been adopted by the authorities in Niger for the achievement of these aims:

The role of the State must be predominant in the development strategy in certain key sectors like energy, education and training, health, the production and distribution of food and communications.

The involvement of the State will be more significant at the level of the guidelines for direct intervention, participation and control.

The authors of the Plan consider that the rôle of the State should be understood to mean that planning should not be so rigid as to exclude the participation of the private sector; the State should, however, involve itself in the necessary co-ordination of the activities of all actors in the development scene so as to achieve the objectives of the Plan.

2. The aims of each sector

(a) *Agriculture*

Agricultural policy in Niger during the Plan period will be based on two basic principles aimed at:

(1) ensuring the population's self-sufficiency in foodstuffs,
(2) raising the standard of living of the rural people.

— In the first instance, the development of dry land crops remains, during the Plan period, the main axis of agricultural policy, a factor of which is taken into consideration in the departmental productivity projects.
— Increase in yield through improving plant materials and the use of modern production techniques (planting techniques, fertilizers, insecticides);
— Support for production by organizing training and giving responsibility to farmers within a co-operative structure and by the supply of inputs with State subsidies.
— Second, the development of irrigated crops will be pursued simultaneously, but gradually because of its special difficulties and its costs.
— The third aspect of agricultural policy concerns the development of the co-operative system. The ultimate aim is to make the agricultural sector completely co-operative. Training, credit and marketing activities will have to be injected into the co-operative structure.
— Plan objectives in figures forecast self-sufficiency in cereals by 1983 and the rehabilitation of cash crops, particularly cotton and groundnuts.

(b) *Stock-breeding*

In this field, the policy is geared towards the meeting of two preliminary conditions:

— The maintenance of an excellent sanitary situation.
— The training of professionals, including stock-breeders.

The quantitative reconstitution of the livestock which is now in progress, will be continued by controlling mortality among young animals, through genetic improvements; poultry keeping will be developed.

(c) *Forests and fauna*

In this field, action is aimed at the protection of the soils and the production of fire-wood and wood for construction within the framework of integrated projects. This activity will be carried out by relying on the mobilization of the masses and by giving priority to the most critical zones. As far as the fauna is concerned, the Plan aims at concentrating on activities likely to attract tourists.

3. The mining and industrial sector

(a) *Mining*

The general policy guidelines in the mining sector will consist of making mining "an asset for national development and an area of international co-operation".

The objectives in this field are:

— The intensification of prospecting, the continuation of feasibility studies and the strengthening of the production capacity with a view to diversifying the mineral resources.

Special emphasis will be placed on the continuation of prospecting for uranium and for oil. The objectives of the Plan are to increase quantitatively the production and also the value added of the sector 2.4 -fold as compared with 1975 (i.e. an annual growth rate of 19.2%) and raise the value of exports from 48.5 billion in 1978 to 118.5 billion F. CFA in 1983.

(b) *Industry*

The long-term principle is to gradually create a solid and diversified industrial base capable of supporting considerable growth when the uranium reserves are exhausted.

Quantitatively, the industrial policy of the Plan aims at multiplying the value added of the sector by 3.9 by the end of the Plan period, or 15,400 million F. CFA in 1983 and to increase exports six-fold, that is to 11,600 million F. CFA. The sector will offer 7714 jobs in 1983 as compared with 3,347 in 1978.

4. Energy

The Plan's objectives as far as energy is concerned, consist of seeking a reliable and independent source of energy. In particular, it will be a question of promoting national energy resources by commencing to work the coal seams, the construction of hydroelectric power dams and by the provision of a reliable source of hydrocarbon fuels. In this context, it is estimated that consumption will rise from 161,700 m^3 in 1978 to 271,000 m^3 in 1983 (i.e. a growth rate of 10.9% per annum).

Niger, given its climate and geographical situation, possesses considerable potential in renewable energy, in particular in solar energy on which advanced research is being carried out, and in wind energy.

5. The place of science and technology in the national plan for development

The Five-Year Plan, 1979-83, includes a chapter entitled Scientific Research and Studies, and this activity is rated amongst the priorities concerning the construction of the future. However, it should be noted that there are no concrete plans for formulating research programmes. The implementation of scientific and technological research has been entrusted to the Research Institutes and Laboratories, in particular to the Institut français de recherche agronomique tropicale —IRAT (French Institute for Research in Tropical Agriculture), the Centre technique forestier tropical —CTFT (Technical Centre for Tropical Forestry), the Institut d'études et de médecine vétérinaire tropical —IEMVT (Institute of Tropical Veterinary Medicine), the Office de recherche scientifique et technique Outre-Mer —ORSTOM (Department for Scientific and Technological Research Overseas), the Bureau de recherche géologique et minière —BRGM (Office for Geological and Mining Research).

The creation of the Institut national de recherche agronomique du Niger —INRAN (National Institute for Agricultural Research in Niger) in 1975 and recently of the Ministère de l'enseignement supérieur et de la recherche scientifique (Ministry for Higher Education and Scientific Research) has changed the situation considerably. Co-ordination and harmonization of the activities of the national institutes will henceforth be carried out by the Ministry.

But research continues to suffer from a lack of adequate means, the consequence of which is that it is very often considered as a marginal activity. It should, however, be noted that special importance is given to Agricultural Research which has a bearing on all the problems posed in the improvement of productivity in the fields of agriculture, stock-breeding and forestry. A global sum of 4,253 million F. CFA has been earmarked in the Plan to finance the agricultural research programme.

Similarly, Niger pays special attention to research concerning renewable energy, in particular solar energy. To this end, a sum of 1,288 million F. CFA has been earmarked in the Plan for the research programme of the Office national d'énergie solaire —ONERSOL (National Department for Solar Energy).

In the other research sectors, which have not been the subject of detailed programming, (in particular those which are linked to global programming), an amount of 1 billion F. CFA has been earmarked *pour mémoire* in the 1979-83 Five-Year Plan.

It would appear that, up to the present, the degree of integration of scientific policy into the overall development policy has been rather low.

There had been a Conseil national de recherche scientifique et technique —CNRST (National Council for Scientific and Technological Research), inter-departmental in conception, which was entrusted with the formulation of a national science policy, advising on the programmes and research to be undertaken within the framework of economic development and with the co-ordination of the activities of the Specialized Committees. But since the creation of the Ministry for Higher Education and Scientific Research, the mandate of this body has not been renewed and it has never met again.

This situation means that, in spite of the existence of a Ministry responsible for science and technology policy, scientific research has lost its inter-departmental aspect and continues to be considered as a vertical sector, as is agriculture, health and industry.

C. Science and technology policy structures

1. History

Prior to the establishment, in 1978, of the Ministry for Higher Education and Scientific Research, science and technology policy was determined by the erstwhile Conseil national de la recherche scientifique et technique — CNRST (National Council for Scientific and Technological Research).

At the time of its creation, the National Council for Scientific and Technological Research had as its main function the formulation of national science policy, advice on programmes, and the financing of research undertaken (within the framework of economic development) in the scientific and technological research institutions.

The National Council for Scientific and Technological Research, attached to the office of the President of the Republic, was granted administrative and financial autonomy thus enabling it to deal with problems of national science policy and to pass to other levels within the research set-up all the decisions and information necessary for the implementation of the programmes.

The Bureau permanent du Conseil national de la recherche scientifique et technique (Standing Committee of the National Council for Scientific and Technological Research) made up of the President, the Vice-President and the Secretary-General, constituted the active body responsible for the continuity of the Council's funtions and for the planning and control of research activities.

Created by Decree no. 78-90, of 5 March 1978, the Ministry of Higher Education and Scientific Research attached to the office of the President, is responsible for:

— The formulation and implementation of National Policy in respect of Higher Education and Scientific Research in liaison with the Ministries concerned;

— relations, in the fields of Higher Education and Scientific Research with foreign countries and international organizations in liaison with the Ministries and national bodies concerned.

To this end, it has responsibility for:
— the University of Niamey,
— ONERSOL (Office national d'énergie solaire -the National Department for Solar Energy),
— INRAN (Institut national de recherche agronomique du Niger —the Niger National Institute for Agricultural Research).

The creation of the Ministry for Higher Education and Scientific Research is the very foundation of the process of setting-up a governmental science and technology policy body.

But the analysis of the situation shows a net setback in this respect. In effect, the National Council for Scientific and Technological Research which was the science and technology policy body, the precursor of the Ministry, no longer exists. Within the Ministry for Higher Education and Scientific Research has been created a Directorate for scientific research which does not as yet function for lack of a Head.

Consequently science and technology policy in Niger, although placed under a governmental authority, continues to be formulated sector by sector. There is no longer a body for interdepartmental joint-consultation able to deal with development problems with which the Ministerial departments are confronted and to direct an overall scientific and technological policy.

Other governmental bodies able to play a part in the formulation of national science and technology policy.

(i) The role of the University

The non-existence of an interdepartmental body capable of attracting contributions from the various national bodies in the field of science and technology policy, makes it difficult to appreciate the role of the University in this respect. The University-level teachers, the majority of whom take part in research programmes, in particular within the Institut de recherche en sciences humaines —IRSH (Institute for Research in the Humanities) at the University of Niamey constitute, beyond any doubt, an unquestionable potential in the formulation and implementation of a national science and technology policy.

(ii) The role of INRAN

Agricultural research in Niger, as in the majority of the States in the sub-region, is the most developed aspect of the scientific potential.

In this respect, its role in the formulation of a science and technology policy is considerable. In effect, the INRAN has a Conseil d'administration —CA (Board of Directors) and a Comité national de recherche agronomique —CNRA (National Committee for Agricultural Research), which are respectively the decision-making and the consultative bodies of the Institute.

The task of INRAN is to give its scientific and technical support to the solution of rural development problems, and to organize and develop research in the various agricultural fields: ecology, agriculture, zootechnic, forestry, rural economy, teaching and training.

It is charged with:
— The preparation of short-, medium- and long-term programmes of agricultural research of national interest. The programmes are discussed with the other departments concerned at the level of the National Committee for Agricultural Research.
— The creation and management of experimental stations, centres and laboratories for agricultural research.
— The responsibility for scientific and technological training of rural development staff.
— The co-ordination of all activities in the field of applied agricultural research in Niger.

The Institut national de recherche agronomique in Niger ensures a permanent scientific basis for investigations and techniques essential for rural development.

Its contribution to the formulation of the national science and technology policy covers almost 50% of Niger's economic activities.

(iii) The role of the private sector, the academic community and the professional associations of scientists and engineers in the elaboration of a national science and technology policy.

As far as we know, there are no learned societies composed of scientists and engineers likely to play a role in the formulation of scientific and technological policy in Niger.

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body

(a) *Official title of the body:* Ministère délégué auprès de la Présidence chargé de l'Enseignement supérieur et de la recherche scientifique

(b) *Postal address:* B.P. 234
Niamey, Republic of Niger

(c) *Main aims and functions of the body responsible for national scientific and technological policy:* and

The functions of planning, programming and budgeting for scientific and technological activities are carried out by the Ministry for Higher Education and Scientific Research whose task is (see Decree 79-44/PCMS/MDP/ESC, 29 March 1979) to formulate and implement national policy concerning higher education and scientific research in liaison with the Ministries concerned.

At the present stage in its development, the Ministry for Higher Eduction and Scientific Research in Niger does not yet have the executive bodies which would enable it to fully play its role. The authorities in Niger are aware of the fact that the development of scientific and technological capacities is inconceivable without an organization to define the scope of the level of responsibility and the relationship between the various research bodies (see National document from Niger submitted to UNCSTD).

To this end, Niger envisages the establishment of a structured organization with four levels corresponding respectively to the requirements of political control, scientific co-ordination, the implementation of basic and applied research and the application of research results to development projects. These different levels were specified in the national documents presented by Niger to the United Nations Conference on Science and Technology for Development as follows:

First level: Political control

An agency integrated into the political administration of the country will be entrusted with the scientific and technological development with authority to fix the orientations, planning, the creation of the institutional facilities and the monitoring of the development of the scientific and technological capacities set up.

Second level: Scientific co-ordination

A representative body of research workers and users will be constituted as an instrument of Government to:
— elaborate a science and technology policy;
— examine the measures aimed at encouraging research and the popularization of science and technology;
— co-ordinate at the scientific level, the research activities and the application of results at the level of the various institutions concerned.

Third level: Implementation of research

Fundamental and applied research institutions, similar to those already in existence, such as ONERSOL, INRAN, IRSH, will gradually be set up in the various sectors of economic, social

and cultural activity. Sponsored by the services concerned, they will have the task of undertaking specific studies, research and experimental programmes related to the needs of the national economy, thus integrating research activities into economic activities.

Fourth level: Application of research results

Offices for economic studies, engineering and analytical, testing and quality control laboratories, as well as institutions for standardization, industrial property, information and scientific and technical documentation will be developed at the level of either each sector, each region of the country, or at national level.

The establishment of these different levels defined by the authorities in Niger for a science and technology policy in the country will enable the Ministry for Higher Education and Scientific Research to:

— perfect a suitable working method for carrying out its functions;
— have at its disposal a structure for co-operation and joint-consultation with the research establishments, the scientific and technological services and the institutions of higher learning.

(d) *International co-operation in Science and Technology*

Cooperation in Niger in the field of science and technology takes place at different levels:

(1) *With the Sahel countries:*

This takes place within the framework of an institution, the Comité Inter-État de lutte contre la sécheresse dans le Sahel (CILSS) (Permanent Inter-State Commission for Drought Control in the Sahel) grouping eight countries: Niger, Chad, Mali, Upper Volta, Senegal, Mauritania, Gambia and Cape Verde.

At the scientific and technological level this co-operation takes the form of the creation of the Sahel Institute with the head office in Bamako. Its objectives are:

— the collection, analysis and dissemination of scientific research results;
— technology transfer and adaptation;
— promotion, harmonization and co-ordination of research and training;
— the training of researchers and technicians.

(2) *Cooperation with developing countries and African States*

With the developing countries and with the African countries in particular, this co-operation is based on similarity of geographical conditions and economic development -factors which are favourable to the exchange of scientific data.

The awareness of the developing countries of the similarity of their conditions of development encourages them at present to recommend a policy of technical co-operation among developing countries (TCDC) based on the recommendations of the Conference held at Buenos Aires in 1978 on this subject.

(3) *Cooperation with developed countries*

Niger co-operates with many countries in the field of Science and Technology, in particular with France, within the framework of a bilateral agreement with that country.

(4) *Cooperation with the United Nations system*

Numerous co-operative projects, financed within the framework of the United Nations system, are being carried out in Niger. The areas to which Niger wishes to give priority in establishing co-operation in the field of Science and Technology are:

— Campaign against desertification;
— Improvement of plant and animal species;
— New forms of energy;
— Mass education and training of professional staff and technicians for scientific research.

E. National resources of the main national science and technology policy-making body

Given the fact that the Direction de la recherche scientifique (Directorate for Scientific Research) at the Ministry for Higher Education and Scientific Research has not yet become operational, it is impossible to ascertain the resources (financial, human, information and equipment) earmarked for the science and technology policy-making body.

At present, the role of the Director of Scientific Research has been assigned to the Secretary-General of the Ministry who co-ordinates all the Ministry's activities. He has at his disposal a Secretariat with two secretary/typists. He also has a messenger and a driver.

No special arrangements exist for the collection, processing and analysis of the factual data concerning the national scientific and technological activities. Nevertheless, these data exist in each specialized institution (INRAN, ONERSOL, IRSH).

F. Links between the national science and technology policy-making body and its counterpart organs in sectorial ministries or government departments

The link between the Ministry for Higher Education and Scientific Research and the corresponding bodies in each Ministry has no special features different from the classical links between traditional Ministries.

The science and technology policy-making body lacks the inter-ministerial mechanism necessary for acquiring information from its counterpart organs in sectorial ministries to enable it to formulate the S & T policy suitable for each sector.

It is therefore by no means certain that the present situation is favourable to the circulation of scientific information nor to any form of feed-back.

G. Critical evaluation of the performance of the national science and technology policy-making body

It is difficult to estimate the impact of the work carried out by a body which is not yet operational. The existing research results of the Research Institutes such as INRAN and ONERSOL are not the result of the national body for science and technology policy, but are the fruits of their individual activities, supported, it is true, by the Government which has placed the means at their disposal.

It is therefore possible to evaluate the economic impact of research undertaken by these Institutions on national development.

(1) *At the level of agricultural research*

As in the majority of West African States, this sector has been active for a long time and the Institut national de recherche agronomique du Niger (INRAN) which has inherited the scientific facilities of the French Institutes from whom it has taken over, continues the work in this sphere.

The research programmes follow three lines of action:

— Search for new varieties adapted to the ecological conditions in Niger.
— Improvement of farming techniques;
— Protection of standing crops as well as stored products.

There have been many results. New varieties of millet in particular have been developed, and their distribution has enabled certain regions of Niger such as Zinder, Maradi, which traditionally have shortages, to become the millet storehouse of the country thanks to their surpluses.

(2) *At the level of ONERSOL*

The Office de l'énergie solaire (Department of Solar Energy) was set up in 1965 to create and manage an experimental centre for solar energy responsible for the development of various prototypes for domestic and industrial utilization of solar energy.

The prototypes which have been developed and distributed to the public include cooking stoves, steam ovens, water heaters and solar distillers:

— a solar cooking-stove with a 1.5 m diameter can cook, around midday, three to four kilograms of rice in an hour.
— solar water-heaters are the most widely distributed appliances among hospitals and maternity blocks, big hotels and individual homes.

Their installation demands, at the present time, an average outlay of 200,000 F. CFA which is amortized by the big institutions within one year, taking the current cost of electricity into account.

The functioning of water-heater requires no additional cost since it consumes nothing but solar energy.

(3) *Outlook for the future*

Despite the non-existence of an operational national science and technology policy-making body responsible for defining and activating national programmes in the field of research, certain research activities have led to tangible results, and their widespread use has enabled the people of Niger to realize appreciable economies.

The authorities in Niger must become aware of this favourable situation and set up a national body endowed with a central directorate capable of formulating and co-ordinating a national science and technology policy.

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Nigeria

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Federal Republic of Nigeria is bordered in the west by the People's Republic of Benin, in the east by the United Republic of Cameroon and in the north by the Republic of Niger and Chad. The south is washed by the Atlantic Ocean.
2. *Area:* 923,768 sq. km
3. *Population:* 84.7 million (1980 estimates)
4. *Population density:* 91 inhabitants per sq. km
5. *Average annual rate of population growth (1970-1979):* 2.5%*

The 1963 census put the country's population at 55.7 million. Nigeria's population is projected to reach 161 million* by the year 2000.

The majority of this population (about 70%) live in rural areas and derive their livehood mostly from agricultural activities, including forestry and animal husbandry. Of the 55.7 million population recorded in the 1963 census, 46.6 million (83.7%) were listed as being in the rural areas. But most of the urban centres, especially the principal cities and towns throughout the country have grown tremendously during the last 20 years, mostly as a result of economic and political-administrative changes.

II. SOCIO-ECONOMIC INDICATORS

Among the particular factors which have shaped the basic structure and character of the Nigerian economy in recent times, the following stand out clearly:

1. The rapid growth of the petroleum industry and of revenue from the sale of crude oil and, consequently of government revenue.
2. The relative stagnation of agriculture.
3. The growth of local manufacturing and processing activities.

* World Bank: Accelerated Development in Sub-Saharan Africa. An Agenda for Action, Washington DC. 1981. Table 33 of the Statistical Annex.

Table 1 Gross Domestic Product at current factor cost, 1973/74- 1979/80 summaries (in million Naira)

Sector	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
1. Agriculture (including livestock, forestry and fisheries)	3,352.1	3,943.0	4,579.5	4,898.0	5,143.4	5,389.1	5,656.8
2. Crude petroleum	2,771.6	5,198.2	4,813.1	6,097.6	6,847.9	5,725.5	7,383.7
3. Manufacturing	611.0	635.7	974.8	1,187.6	1,441.8	1,750.2	2,090.2
Other	5,383.3	6,685.7	9,070.3	11,643.4	13,325.4	14,505.4	16,294.0
Total:	12,118.0	16,462.6	19,437.7	23,826.6	26,758.5	27,370.2	31,424.7

Source: Derived from Table 2A of Federal Ministry of National Planning, *Guidelines for the Fourth* National Development Plan, 1981-85, Lagos, 1980, p. 16.

III. NATURAL RESOURCES OF NIGERIA

1. Mineral resources: The main mineral resources of Nigeria include cassiterite, coal, columbite, clay, felspar, gold, kaolin, lead ore, limestone, monazite, tantalite, thorite, colframite, lead/zinc, zircon, molybdenite, marble, shale, salt and zinc ore.

Petroleum has, however, been the most important natural resource in the development of the Nigerian economy during the last twenty-years.

The share of agriculture in the GDP has dropped sharply over the years, not just for reasons of expansion of other sectors but also as a result of the decline in agricultural productivity. Agricultural production techniques, existing storage systems and methods, pests and diseases, credit systems and marketing arrangements—all seem to be in need of study and reform. Several factors have been identified as possible explanations of Nigeria's low agricultural productivity. Among these are inadequate understanding of the peasant production system, inadequate data and information, poor planning, and the oil-boom which created an illusion of wealth and diverted attention and resources away from agricultural activity to other development areas.

Table 2 Oil revenue as percentage of total government revenue, 1961, 1970 and 1975-1980*

	1961	1970	1975/76	1976/77	1977/78	1978/79	1979/80
1. Total government revenue (₦ million)	223.6	758.1	5,861.5	7,070.5	8,701.7	7,387.3	8,805.6
2. Oil revenue (₦ million)	17.1	196.4	4,611.6	5,548.5	6,847.9	5,422.4	6,560.7
3. (2) as % of (1)	7.6	25.9	78.7	78.5	78.7	73.4	74.5

2. Agricultural resources Nigeria has a vast area of arable land on which almost all tropical crops could be grown, and the country's major crops include cocoa, oil-palm, groundnut, rubber, cotton, coffee, tobacco, wheat, fruits and vegetables, cassava and sugarcane. However, the performance of the agricultural sector has been disappointing during the period 1962-1980 covered by the first three National Development Plans.

Table 3. Indexes of per-capita food production, food prices and value of food imports, 1970-1979.

Year	Index of per-capita production (1969-71 = 100)	Index of food prices (1970 = 100)	Value of food imports (₦ million)
1970	102	100	57.7
1971	95	128	88.0
1972	94	132	95.1
1973	86	138	126.3
1974	91	159	155.7
1975	91	224	297.9
1976	91	283	439.0
1977	80	320	736.4
1978	90	327	1,114.6
1979	91	354	1,246.1

Source: Falusi, A.O. "Fertilizer Use in Nigerian Agriculture, etc." in International Food Policy Research Institute, *Food Policy Issues and Concerns in Sub-Saharan Africa,* February 1981, p. 148.

IV. MANUFACTURING INDUSTRIES AND PROBLEMS OF DEVELOPMENT

The manufacturing sector has been growing considerably, especially in terms of its total contribution to the GDP, the range of items manufactured and the employment attributable to it. This shows clearly in Table 1. Also the sector's rate of growth was at least three times as high as the rate of growth of GDP throughout the Third National Plan period.

However, value-added in the sector and the share of manufacturing in the GDP both remain small, the latter being only about 7.5% at its highest in 1977-78. The expansion of manufacturing in Nigeria has been retarded by many factors; among them:

— poor infrastructures (water, electricity, etc.),
— weak agricultural base,
— shortage of industrial manpower,
— inadequate credit facilities, and
— a high level of dependence on imported technology.

Manufacturing is mostly in the hands of the private sector (private sector's share of paid-up capital in the sector, as at 1974, was 78.7% of total paid-up capital) though it is expected that public initiative will play a greater role in the development of the sector in future.

Though the efforts in development planning and implementation in the period since independence in 1960 have achieved considerable economic and social improvements, the problems of further development now seem to be more clearly recognized and also appear to pose even greater challenges to the initiative of government and of the people and to the entire machinery and process of national planning. Among the major problems already identified, the following stand out prominently:

— low and declining agricultural productivity and output and the associated shortages,

* Figures for 1961 and 1970 from Iwayemi, Akin, *op.cit.* Figures for 1975-80 from Federal Ministry of National Planning Guidelines for the Fourth National Development Plan 1981-85, Lagos, 1981

— inadequate and unreliable infrastructure, especially water, electricity and telecommunications,
— overdependence on oil and oil revenue,
— low productivity in all sectors of the economy,
— high-level unemployment and under-employment,
— excessive dependence on foreign technology,
— widespread use of inappropriate technology,
— low value-added in manufacturing,
— virtual restriction of indegenous enterprise to trade and services,
— inequitable income distribution,
— counter-productive consumption (demand) patterns.

In order to deal with these problems, Nigeria, during the 1981-85 period, is according highest priority to agricultural production and agro-based processing activities, the strengthening of infrastructure and the development of manufacturing, beyond mere 'import-substitution'*. Overall, it is expected that the effective pursuit of these priorities will advance the economy and the country towards self-reliance and self-sustaining development and that this will be reflected in greater self-sufficiency in food production, diversification of national productive capacity, indigenization of technology and the raising of productivity in all sectors of the economy. The economy is also projected to grow at 7% per annum, in real terms, during the 1981-85 Plan period.

V. THE GOVERNMENT

Nigeria is a Federation consisting of nineteen states and a Federal Capital Territory. It operates a presidential system of government. For more than thirteen years (16 January 1966-30 September 1979) the country was under military rule.

Civilian government was restored under a new Constitution. Legislative powers at the centre are vested in a National Assembly which consists of a Senate and a House of Representatives. At the State level, legislative powers are vested in the House of Assembly of each State.

Subject to the provisions of the Constitution, the executive powers of the Federation are vested in the President while the executive powers of each State are vested in the Governor of that State. There is also a third level of government whose functions and powers (like those of the Federal and State levels) are clearly defined in the Constitution.

Subject to the provisions of the Constitution, each of the three levels of government is autonomous and has an important role to play in the national precess of policy formulation and implementation and in the planning and execution of development programmes, within its own jurisdiction. However, the set of legislative powers reserved to the Government of the Federation shows clearly that the Constitution intends a strong centre.

The particular subject of this survey, i.e. scientific and technological education and research, their application to development and the provision of services and infrastructure to facilitate all these, belongs in the current legislative list.

B. The place of science and technology within the national development plan

I. MAIN OBJECTIVES OF THE 1981-1985 PLAN

The 1981-1985 National Development Plan gives high priority to agriculture, agro-based manufacturing industries, expansion of the infrastructure and to heavy industry. The plan underscores a self-reliant development.

II. THE PLACE OF SCIENCE AND TECHNOLOGY WITHIN THE PLAN

The various development priorities and objectives indicated in the previous paragraphs clearly imply a major and distinctive challenge in the area of technology development and, consequently, the need to articulate an appropriate science and technology (S & T) development policy, as part of national development strategy. However, while the need to promote and manage technology development has always been noted, previous national development plans in Nigeria, up to 1980, do not seem to have included any specific strategy as far as this objective is concerned.

The Nigerian Council for Science and Technology (NCST), in December 1975, published the brochure, *National Policies and Priorities for Research in Science and Technology*. The document contained a review of the status of science and technology in the country, as at that time, in terms of institutions, fields of scientific research, manpower and expenditure on research. The Council also identified clearly in the document what it believed to be "the national policies and research programmes in science and technology in support of national development activities in all sectors" as well as strategies for implementing such policies, with particular reference to the 1975-80 Plan Period**. This was intended to serve as "the basis for sectoral and overall co-ordination of research activities in the country."

According to the Council, the document had been prepared "with the participation of scientists at the bench level, as well as development officers in Ministries in order to achieve an integrated approach to scientific, technological and economic and social development"**.

But, despite this initiative, not much focused co-ordination appears to have been achieved in terms of the enunciation of specific research and experimental development programmes in the 1975-80 Plan document. The National Science and Technology Development Agency (NSTDA), established in 1977, did attempt to bring about a measure of deliberate co-ordination on the ground towards the close of the plan period. But the Agency did not have enough time to register a definite impact in this direction and it would be right to conclude that, though both NCST and NSTDA did make some efforts to impose some policy structure and co-ordination, technology development in the country until 1980 appears to have proceeded more or less spontaneously," through the medium of education and training, licensing and registration of patents, trade marks and the like, technical assistance arrangements with foreign countries, research and development (both basic and applied), and exposure through trainee attachment and more significantly through operation and maintenance of technical equipment in use in the country".***

For the 1981-85 plan period, due to the more decisive emphasis now being given to the objective of self-reliance, more definitive steps are being proposed to accelerate and indigenize technology development in every sector through the various media noted above but also through other initiatives to relate the science-education and research programmes of all relevant institutions more closely to the needs of agricultural and industrial production, to promote the use of local research facilities and expertise, to strengthen extension services in agriculture

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* Federal Republic of Nigeria, *Guidelines for the Fourth National Development Plan, 1981-85*, Federal Ministry of National Planning, Lagos, 1980, pp. 19-23.

** NCST Secretariat: *National Policies and Priorities for Research in Science and Technology*, Cabinet Office, Lagos, December, 1975, p. 5

*** Federal Republic of Nigeria: Guidelines, *op. cit.*, p. 33

and industry so that results of research are readily available to potential users in both sectors, to upgrade the technological and inventive capacity of the informal sector, to enhance the country's indigenous capacity (public and private sectors) for selection, acquisition, adaptation and development of appropriate technology from the world's stock, and to develop necessary support services.

An examination of the objectives and policies in respect of particular sectors, such as agriculture, manufacturing, mining, transport, communications, power and housing, shows that the question of technology development is also considered at this level, mostly as part of the problem of inadequate indigenous executive capacity. Similarly, an attempt has always been made in the planning process to relate manpower development policy and the programmes of the national educational and training system which flow from it to the overall projected demand of the economy for scientific and technological manpower.

C. The national science and technology policy-making machinery: evolution

Serious attempts to establish a science policy-making machinery in Nigeria date back to July 1966 when, in response to a request of the Nigerian Government (especially the Federal Ministry of Education and the Federal Ministry of Agriculture and Natural Resources), a Unesco mission, undertaken by Mr N.R. Martin, arrived in Lagos to advise the government in this field.

This science-policy development mission lasted four years and involved extensive consultation with relevant ministries responsible for Agriculture, Health, Industry, Works and Housing and Mines and Power, with regional governments and with universities and research institutes. The mission submitted its report and recommendation to the Cabinet Office in January 1967.

After further review and government study of the proposals contained in the Martin Report*, Decree No. 6, 1970 was promulgated in February 1970. That Decree:

(i) repealed a previous decree (No. 83, 1966) which had set up a Nigerian Council for Scientific and Industrial Research, NCSIR, a body which never actually came into being, and
(ii) established the Nigerian Council for Science and Technology, NCST, and the following four specialised Research Councils:
    Agricultural Research Council of Nigeria (ARCN)
    Industrial Research Council of Nigeria (IRCN)
    Medical Research Council of Nigeria (MRCN)
    National Sciences Research Council of Nigeria (NSRCN)

According to the 1970 Decree, NCST was to be sponsored by the Cabinet Office and the Research Councils by the appropriate ministries which, for NSRCN was the Federal Ministry of Education. The objectives and functions of NCST were quite comprehensive, embracing, as they did, the formulation and development of national science and technology policy**, the promotion of the application of the results of scientific activities to the development of agriculture, industry and social welfare, the co-ordination of the programmes and budgets of the specialised Research Councils to "ensure that they are in harmony with national policies", the conduct and the maintenance of appropriate support activities, and the maintenance of appropriate relationships with relevant international agencies and with "corresponding scientific organizations in other countries".

NCST, was inaugurated in April 1970 and proceeded to establish its specialized Research Councils: Agricultural Research Council in 1971, Industrial and Medical Research Councils in 1972 and the Natural Sciences Research Council in 1973. The NCST also initiated other activities in pursuit of its objectives, e.g. the setting up of an expert committee on atomic energy, the survey of middle-level technical manpower needs of Nigeria and of requisite training and the inventory of scientific and technological resources and activities in Nigeria. It can be said that the Council devoted the first three years of its existence to the establishment of a structure for the management and co-ordination of scientific and technological activities and to the gathering of material which would enable it to define its work more concretely (in terms of the S & T needs of the various sectors of economic and social development) and to determine appropriate guidelines for a national science and technology policy.

On the basis of these explorations, NCST began to work out research programmes and projects "which should support national economic development in the quinquennium 1975-80", it advised relevant ministries regarding the establishment of semi-autonomous research institutes under the management of the specialized Research Councils and started to consider ways of ensuring the systematic application of science and technology to national development on an enduring basis.

However, despite its initial efforts, the official view was that NCST had proved ineffective and that it was necessary to scrap it. Many reasons were given for the failure of NCST. One was that the Council lacked executive powers and was therefore unable to implement its own plans. Another was that it was too large and unwieldly, and therefore found it difficult to co-ordinate the activities. Another reason was that the NCST had no control over the specialized Research Councils, through which it was expected to operate since the latter were, in effect, subject to the direction and procedures of the different ministries. The final reason advanced was that the NCST lacked representation at the highest policy-making level in the country with the result that there was usually no one to defend and push its proposals at that level.

To remove these shortcomings, the NCST and the Research Councils were scrapped and an autonomous and more powerful body, the National Science and Technology Development Agency (NSTDA) was established in 1977 (Decree No. 5, January 1977). Its functions were essentially the same as those of its predecessor, NCST, but there were some important organizational differences between the two bodies. For example:

— unlike NCST, NSTDA had executive powers,
— NSTDA Chairman was a political officer (a Commissioner) who sat on the Federal Executive Council,
— NSTDA was more wieldy. It had only 15 members on its Council whereas its predecessor had 36,
— the NSTDA Council was more deliberately professional in composition, being made up mostly of distinguished scientists,
— Ministries or permanent Secretaries, as such, were not represented on NSTDA.

Thus, it can be said that NSTDA was smaller, more professional in composition, less subject to bureaucratic controls, more strongly connected to the Federal policy-determination centre, through the Commissioner-Chairman. It was altogether a more powerful executive body than NCST. From its inception, NSTDA worked energetically and attempted to restructure and integrate the 23 research institutes which came under its control into a better co-ordinated, more relevant and more productive system for advancing the country's scientific and technological capacity. In 1979 the NSTDA was transformed into the Federal Ministry of Science and Technology.

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* N. R. Martin: Memorandum on Outline of an Organization for the Formulation of a National Science Policy in Nigeria (see Unesco Document FR/TA/NIGEREPS 1, Nigeria: The National Science Policy Machinery, Paris, December 1970, Annex II.

** The field of scientific knowledge covered are agricultural sciences, experimental sciences (physical and chemical sciences and mathematics) industrial sciences, engineering and technology, medical sciences, environmental sciences (biosciences and geosciences) and social sciences.

D. The aims, scope and functions of the national science and technology policy-making body

1. *Official designation:* Federal Ministry of Science and Technology
2. *Postal address:* P.M.B. 12793,
   Lagos, Nigeria
3. *Legal status:* The Federal Ministry of Science and Technology was established by Parliament in October 1979 by the Science and Technology Act, January 1980, and by which Act the NSTDA was formally dissolved and its functions and responsibilities were transferred to the new ministry.
4. *The statutory functions of the ministry* include:

— formulation of national policy on science and technology;
— promotion and co-ordination of scientific and technological research;
— liaison with universities and polytechnics on scientific and technological activities in relation to manpower development and training;
— promotion and administration of technology transfer programmes;
— encouragement and promotion of science and technology generally*.

The Ministry, in carrying out these functions, is expected to undertake the following activities:

(i) formulating a comprehensive national policy on science and technology and ensuring its implementation;
(ii) preparing periodic master-plans for the development of science and technology, including financial requirements for the implementation of such plans;
(iii) preparing annual budgets for scientific and technological research development and receiving grants for allocation to Research Institutes;
(iv) supervising and co-ordinating the activities of research institutes and centres established under the Ministry;
(v) providing funds for research development and technology in the Universities and Polytechnics as well as research and development departments in the public and private sectors in order to solve specific problems;
(vi) encouraging innovations and inventions, identifying and developing endogenous science and technology, e.g. by sponsoring programmes on the media, maintaining science and technology museums;
(vii) promoting and supporting science education, for example, by intervention in curriculum development, by organizing science fairs and prizes for excellence in science and mathematics education;
(viii) providing or ensuring the provision of effective means for the dissemination of the results of scientific and technological research and to facilitate their application;
(ix) promoting co-operation in science and technology through participation in international and regional organizations and with similar bodies in other countries with a view to profiting from the experience and expertise of other scientists, and contributing to the advancement of science and technology for the benefit of mankind.

The Ministry is made up of six departments, namely:

1. Administration and Finance;
2. Science and Technology Planning;
3. Agricultural Sciences;
4. Industrial Sciences and Energy;
5. Medical and Natural Sciences; and
6. Technology Transfer and Science Education.

The Administration and Finance Department is responsible for general administration, that is, administration of the ministry's own staff and financial matters affecting the ministry, the institutes, agencies and other parastatals attached to the ministry.

The Department of Science and Technology Planning, Programming and Evaluation is responsible for the co-ordination and development of overall national sciences and technology policies, the devising of a strategy for implementing such policies, the assessment of financial and other requirements, the evaluation of the impact of scientific and technological activities on economic and social development, and the co-ordination and evaluation of Nigeria's participation in international scientific and technological programmes and activities.

Each of the specialized sectoral departments (Agriculture; Industrial Sciences and Energy; and Medical and Natural Sciences) is responsible for identifying priorities and problems and for initiating measures to promote necessary research and technological development as well as the application of the results thereof in its own sphere of competence.

The Department of Technology Transfer and Science Education is charged with the responsibility for initiating measures to facilitate and promote effective technology transfer, mobilization and development of indigenous technology, the development and popularization of scientific and technological education, the dissemination and transfer of research findings to users.

Each of the six departments, except the Department of Administration and Finance, is headed by a Director. The Head of the Administration and Finance Department is the Secretary for Administration and Finance. Each Director is responsible to the Permanent Secretary who, in turn, is responsible to the Minister. This structure conforms to what obtains in a typical federal ministry.

E. The resources of the federal ministry of science and technology

I. FINANCIAL RESOURCES

As shown in Table 4 below, it would appear that, since 1976, there have been specific and substantial budgetary allocations to the public scientific and technological research system in Nigeria, especially since 1979, though it is difficult to isolate precisely how much of such allocations were specifically meant for the science and technology policy-making body itself rather than for running the research establishments under it.

Table 4. Recurrent expenditure of S & T policy-making body, 1977-81** (in million of Naira)

	1977/78	1978/79	1979/80	1980	1981
Personnel costs	–	–	1.0	1.29	1.86
Other charges	39.95	30.60	31.20	45.76	83.67
Special expenditure	–	–	0.83	0.66	0.69
Total	39.95	30.60	33.03	47.71	86.22

Source: Recurrent and Capital Estimates of the Federal Republic of Nigeria, several years.

* See Federal Republic of Nigeria, *Brochure on Federal Ministry of Science and Technology*, Federal Ministry of Science and Technology, Lagos, 1981.

** NSTDA from 1976-1979 Federal Ministry of Science and Technology since October 1979.

The item 'Other charges' in the table above includes the following main expenditure sub-heads:
— NSTDA/Ministry running expenses
— Grants to Research Institutes, and
— Grants for research projects in the Universities, etc.

The running expenses alone stood at ₦ 1,102,310 (actual) for 1977/78, ₦ 997,310 for 1978-79 and ₦ 1,000,000 for 1979-80.*

Following the establishment of the Federal Ministry of Science and Technology, such expenses, as allowed for in the budget, rose sharply.

II. HUMAN RESOURCES

Perhaps the most important problem which the new ministry faces is shortage of professional staff. According to official information, out of five S & T departments of the ministry, only one, the Department of Agricultural Sciences can be said to have enough staff to get on with its assignment. But even that Department has many vacancies at the level of Chief Research Officer and below, which will have to be filled if it is to fully cope with its responsibilities.

F. Links between the federal ministry of science and technology and related sectoral ministries

It is proposed that the Ministry will be advised by a National Advisory Council on Science and Technology (NACST) which will work through a number of specialized committees and membership of which will therefore be made to represent the different specializations in science, technology and their application. However, even though the Ministry had been in existence for two years as at the time of this study, neither NACST nor its specialized committees had been set up.

Rather, the Ministry seems to have relied hitherto on limited consultations with selected persons and *ad hoc* panels on specific matters, as the need has arisen. More recently, the Ministry organized a National Conference on Science and Technology Policy in Lagos to obtain from as broad a spectrum of S & T interests as possible materials and ideas which can be used in formulating a comprehensive national science and technology policy and in working out the most appropriate modes of its implementation.

G. Critical evaluation of the performance and effectiveness of the national science and technology policy-making body

I. IMPACT

Unesco consistently refers to science and technology policy-making as pertaining to:

> all research and experimental development (R & D) operations, including scientific and technological services (STS) as well as to the transfer and innovation process which ensures effective use of discoveries and inventions in the national economy**.

Thus, ideally, national science and technology policy is effective only in so far as it guides research and experimental development (R-D) and scientific and technological services (STS) activities and international scientific and technological transfer towards the achievement of specified national development goals and within the overall national strategy for pursuing those goals.

The practical consequences of all science and technology policies and activities lie, essentially, in the innovative changes which they facilitate, encourage and promote in the different sectors of national economic and social development.

One way to evaluate the performance of Nigeria's science and technology policy-making machinery, therefore, is to find out what definite contribution, if any, it has made in respect of the following specific national objectives:
— Agricultural development, especially, cash-crop development, raising of agricultural productivity and expansion of food production and the transformation of traditional agricultural technology;
— Industrial development;
— Reduction of overall technological dependence;
— Development of national S & T potential, especially, manpower, research and training, experimental development, and STS, and
— Establishment of an effective national institutional framework for generating appropriate policy on these matters, for pursuing the objectives mentioned above on a regular and continuous basis and for consolidating any resulting achievements.

In terms of these criteria, the national S & T policy-making machinery in Nigeria appears to have made significant efforts and to have recorded some achievements. But, what is even more definite is that there is a lot of room for improvement.

Fortunately for this study, the 15th Annual Conference of the Science Association of Nigeria (SAN), 1975, was devoted to the theme, "Science, Technology and National Development" and many of the papers have proved quite useful.*** Also, the NSTDA publication *"Science and Technology for Development", (1979), contains a fairly detailed discussion of the problem and situation of technological dependence.*†

Of the 23 research institutes previously under NSTDA and now under the Federal Ministry of Science and Technology, 18 are for agricultural or agro-allied research (including research in animal health and production, in horticulture and in forestry). The remaining 5 institutes, between them cover leather research, oceanography and marine research, trypanosomiasis research, road and building research, medical research, industrial research and project and technology development. The university departments have been mostly involved in basic scientific research.

Other agencies whose activities have been relevant to S & T development in Nigeria are the research departments of ministries, responsible for Agriculture and Natural Resources, Mines and Power, Aviation, and Water Resources, the River Basin Development Authorities and some private-sector R & D establishments.

On the whole, the impact on economic and social development of these agencies and of the S & T policy-making machinery has been very limited, more so in industrial development than in agriculture. In the industrial sector the activities of the Federal Institute for Industrial Research and the Product Development Agency are notable. But then, as NSTDA itself

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* See Federal Republic of Nigeria: *Recurrent and Capital Estimates,* 1979-80, p. 383.

** Unesco, *An Introduction to Policy Analysis in Science and Technology,* Science Policy Studies and Documents, No. 46, Paris, 1979, pp. 15/16.

*** *See SAN, Bulletin of the Science Association of Nigeria,* Vol. 1, No. 1, Feb. 1975, especially the contributions by F.M.A. Ukoli, D.E.U. Ekong, P.I. Amenechi, A. Maduemezia and S.D. Onabamiro.

† NSTDA, Science and Technology for Development, Lagos, 1979 (substantially, Nigeria's paper to the 1979 Vienna Conference).

confirms, industrial research is only recently being defined. The provision of R & D support to local industries is growing at the same slow pace as indigenous industrialization*.

As far as this sector is concerned, it can be concluded that though there have been attempts to promote and generally influence relevant research activities, the science and technology policy-making machinery does not seem to have worked out any systematic or comprehensive national R & D strategy for advancing industrial technology.

Agricultural research has received considerable attention in Nigeria, dating back to 1899 when an agricultural station was opened at the site now known as Moor Plantation, Ibadan, to propagate rubber trees. This and other early initiatives were concerned with the development of export crops: cotton, rubber, palm produce, cocoa, timber, leather—all for industries located in Europe.

Since independence in 1960, much useful agricultural research has been and continues to be done on food crops, tree crops, livestock, forestry, fishery, crop storage, soil management, agro-meteorology, mechanization and extension techniques. Some concrete improvements in agricultural practice have resulted from these S & T activities, e.g. the widespread adoption of improved varieties of rice, oil-palm, cocoa and maize. But, by and large, these activities themselves remain unco-ordinated and their impact on agricultural practice and production has been much lower than it would have been, if the science and technology policy-making machinery had developed and pursued during this period a deliberate national scientific and technological research policy to agricultural production.

Two reasonable inferences that one could make from the foregoing review of the impact on agriculture and industry are that there has not been any significant reduction in overall technological dependence and that the development of national S & T potential has not been as fast or as deliberate as it could be.

There are many indications that technological dependence remains at a high level. Only minimal research and development support is yet provided to local industries, for example, in the utilization of local raw materials and equipment or in adaptation, design and manufacturing activities.

There is still an acute shortage in the supply of local scientists and technologists with requisite skills in industrial research and development. Nor is there any major initiative or breakthrough in the local production of simple equipment and implements in support of domestic activities, agricultural production or the activities of small and medium-sized industries. There is abundant evidence of creativity on the part of local entrepreneurs in these areas but their efforts remain largely unencouraged and unco-ordinated. Finally, the dependence of the country remains almost total with respect to scientific equipment and its maintenance.

As Nigeria's national paper at the Vienna Conference (1979) makes clear, continuing high-level of technological dependence has affected the development potential of the country in several ways: it stifles the effective transfer of technology while also implying widespread adoption of inappropriate technology, especially in industry; it represents a substantial drain on the country's foreign exchange (payment for foreign technology and imported inputs, and for finished goods) though the magnitude of the leak is unknown since: the exact amount of payments in terms of royalties, technical services, rents and licence fees for use of patents is not known in Nigeria because there is as yet no central agency that monitors technology acquisition**.

Perhaps the most important indication (and explanation) of the continuing underdevelopment of Nigeria's S & T potential is that, despite the prolonged official awareness of the need, no sustained effort has been made to implement and co-ordinate the country's science and technology policy and programmes of action on a systematic, continuous and cumulative basis.

II. OBSTACLES AND DIFFICULTIES

The obstacles and difficulties retarding the development of S & T potential and the application of science and technology to economic and social development in Nigeria are many. The major obstacles include:

(1) Inadequate investment in science and technology (in research and experimental development and STS). For example, the CASTAFRICA Conference (1974) in its Recommendation 1 urged African countries to increase their annual expenditure on R & D and supporting scientific and technological public serives (STS) so as to attain, if possible, before 1980, the target figure of a minimum of 1% of the GNP.*** It would be hazardous to put a particular annual value to total national investment in S & T during the period, say 1975-1980, but it would, most probably fall far below the recommended 1% target in Nigeria.

(2) Shortage of graduate scientists and technologists and of middle-level technical manpower and the inadequacy of facilities for bridging that gap. The CASTAFRICA Conference also recommended (Recommendation 3), for the category of African countries to which Nigeria belongs, a 1980 target of 2,000 scientists and engineers per million of population and 200 R & D scientists and engineers per million of population. But, according to Nigeria's national paper to the 1979 Vienna Conference, "there are only about 22,000 S & T personnel in all categories of the modern sector. The number with graduate training is less than 4,000".

For the category of middle-level technical manpower, 1975 projections show a little over 6,000 as likely to be available, which implies a shortfall of about 108,000.†

(3) Lack of suitable media for communicating the results of research and experimental development to potential users and the general public (e.g. journals, technical books, public technology centres, S & T documentation centres).

(4) Inadequate conception of the nature of S & T policy and of what proper S & T planning involves and, consequently, the absence of any proper national S & T policy or plan.

(5) Demonstrated lack of confidence, in official circles, in the Nigerian scientist, a point emphasized in almost all past conferences of the Science Association of Nigeria (SAN).

(6) Partly as a result of (5), but also for other reasons, strong official preference for advice from foreign scientists, engineers and consultants.

(7) Unsatisfactory relationship between science administrators in the ministries, on the one hand, and professional research scientists and technologists in other establishments, on the other.

(8) Insufficient 'team work' on the part of Nigerian scientists.

(9) Deficiencies in the scientific background and training experiences of many of Nigeria's scientists and technologists, e.g. in the environment and facilities for training.

(10) Extroverted private sector with a strong aversion to using Nigerian scientists and to letting them into the critical aspects of production science and technology.

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* NSTDA—Science and Technology for Development, pp. 33 and 34.

** NSTDA—Science and Technology Development p. 17

*** Unesco, *Science and Technology in African Development,* Science Policy studies and documents, No. 35, Paris, pp. 14-16.

† NSTDA. *Science and Technology for Development,* p. 20.

(11) Unsatisfactory conditions of service for scientists and technologists (remuneration and other incentives, workload and facilities for work).

Despite these difficulties, the prospects for S & T development in Nigeria are reasonably good. Judging from Nigeria's paper to the 1979 Vienna Conference, most of the obstacles are clearly recognized and NSTDA was beginning to tackle them methodically. The scrapping of NSTDA and the creation of a new Federal Ministry of Science and Technology is a significant development but it is too early to say whether the new arrangement will advance the cause of S & T policy and development in Nigeria. What happens will depend very much on the clarity, imagination and drive of the ministry's leadership, on the appropriateness of its organizational structure for formulating and co-ordinating the comprehensive national S & T policy, on the resource support which they can coax out of government and other appropriate agencies and on their effectiveness or otherwise in mobilising all relevant professional groups (science teachers, science administrators, research scientists, technologists, other technical manpower, and entrepreneurs in agriculture, industry and other sectors) as well as the society at large in support of the country's move for endogenous and self-reliant technological development.

Senegal

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* Located in the Sudano-Sahelian region, Senegal is bounded on the west by the Atlantic Ocean, on the north by the Senegal River, on the east by the Falémé, a tributary of the Senegal, and on the south by the foothills of Fouta-Djalon and Guinea-Bissau.
2. *Area:* 196,722 sq. km
3. *Population:* 5,500,000 inhabitants (1979)*
4. *Density:* 28.7 inhabitants per sq. km.
5. *Average annual population growth rate (1970-1979):* 2.6%*

It is estimated that the population of Senegal will be 6,498,875 in 1985.

In 1980, nearly 43% of the population was under 15 years. The economically active population between 15 and 64 years old is estimated at 2,635,374 or nearly 46% of the total population. The Senegalese population is relatively urban and not more than 70% are rural dwellers.

II. SOCIO-ECONOMIC INDICATORS IN 1980 (in F. CFA):

1. The Gross Domestic Product (GDP): 517,600 million
2. The GDP per capita: 91,331
3. Trade balance (F. CFA):
   - — Import level 264,000 million
   - — Export level 179,000 million
   - — Deficit 85,000 million
4. General budget of the State in 1979/80:
   - i. Recurrent budget 119,819 million
     - — Receipts 116,737 million
     - — Deficit 3,082 million
   - ii. Capital budget 12,368 million
     - — Receipts 27,409 million
     - — Deficit 15,041 million
   - iii. Total deficit 18,123 million

III. THE NATURAL RESOURCES OF SENEGAL

1. Relief and drainage Senegal is a flat country except for the volcanic peninsula of Cap Vert and the south-east region.

Senegal has 400km of maritime coasts and a hydrographic network made up of the following main rivers:
— The Senegal (1,800 km) from Fouta-Djalon to the sea,
— The Saloum (130 km), a tributary of the Senegal,
— The Gambia (850 km) whose source is in the Fouta-Djalon, and
— The Casamance (300 km).

2. Geological and mineral resources

The primary mineral resources of Senegal are calcium phosphate with an average annual production of 1,600,000 tonnes and bauxite with an annual production of 208,000 tonnes.

Senegal produces on the average 350,000 tonnes of marketable cement annually and possesses extensive iron deposits. It also produces titaniferous sand from which several heavy minerals are extracted: ilmenite, rutile, zircon, etc., and marine salt (140,000 tonnes).

3. Agricultural resources

(a) *Cash crops*

The principal agricultural product of Senegal is groundnut (1,300,000 tonnes/year) which contributes nearly 43% to the national budget. Other cash crops are cotton seed (30,000 tonnes/year), sugarcane, (400,000 tonnes/year) and tomatoes (25,000 tonnes/year).

(b) *Food crops*

These are mainly cereals:
— Millet-sorghum 620,000 tonnes/year
— Paddy rice 125,000 tonnes/year
— Maize 45,000 tonnes/year
— Niébé 31,000 tonnes/year

The country has a cereal deficit of nearly 300,000 tonnes. A large part of foreign currency obtained from the sale of groundnuts is used to import food.

IV. MAIN EXPORTS AND TRADE BALANCE OF SENEGAL

Senegal's exports are primarily raw materials: natural phosphate (9/10 of which is exported) and groundnuts.

The export pattern (see Table 1) shows strong commodity concentration:
— With respect to exports, the proportion of groundnuts and their by-products varied, according to harvests, between 35% (1973) and 49% (1977). The decrease in the price of phosphate since 1976 has led to a decrease in its proportion of exports, from 27% (1974) to 10% in 1977.
— With respect to imports, the proportion of food commodities has considerably decreased from 35.7% in 1973 to 20% in 1977 in favour of capital goods which have made up more than 21% of imports since 1973.

In all, the overall deficit is primarily due to the importation of capital goods, manufactured and semi-manufactured consumer goods, energy and lubricants and to a lesser degree, to the importation of food, beverages and tobacco. (See Tables 1 and 2).

* World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action; Washington DC, 1981, pages 22 and 33 of the statistical Annex.

Table 1. Evolution of foreign trade (1960-1978) (in millions of F. CFA)

Years	At current prices			Cover rate (%)
	Export	Import	Deficit	
1960	27,878	42,479	− 14,601	66
1961	30,657	38,334	− 7,677	80
1962	30,671	38,206	− 7,535	80
1963	27,280	38,525	− 11,245	71
1964	30,243	42,393	− 12,150	71
1965	31,713	39,635	− 7,922	80
1966	36,764	38,313	− 1,549	96
1967	33,889	38,815	− 4,926	87
1968	37,369	44,529	− 7,160	84
1969	31,906	51,299	− 19,393	62
1970	42,181	53,657	− 11,476	79
1971	34,707	60,601	− 25,094	57
1972	54,412	70,351	− 16,139	77
1973	43,237	79,780	− 36,543	54
1974	93,973	119,376	− 25,403	79
1975	99,101	124,616	− 25,515	80
1976	115,925	153,687	− 37,962	75
1977	152,920	187,547	− 34,627	82
1978	95,259	170,314	− 75,055	56

Source: National Economic and Social Development Plan of Senegal (1981-1984)

V. THE MANUFACTURING INDUSTRIES OF SENEGAL AND DEVELOPMENT PROBLEMS

Senegal has a considerable number of industries for processing the natural resources of the country.

(a) *The food industries*

The oil industries of Djourbel, Rufisque and Ziguinchon. Currently, these oil mills press the largest part of the groundnut production producing 200,000 tonnes of oil and 400,000 tonnes of groundnut cake of which a large part is exported.

Breweries and carbonated drink factories produce 350,000 hectolitres per year.

(b) *The Textile Industries* produce approximately 20 million metres of cotton cloth per year. A sisal factory produces bags and ropes.

(c) *Other Industries*

Cement factory (300,000 tonnes/year)
Liquid-air, Tobacco (1,500 tonnes of cigarettes/year)
Packaging, Naval construction, Wood industry, etc.

In all, the industrial sector has 350 enterprises employing 40,000 people, and whose turnover has increased by 75% in five years. Production fully covers local demand for oils, flour, biscuits; it covers 80% of the demand for confectionery, beverages, tobacco, cement, 65% for shoes and 30% for yarn.

Oil, canned goods, beer, textiles and cement are exported.

(d) *Development problems*

The Development Plan, whose objectives are set out further on, provides for the domestic use of the nation's natural resources through the development of industries (particularly agro-based ones) in order to:

i. improve the country's balance of trade by producing domestically a substantial part of goods which are at present imported,
ii. accelerate economic expansion through diversification of activities,
iii. increase employment opportunities.

But these objectives are confronted with several obstacles which may be divided into three groups:

i. *Natural obstacles*

The most severe obstacle is the Sahelian climatic conditions in which Senegal is located and which seriously affect agricultural production.

Table 2. Exports: by end-use groups (in millions of F. CFA)

	1973	1974	1975	1976	1977	1978
Food, beverages, tobacco	14,137	19,326	24,260	27,085	47,301	32,415
Energy and lubricants	2,537	5,307	6,948	5,315	12,772	13,640
Animal or plant raw materials	11,274	29,620	29,329	53,616	57,080	18,382
Mineral raw materials	5,641	26,677	23,630	18,760	18,125	17,055
Manufactured and semi-manufactured goods	2,652	5,107	4,992	4,319	6,122	5,018
Capital goods	2,436	2,360	3,017	2,319	3,082	2,443
Consumer goods	4,560	5,516	6,905	4,511	8,440	6,307
Industrial gold	–	–	–	–	–	–
	43,237	93,973	99,101	115,925	152,922	95,260

Table 3. Imports: by end-use groups (in millions of F. CFA)

	1973	1974	1975	1976	1977	1978
Food, beverages, tobacco	28,630	40,500	29,312	34,349	37,553	36,86
Energy and lubricants	4,854	15,524	14,840	19,034	23,437	23,92
Animal or plant raw materials	3,722	3,781	5,372	10,115	9,886	7,960
Mineral raw materials	199	215	386	578	784	552
Manufactured and semi-manufactured goods	11,139	20,178	28,617	33,782	41,118	35,839
Capital goods	17,228	21,788	23,333	25,242	39,232	32,976
Consumer goods	13,997	17,388	22,756	30,757	34,810	32,452
Industrial gold	11	2	–	30	27	11
	79,780	119,276	124,616	153,887	187,547	170,314

ii. Technical obstacles

— Insufficient basic scientific data,

— Inappropriate technology used by farmers, and workers (see National Document prepared for the 1979 United Nations Conference on Science and Technology for Development— UNCSTD).

iii. Economic obstacles

These are not obstacles peculiar to Senegal; they constitute a common denominator for most developing countries. These countries do not generally possess sufficient natural resources to ensure the financing of their investments. Their budgets generally rely on fiscal receipts primarily used for recurrent expenditure; they are insufficient for the investments necessary for economic takeoff.

(e) *The main assets and favourable conditions*

The increasing development of a scientific and technological potential, as well as that of higher education in Senegal, constitutes definite advantages in accumulating a scientific data base and in preparing qualified local manpower for the creation and management of national production units. The growth of numerous manufacturing industries and the use of local products will enable limits to be set on imported consumer goods in favour of capital goods for economic development.

VI. GOVERNMENT

The political system in Senegal is a presidential one. In accordance with the constitution of 8 March 1963, executive power is vested solely in the President of the Republic.

The constitutional law of 26 February 1970 introduced a decentralization of power by appointing a Prime Minister who handles the administration. The Prime Minister and the other members of Government are responsible to the President of the Republic.

The constitution provides for a parliament whose members are elected for a four-year term. The Parliament makes the laws, approves the Budget and fixes the salary scales for civil servants.

Senegal is divided into eight administrative regions, composed of twenty-eight departments, which are in turn divided into districts.

The basic administrative unit is the Department headed by a Prefect holding the powers of the Republic and representing the Ministers responsible for the execution of the laws and regulations and control of local communities. The District Chiefs, who are civil servants, are subordinates. There are several political parties in Senegal.

B. The national development plan and the place of science and technology therein

I. THE MAIN OBJECTIVES OF THE NATIONAL DEVELOPMENT PLAN

Senegal's First National Development Plan, drawn up after the nation's independence in 1960, covered the period 1961-1965. Senegal completed its fifth Four-Year Development Plan in 1980. Since the Third Plan (1969-73), very long-term global perspectives have been defined from which are to be drawn the objectives of future development plans. The goal is to triple the present average standard of living by the year 2000.

The latest year for which detailed accounts are available is 1976. Estimations were made for subsequent years. The year 1980 has been used as a base line.

The economic growth of Senegal during the Sixth Plan is as follows (1981-85):

Annual growth rate:
Primary sector: 3.4%
Secondary sector: 5.0%
Tertiary sector: 2.8%

The global growth of the GDP is 3.5%. The main axes of the strategy for achieving the Senegalese society of the future as laid down in the plan are:

— to ensure the real participation of the people in decision-making,

— to organize economic and social development in the context of national development,

— to master the factors of production by technological adaptation, by the encouragement of Senegalese capital and by the processing of local raw materials.

II. SECTORAL OBJECTIVES

1. Agriculture

Agriculture is the driving force of the country's economy. The priority attached to this sector is based on two objectives:

— to raise the standard of living of rural dwellers (70% of the population) whose income is low,

— to encourage the development of processing industries for agricultural products.

The Senegalese agricultural policy aims at attaining self-sufficiency in food production; the food deficit amounts at present to nearly 300,000 tonnes of cereals.

The objectives of the Sixth Plan with respect to the agricultural sector are to:

a) increase cereal and other food crop production by using improved varieties (millet, sorghum, paddy rice, maize, etc.),
b) stabilize groundnut oil production at approximately 1,200,000 tonnes,
c) diversify cash crops and increase their yield (cotton, groundnut, sugarcane, tobacco),
d) increase horticultural production,
e) mechanize farming,
f). develop crop irrigation,
g) create the support services,
h) train agricultural workers.

With respect to livestock raising, the Plan is concerned with:

(i) specialization of livestock-raising by regions:
— Forest-grazing region: animal breeding,
— Senegal River: production—intensive grazing, fattening of livestock, breeding,
— Casamance and Eastern Senegal: trypanosomiasis-resistant livestock breeding, fattening of livestock,
(ii) development of cattle, sheep and goat raising: by improving the conditions for stock breeders, by satisfying their needs for animal food and for sanitary products.

In the field of forestry, attention will be directed to reaf-forestation for firewood production and for the improvement of the environment.

In the fishing sector: modern methods will be adopted to enable marine fisheries to grow. These objectives entail the provision of engines for the fishing boats used in small-scale fishing and by adopting industrial programmes in fishing with a view to attaining a growth rate of 30% per year during the Plan period.

2. Industrial sector

(a) *Extractive industry*

The Plan aims at increasing phosphate production through investment. It also provides for studies for quarrying marble from eastern Senegal according to local demand. Oil prospecting by private companies continues.

(b) *Manufacturing industries*

In the manufacturing industries, the main objectives outlined since the Third Plan are continuing; the aims are to:

— obtain the necessary conditions for strengthening and developing industrial policy (credit policy, investment code, encouragement of small-scale industry, creation of infrastructure for attracting industry),
— further integrate agriculture and industry by taking advantage of and processing local commodities through the creation of agro-industrial complexes, in the vegetable production sector as well as in other sectors such as livestock raising, fisheries and forestry.
— ensure the encouragement of local entrepreneurs and to extend national participation in the industrialization of the country.

(c) *Place of science and technology in the national development plan of Senegal*

Since Senegal's independence, its government has been constantly concerned with orienting science and technology research towards satisfying the nation's socio-economic developmental requirements. Thus, since the Second National Development Plan, (1965-1969), scientific research development has been examined globally. Preparatory work for this second Plan led to the creation of a Commission de la recherche scientifique (Scientific Research Commission) to establish a national scientific development programme. Subsequently, a permanent body was established to take reponsibility for the organization and the implementation of a national science policy.

The present structure created for formulating Senegalese science and technology policy (see structure further on) is perfectly suited for the integration of science and technology in the national development process because of its various subsidiary bodies.

i. *The Conseil interministériel de la recherche scientifique (CIRST- Interministerial Council for Scientific and Technological Research):* set up by decree no. 66-813 of 26 October 1966, is the advisory body on the Government's science and technology policy. It is a horizontal institution which groups all ministries concerned with the use of scientific and technological research results.

ii. *Les Commissions consultatives scientifiques permanentes (The Permanent Scientific Consultative Commissions).* Their role is to prepare the appropriate studies, surveys and suggestions related to research activities in their respective fields for the deliberations of the CIRST. These consultative councils play an important part in research programming.

iii. *Le Secrétariat d'état de la recherche scientifique et technique (The State Secretariat for Scientific and Technological Research)* is a central executive body of the CIRST. It is responsible for preparing the CIRST's decisions and seeing to their implementation.

The importance of the role of science and technology in the Development Plan can be appreciated by following the evolution of the budgetary provision for it during successive Development Plans.

This evolution is as follows:

2nd Plan (1965-1969):	7 billion (F. CFA)
3rd Plan (1969-1973):	10.804 billion (F. CFA)
4th Plan (1973-1977):	23.385 billion (F. CFA)
5th Plan (1977-1981):	11 billion (F. CFA)

The oldest and most developed research sector in the country is agronomic research. The Institut sénégalais de recherche agricole—ISRA (Senegalese Institute for Agricultural Research) integrates research on natural environment and rural development. Medical and pharmaceutical research is conducted by the Faculty of Medicine and Pharmacy of the University of Dakar; research in food technology is undertaken by the Institut de technologie alimentaire—ITA (Institute for Food Technology) and research on renewable energy sources is conducted by the Centre d'étude et de recherche sur les énergies renouvelables—CERER (Centre for the study and research on renewable energies).

The development strategy for research, as laid down by the Sixth Plan is a continuation of the general orientations which have governed research policy since the Fourth Plan. Because of the very limited financial resources, programmes and research projects are oriented towards satisfying the clients' needs, while simultaneously giving these programmes a foward-looking dimension necessary to research before it becomes a "factor of development". The objectives of the Sixth Plan were focussed on the "Studies and Research" sector, taking this guideline and the Plan directives for the recovery of the economy into consideration. It is primarily a matter of increasing production by freeing it from technical constraints, climatic variations and dependence on various outside sources. This major concern means that the various sub-sectors need to improve their productive machinery, and know-how to achieve more rational use of the natural potential and an increased mastery of the development process.

The industrial and energy technologies policy is an austere one aimed at energy savings and particularly the reduction of the oil bill through intensive use of renewable energies. The objective in this area is to acquire more knowledge concerning the unconventional energy sources in order to make maximal use of them.

C. National science and technology policy structure

The organization of science and technology policy in Senegal is relatively old. Following the field work carried out by an expert from the Science and Technology Policy Division of Unesco in 1965 and recommendations made concerning the creation, at the highest governmental level, of an interministerial co-ordinating body for scientific research and a Permanent Secretariat, Decree No. 66813 of 26 October 1966 established the Conseil interministériel de la recherche scientifique et technologique (Interministerial Council for Scientific and Technological Research) as well as the Bureau des affaires scientifiques et technologiques (Office for Scientific and Technological Affairs) placed under the authority of the Secretary-General of the office of the President of the Republic. These structures operated with the assistance of an expert from Unesco during the initial phase (1960-1970).

During the preparation of the Third Four-Year Plan for Economic and Social Development, management was seen as an instrument for integrating science and technology with development. In 1969, a request was made to the UNDP to create a Centre for the inventory of scientific potential and technological forecasting. In 1971 this project led to the establishment of the Centre national de planification de la recherche scientifique et technologique (National Centre for Science and Research Planning (Project UNDP/Unesco/SEN/13).

Following the creation of the post of Prime Minister in 1971, the Interministerial Council was attached to that office. The Interministerial Council for Scientific and Technological Research has been presided over by the Prime Minister since then and is the highest decision-taking body with respect to science policy.

The Office of Science and Technology Affairs became the Direction des affaires scientifiques (Directorate for Science Affairs) and came under the authority of the Secretary of State at the office of the Prime Minister responsible for the Plan, which in turn became the Ministry of Planning and Co-operation in April 1973.

The Délégation générale à la recherche scientifique et technique—DGRST (General Delegation for Scientific and Technological Research) attached to the Prime Minister's office was established by Decree No. 73-1100 of 11 December 1973.

According to Decree No. 73-1975 of 16 February 1974, the Direction de la science et de la technologie (Science and Technology Directorate), the ministries' research centres and stations with the exception of those attached to the university came under the direction of the General Delegation for Scientific and Technological Research. The Institut de technologie alimentaire (ITA) (Institute for Food Technology) is under the direction of the General Delegation for Scientific and Technological Research.

Decree No. 75-246 of 27 February 1975 describes the organization of the General Delegation for Scientific and Technological Research.

According to the provisions of the decree, the General Delegation for Scientific and Technological Research was intended to assist the Prime Minister in formulating and implementing Government policy in scientific and technological research.

The General Delegation for Scientific and Technological Research had three directorates and a General Administrative Service:

— a Direction scientifique et technique (Science and Technology Directorate)
— a Direction d'assistance administrative et financière (Administrative and Financial Assistance Directorate)
— a Direction des relations extérieurs (External Relations Directorate) and
— a Service de l'administration générale et de l'équipement (General Administration and Means Service)

The Centre national de documentation (National Documentation Centre) was attached to the General Delegation for Scientific and Technological Research in 1977.

The General Delegation for Scientific and Technological Research became a Secretariat of State responsible for scientific research (SERST) attached to the Prime Minister's office on 9 April 1979.

The organization of SERST was spelt out in Decree No. 80-380 of 15 April 1980. According to this decree, SERST formulates and implements Government policy on scientific and technological research. Its triple role is to encourage, co-ordinate and oversee scientific and technological research, to ensure the effective utilization of the national scientific potential in the technological, economic, social and cultural development of the country. In addition to the secretariat of the Secretary of State, SERST performs its functions with the assistance of a number of technical and administrative services:

— La Direction de recherches agricoles et agro-industrielles—(DRAAI) (Directorate for Agricultural and Agro-industrial Research)
— La Direction de l'innovation et du progrès technique—(DIPT) (Directorate for Innovation and Technological Progress)
— La Direction des recherches médicales et pharmaceutiques—(DRMP) (Directorate for Medical and Pharmaceutical Research)
— La Direction des recherches en sciences sociales et humaines—(DRSSH) (Directorate for Social and Humanities Research)
— La Direction de synthèse (Co-ordination Directorate): La Direction des études, des projets et du plan—(DEPP) (Directorate for Studies, Projects and Planning)
— L'inspection des affaires administratives et financières (Inspectorate for Administrative and Financial Affairs)
— Le Service de l'administration générale et de l'équipement (General Administration and Means Service)
— Two associated services:
  • Le Centre national de documentation scientifique et technique (National Science and Technology Documentation Centre)
  • L'Institut sénégalais de normalisation (Senegalese Institute of Standards.

The various changes in the structure of the science and technology policy system since 1966 show the vitality of a constantly evolving organization seeking a better balance between economic development priorities and the political will for science and technology to serve this development. Senegalese science policy is initiated by SERST, which is in turn advised by the Advisory Commissions made up of researchers and development authorities, chosen for their scientific and technological competence. The proposals are then debated at governmental level by the CIRST.

Other governmental bodies which play a role in the formulation of national science and technology policy.

(a) *The role of the university*

The University of Dakar has extensive experience in training researchers and can play an important role in increasing Senegalese scientific potential.

As a centre for disseminating knowledge, it can help the national science and technology policy-making body in formulating and implementing research programmes and in the dissemination of scientific research results. It is represented on the consultative commissions to provide scientific and technical advice on the programmes to be submitted to the CIRST.

University lecturers constitute an important potential for scientific research because of their number and their level of scientific knowledge.

(b) *The role of private bodies*

These bodies play practically no role in the formulation of national science and technology policy which at present remains an area reserved for State decision.

D. Aims, scope, functions and responsibilities of the main science and technology policy-making body

1. *Official name of the organization:* Secrétariat d'état à la recherche scientifique et technique—SERST (Secretariat of State for Science and Technology Research).

2. *Postal Address:* Secrétariat d'état à la recherche scientifique et technique
B.P. 3218,
141, rue de Bayeux et Émile Zola
Dakar,
Senegal.

3. *Legal and administrative status:*

The Secretariat of State for Scientific and Technological Research (SERST) is a ministerial-level governmental body. Created on 9 April 1979, the Secretariat of State for Scientific and Technological Research was established by Decree No. 80-380 of 15 April 1980 and is attached to the Prime Minister's office.

4. *Aims and main functions of SERST*

The principal mission of the SERST is to formulate and implement government scientific and technological research policy.

The SERST's main function is to promote, co-ordinate and control scientific and technological research activities in order to ensure their effective participation in the national economic, social and cultural development effort.

The SERST is responsible for the planning, programming and budgeting for all scientific and technological research activities in Senegal.

(a) *Programming and Studies*

The SERST has formulated and implemented medium-term indicative plans intended as a basic framework for the programmes and research projects to be undertaken or pursued during a given period.

The First Indicative Plan which appeared covered the agricultural sector; this was followed by a Plan for agro-industry. A survey of the clients' requirements at regional level was undertaken in respect of each of these sectors.

The Indicative Plans concerning renewable energies, medical and pharmaceutical research are being prepared. Similar research plans are under consideration for industrial, mining and handicrafts research sectors. Work done in research programming has been very useful in the preparation of the Sixth National Economic and Social Development Plan.

(b) *Budgeting*

The research budget is the result of combining financial data concerning all scientific and technological research throughout the nation. The SERST sends a questionnaire to the different ministerial departments which make use of research and they, in turn, make known their research needs and the budget allocations they will make for research and development activities. The responses to these questions and the needs expressed by the research institutes allow the SERST to prepare the comprehensive budget which is presented to the CIRST.

(c) *Promoting, co-ordinating and control of science and technology research funtions*

The role of scientific and technological research promotion involves influencing research in order to initiate and orient research programmes on the one hand, and to increase the number of national researchers on the other, while at the same time facilitating their integration into national structures. This role also involves encouraging the State to protect and exploit the national heritage of inventions and discoveries, and to develop human and material resources for national research.

The co-ordinating and controlling roles involve all research activities and studies in progress throughout the nation.

They also involve defining objectives, establishing programmes, delineating the functions of each research institution or body, determining the stages of execution, distribution of grants, monitoring of the execution of programmes and ensuring that the decisions of the CIRST are implemented.

(d) *Implementation of scientific and technological activities*

In addition to the science and technology services which make up the technical directorates, the SERST undertakes its research programme by using the facilities available at the national laboratories, stations and research centres, including the laboratories of the University of Dakar and those of foreign institutions such as ORSTOM, the Pasteur Institute, etc.

In Senegal, scientific and technological research activities cover five major fields:

(i) *Agronomic research*

The Institut sénégalais de recherche agricole-ISRA (Senegalese Institute for Agricultural Research) undertakes work covering all aspects of agricultural research such as:
— Agronomy and bio-climatic research
— zootechnical and veterinary research
— forestry and hydro-biological research
— oceanographic and fisheries research.

(ii) *Food research*

Food research is undertaken by the Institut de technologie alimentaire (Institute of Food Technology). The research activities concern the use of local products, their processing and/or preservation. The programmes are primarily concerned with the processing of fish (including shellfish), meat, cereals and horticultural products, the aflatoxin problem, etc.

(iii) *Medical and pharmaceutical research*

Research in this field is conducted at the Faculty of Medicine and Pharmacy, in the University institutes, at the Ministry of Health, at the Pasteur Institute of Dakar and at ORSTOM.

(iv) *Social science research*

The Direction des recherches en sciences sociales et humaines (Directorate for Social and Human Sciences Research) was recently created (April 1980). The Indicative Plan for its research programmes is being prepared.

(v) *Energy research*

In this field, efforts are mainly concentrated on renewable energy research (biomass, solar energy, wind energy, etc.) and energy-saving (the perfection of a prototype of a household stove for saving fuel wood).

(e) *Advisory services to the Government*

The SERST advises the Government on the choice of technology for different development projects. This is the main function of the Direction de l'innovation et du progrès technique (Directorate for Innovation and Technological Progress) whose responsibilities are to:
— define and implement a policy on transfer of operative technologies by sector of activity,
— study the technical, economic, social and legal implications of innovations and technological progress.

(f) *Advocacy for science and technology*

The existence of a Comité interministériel pour la recherche scientifique et technologique (Interministerial Committee for Scientific and Technological Research—CIRST), facilitates the

advocacy by SERST of science and technology; the deliberations of the CIRST in which each ministry which uses research results advocates for its own research programmes and budget constitute the highest forum for defending the interests of the national scientific community.

E. Working methods of the Secretariat of State for Scientific and Technological Research

Senegalese science and technology policy is formulated by the SERST on the advice of its Consultative Commissions. It is then debated by the CIRST and thereafter approved by the Government.

The organization and functions of these various levels are as follows:

— the CIRST, the highest orientation and decision-making body for science and technology policy meets in annual session under the Chairmanship of the Prime Minister and examines proposals submitted to it by the SERST.
— Six Consultative Commissions made up of scientists and clients assist the SERST with suggestions and recommendations concerning:
  • Current activities, results obtained and their application to development;
  • proposed modifications: termination of projects, change of direction, new activities;
  • classification of these activities in terms of priority according to laid-down criteria;
  • necessary means for their implementation;
  • training, further training, refresher courses, and employment of research staff.

These commissions' responsibilities are linked with and correspond to the Directorates of the SERST which provide the commissions with secretarial services. The most important of these commissions are:

— Consultative Commission for Agricultural and Agro-industrial Research: Directorate for Agricultural and Agro-Industrial Research (DRAAI);
— Consultative Commission for Medical and Pharmaceutical Research: Directorate for Medical and Pharmaceutical Research.
— Consultative Commission for Technological and Industrial Research: Directorate for Innovation and Technological Progress (DITP).
— Consultative Commission for Social and Human Sciences Research (DRSSH).

Technical Committees are created for the different commissions to examine specific questions and prepare position papers on them for submission to the latter.

Special Regional Development Committees concerned with scientific and technological research examine at regional level the same problems which the consultative commissions consider at the national level. Meetings of these Regional Committees are prepared by working parties in each field covered by the national consultative commissions.

F. Co-operation with research establishments

Several types of links exist or are foreseen between the SERST and the research establishments.

1. The most direct links are located within the institutional framework of supervision which the Secretariat of State exercises in respect of certain bodies, in particular of the Senegalese Institute for Agricultural Research (ISRA) and the Institute for Food Technology (ITA).

2. The SERST participates or will be participating in the near future in the councils of public and para-statal bodies whose administrative supervision is the responsibility of other ministerial departments. Instructions have been given by the Prime Minister to the Minister for Higher Education (Letter no. 6756/PMSP of 5 August 1980) so that the SERST will be officially represented on the following bodies:

— the University Council as well as on its Research Commission,
— the Research Commissions of the various faculties,
— the Governing Boards and Scientific Councils of autonomous establishments within the University,
— the various Councils of University Institutes and faculty institutes partially or totally concerned with research.

Similar instructions have been given to all other ministries which supervise establishments undertaking research to ensure that the SERST is represented on the councils of these research bodies.

G. International science and technology research co-operation

Senegal's international co-operation in scientific and technological research takes place at two levels:

1. Bilateral co-operation with African countries.

This co-operation involves either the signature of bilateral agreements for the execution of joint programmes or the exchange of experts. This type of co-operation is practised in Senegal with many countries of the sub-region.

— *With Mali:* Co-operation is mainly in the field of agronomy and zootechnology research and involves the exchange of plant and animal samples as well as the results of laboratory analysis of certain agricultural products.
— *With Mauritania:* Co-operation is mainly in veterinary research (joint survey on trypanosomiasis in livestock in border regions) and zootechnological research (exchange of specimens for animal research—cattle, local races of ruminants).
— *With the Ivory Coast, Zaïre, Cameroon, Upper Volta, etc.:* Co-operation primarily involves the exchange of experts on the basis of technical co-operation agreements.

2. Co-operation with non-African countries

Senegal has the closest links of co-operation with France, among the European countries, in the field of scientific and technological research. This co-operation takes place within the framework of the Franco-Senegalese Convention of 1960, No. 12/C/60/A of 2 December 1960, in the fields of agricultural and oceanographic research.

This Convention assigned the National Research Centres to the relevant French Institutes specialized in tropical agricultural research. The Convention was revised on 17 January 1974.

— The new Convention covers all scientific and technological research.
— The Senegalese research centres and stations are now managed by Senegalese research institutions.
— French researchers working in Senegal are attached to research institutions in joint programmes, mainly undertaken with GERDAT Institutes.*

3. Co-operation with the United Nations system

The Case of Unesco

Between 1966 and 1977 efficient and continuous co-operation with Unesco enabled the foundation to be laid for the main national science and technology policy-making body. This co-operation continues and takes various forms according to the evolution of the structure and national requirements.

* Groupement d'Étude et de Recherche en agronomie tropicale.

The case of UNDP and of FAO

Several development projects have research components. Co-operation with UNDP takes place within the framework of its technical assistance projects, many of which are executed by the FAO.

Generally speaking, Senegal's international co-operation in science and technology is becoming progressively more diversified, both with industrialized countries (such as Belgium, Canada, the United Kingdom, the United States) and with developing countries (Brazil, India, Morocco, etc.).

H. Own resources of the main national science and technology policy-making body

1. Financial resources

(a) *The main sources of operating finance*

Analysis of the sources of finance of the national science and technology policy-making body of Senegal from the General Delegation for Scientific and Technological Research up to the SERST indicates that the bulk of the operating resources comes from the national budget.

(b) *Evolution*

Between 1974 and 1978, government grants to the SERST covered an average of 75% of the latter's total budget.

The operating budget of the SERST has progressively increased: 24.6% between 1974-75 and 1975-76 and 37.6% between 1975-76 and 1976-77; but this progression slowed down between 1977-78: 20.3% (see Table 4).

Table 4: Budget of the Secretariat of State for Scientific and Technological Research
(thousands of F.CFA)

Years	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Staff	27,871	38,338	54,682	83,415	110,560	148,299	131,903	152,640
Materials	20,841	20,330	25,266	31,745	48,396	51,906	51,906	44,906
Common headings	30,521	19,778	21,452	20,000	107,832	37,666	–	–(1)
Equipment budget	–	–	–	–	–	25,000	41,750	–
Total national budget	*79,233*	*78,446*	*101,400*	*135,160*	*266,788*	*262,871*	*225,559*	*197,546*
External sources	6,200	26,134	53,320	38,055	78,219	40,250	28,900	–(1)
Grand total	85,433	104,580	154,720	173,215	345,007	303,121	254,459	197,546

1) Not yet available

The growth of the body's operating budget continued after the creation of SERST and may be seen as follows (all sources combined):

	1978/79 F. CFA	1979/80 F. CFA	1980/81 F. CFA
SERST Operating budget (all sources combined)	158,956.000	215,925.000	183,809.000

Outside aid for scientific and technological research has tended to diversify and increase over the past two years because of measures taken by the SERST.

In addition to its own operating budget, the SERST receives considerable outside assistance for its research programmes; France is the main partner, particularly as regards financing of the research programmes undertaken by the Senegalese Institute for Agricultural Research (ISRA); France contributes about 85% of the budget of this institute.

The United States contributes both directly and indirectly through regional projects. Canada finances several research programmes at the National Centre for Agronomic Research at Bambey.

The Federal Republic of Germany supports the Institut sénégalais de normalisation—ISN (Senegalese Institute of Standards). Considerable assistance is provided by the European Development Fund (EDF), the World Bank, UNDP and Unesco, especially in the context of research programmes integrated into development projects.

2. Human resources

The Secretariat's staff has evolved in the following manner over the preceding budgetary periods, 1978-1979 and 1979-1980.

Staff has increased in number over two years by nearly 129%. This increase enables the creation of new structures and the enlargement of the Secretariat of State's field of action to new research areas beyond those covered by the erstwhile General Delegation for Scientific and Technological Research. There is a large proportion of professionals (40 to 43% of the total staff). (See Table 5)

3. Information resources

(a) *Survey of scientific and technological potential*

The first survey of the national scientific and technological potential was undertaken in 1972 prior to the creation of the General Delegation for Scientific and Technological Research.

Table 5. Staff of the Secretariat of SERST

Staff	On 30 June 1978	On 30 June 1980	Variation
Professional staff (including technical assistants)	21 (3)	51 (7)	+ 30 + 4
Secretaries	9	20	+ 11
Technical staff	5	16	+ 11
Service staff			
— drivers	9	17	+ 8
— messengers	2	8	+ 6
— caretakers	2	2	–
— switchboard operators	2	3	+ 1
— gardener	1	1	–
— roneo operator	1	1	–
Total	52	119	+ 67

The second survey was made in 1975. Information collected was computer analysed. The results were presented in a report entitled: "Analyse du potentiel scientifique et technique" (Analysis of Scientific and Technological potential) published in July 1976.

Later, a programme index system was prepared. To help the consultative commissions have an overall view of programmes and undertake a rapid sector analysis, the programme index system was computerized using the OSIRIS integrated system. Thus, both the inventory of the scientific and technological potential and the analysis of the programme index system were accomplished by using the OSIRIS system.

This computerized integrated system set up by an expert from Unesco has wide application in the statistical analysis of data with a list-type structure. This service was also made available to other agencies, such as the Ministries of Education, of the Interior and of Rural Development.

(b) *Bibliographic information:* Le Centre national de documentation scientifique et technique—CNDST (National Science and Technology Documentation Centre)

The SERST possesses a National Science and Technology Documentation Centre. This Centre was created in 1976 as part of a Unesco/UNDP project. Its main function is to co-ordinate and promote national scientific and technological informational activities.

The Centre works with an operating manual covering the entire range of data processing documentation. Sophisticated reproduction equipment including an offset printing machine, microfilm and microfiche material was received at the CNDST within the framework of the project SEN/74/003.

Among the achievements, the CNDST has processed 250 documents leading to the publication of a documentation index. At present, the centre possesses 7,000 to 8,000 documents obtained from various sources.

(c) *Equipment/facilities*

The SERST uses three buildings in Dakar, one privately-owned and two which are public property.

While this study was being undertaken, the SERST was in the process of moving into new premises on the Boulevard Pinet Laprade, whose garages and halls were converted into twelve additional offices.

Other arrangements are being made for housing the National Science and Technology Documentation Centre.

I. Links between the national science and technology policy-making body and its counterpart organs in sectoral ministries or government departments

The main function of the national science and technology policy-making body is to ensure:

— that applied research programmes contribute effectively to the solution of problems facing the socio-economic development of the nation and that fundamental research programmes contain elements which can have some impact on the country's development;

— that through constant dialogue a useful exchange of ideas occur within the scientific community on the one hand, and between scientists and research clients on the other.

To facilitate the performance of the above tasks, bodies have been created to ensure close links between the SERST and the user Ministries. These are:

— the Conseil interministériel de la recherche scientifique et technique—CIRST (Interministerial Council for Science and Technology Research), composed of ministries which are users of research results,

— the Commissions consultatives (Consultative Commissions) of the CIRST corresponding to research fields, which bring together researchers and development authorities,

— the Comités techniques (Technical Committees) made up of specialists.

Links are maintained at the various levels to ensure liaison between SERST and the sectoral ministries.

These links ensure an effective flow of scientific information, and enable clients to familiarize themselves with various research programmes so as to be able to express views on them in relation to the problems with which they are confronted in their development tasks. The system also allows researchers to bring their activities more in line with the realities in the field.

J. Dynamic assessment of the performance of the national science and technology policy-making body

Two recent inventories of the national scientific and technological potential give a relatively recent picture of the science and technology research situation in Senegal.

The first was made in 1972 under the auspices of the Centre national de planification scientifique et technologique (National Science and Technology Planning Centre) aided by Unesco.

The second was undertaken in 1975 within the framework of the project SEN/74/003 executed by Unesco with UNDP financing.

No exhaustive inventory has been made since that date.

These inventories and various complementary studies have shown that Senegal possesses one of the most developed scientific and technological potentials in Western Africa and that the development of this potential has been constantly supported by the governmental authorities of the country.

Since the country's independence, President Senghor has reaffirmed his concern to see Senegal reach the stage of modern development with the help of the most appropriate scientific tools.

In particular he declared:

"And there can be no progress in development without innovation, without invention and thus without research".

This affirmation did not remain a mere academic reflection but was transformed into a political will to endow the country with a national scientific and technological research capacity and to accept the financial sacrifices involved.

1. The impact on economic development

A Sahelian country, 80% rural, Senegal's major development objective is to develop its agriculture in order to achieve food self-sufficiency. This option has entailed giving the greatest weight to agronomic research in the national scientific and technological development process.

Nevertheless, the other sectors, such as renewable energy research, medical research and social and humanities research, are also the subject of close attention by the Senegalese authorities.

But the most noticeable results with a direct impact on the socio-economic development of the country have been achieved in the agricultural sector.

(a) *Agronomy research results at present transferable to development*

In the area of agronomic research, tangible resuls are at present available for dissemination; they are concerned with:

— the genetic improvement of the main crops and the breeding of varieties with high-yielding potential and which are adapted to the different regions of Senegal (groundnut, sorghum, millet, sugarcane, cotton, etc.). In a controlled environment, the yield of these crops are at least five-fold;

— farming techniques: better understanding of the natural environment, of bioclimatology and the land have resulted in the improvement of farming techniques which allow substantial saving of water and rational use of chemical fertilizers, for example the improvement of the soil
— Plant protection and crop storage should reduce loss due to various causes by 30 to 40%.
— In the area of animal husbandry, the Laboratoire national de recherche vétérinaire (LNRV) of Dakar-Hann produces annually 20 million doses of animal vaccine which are exported throughout Western Africa. The activities of this laboratory have had significant impact on animal production in Senegal by improving the physical characteristics of livestock and conditions of production which are economically and socially more profitable.

Experiments in fodder production on the Sangal Kam Experimental Farm have shown that it is possible to produce cows capable of producing 30 litres of milk per day.

In the area of forestry research, tree species with rapid growth rates have been found, offering a partial solution to the reafforestation problems and the fight against desertification; solutions are also being found for the serious problem of fuel wood shortage in the area.

The Centre national de recherche forestière—CNRF (National Forestry Research Centre), of Senegal estimates that one hectare of eucalyptus yields as much wood as fifty hectares of natural forest in the Sahelian region.

(b) *Medical and traditional pharmacopoeia research*

Less spectacular results have been obtained in medical research in the areas of hygiene and nutrition, such as the early detection of malnutrition, infectious and parasitic diseases, etc.

Efforts are being made to make the best possible use of the natural medicinal substances available in Senegal.

(c) *Renewable energy research*

At the Centre d'étude et de recherche en énergies renouvelables—CERER (Centre for the Study and Research on Renewable Energies), research has been extended to the field involving the testing of prototypes and pilot operations. The Centre has just perfected prototypes of household stoves which allow housewives to economize on fuel wood by about 40%.

The Centre is undertaking appropriate steps to distribute these stoves.

Efforts have been made in fields such as the pumping of water, food preservation and electricity production in rural areas. The following experimental projects have begun:
— At Diakhao, electricity is produced by a solar heating station with a capacity of 25kW in order to eventually provide water and electricity for the village.
— At Bakel, a thermodynamical process is applied to pumping water from the river to irrigate the immediate area converted by the SAED and to produce electricity at a station with a capacity of 30kW.

(d) *Industrial production*

To strengthen the links between research and its applications, the Government of Senegal created in 1976 the Société industrielle des applications de l'énergie solaire (SINAES) which has already started its first experimental pilot projects. It will pass to the industrialization phase after the construction at Thies of a plant for solar equipment and will also be responsible for the maintenance of all existing solar energy stations.

(e) *Food technology*

The research results obtained by the Institut de technologie alimentaire—ITA (Food Technology Institute) will henceforth enable bread to be made from local cereals; the method will help reduce the importation of wheat the price of which is constantly rising.

2. Impact on the development of the national science potential

(a) *Evolution of the science and technology policy-making body*

The Senegalese Government has, since independence, committed itself to giving priority attention to the organization and creation of a national science and technology policy-making body. The progressive and continuous development of the Senegalese science potential is an outcome of real political will favoured by the historical development of the country.

As early as 1966, with Unesco's support, a Conseil interministériel de recherche scientifique et technique (Interministerial Council for Scientific and Technological Research) and a Bureau des affaires scientifiques et techniques—BAST (Office of Science and Technology) attached to the Presidency of the Republic were created.

In April 1970, BAST became the Direction des affaires scientifiques et techniques (Directorate for Scientific and Technological Affairs) and was transferred to the State Planning Secretariat.

Three years later (1973), the General Delegation for Scientific and Technological Research (DGRST) was created and attached to the Prime Minister's Office. Six years later, in 1979, it became the SERST. This progressive evolution of the science policy-making body is proof both of the internal dynamism of the system, and of the desire of Sengalese authorities to endow the country with a conceptual and organizational instrument for science and technology policy adapted to the socio-economic and cultural realities of the country.

(b) *Evolution of means*

The evolution of the science and technology policy-making body has been matched progressively by State resources; the budgetary changes accompanying each transformation of the science and technology policy-making body indicate the political will of the Senegalese authorities to endow the country with a body responsible for science policy, conscious of the importance of research and development in the national development process.

In 1971-72, the budget of the Directorate for Scientific and Technological Affairs amounted to barely 6 million F. CFA. Two years later, after the creation of the General Delegation for Scientific and Technological Research, this budget rose to over 84 million F. CFA, to 104 million F. CFA in 1975-76 and 144 million F. CFA in 1976-77.

In 1979-80, the operating budget of the SERST amounted to 215 million F. CFA. At the national level, it was estimated that, in 1975, 0.44% of the GDP (calculated on national resources only) was devoted to scientific and technological research. This figure becomes 1.3% (of GDP) if all financial resources for science and technology in that year are taken into consideration.

(c) *Development of the human scientific potential*

The most recent survey of the national scientific and technological potential shows that 661 persons devote a large part of their time to research. This time varies between 100% for the staff of the institutes to virtually 0% for certain lecturers/researchers.

In 1975, the distribution of the 661 researchers was as follows:
— 480 lecturers/researchers of the University;
— 181 researchers outside the University;

By nationality this distribution is approximately the following:

Senegalese nationals: 30%
French: 58%
Other nationals: 12%

In 1972, 20% of researchers were Senegalese nationals. The increase was greatest in agricultural research; this category of personnel rose from 14% to 34% between 1972 and 1975, representing an average growth rate of 6% per year.

Decree No. 80-989 of 3 October 1980 has recently been adopted concerning the status of research personnel. It has not yet been applied with respect to the material advantages it provides for this category of staff.

3. Obstacles and difficulties encountered

The difficulties encountered by the national science and technology policy-making body during its evolution are of three types:

(a) *Institutional and organizational difficulties*

This first category of difficulties is inherent in any undertaking which lacks experienced professional staff for its operation. The different changes as well as the various hierarchical modifications—at one time to the Presidency (1966-1970), later to the Prime Minister (1971-1973), or to the Minister of Planning (April 1973) and again to the Prime Minister (December 1973)—indicate the authorities' concern about the best location for science and technology within the governmental setup. It is important to note in this process and search for the best structure to adopt for the science and technology policy-making body that there has been a qualitative development of the body since 1966. Each stage reflected a degree of maturity consonant both with the level of economic, social and cultural development reached by the country, and with the available human potential.

This caution possibly allowed Senegal to avoid errors such as those encountered by other African countries, in which the national structure of science policy regressed—sometimes to a point of no return—following the failure of its own operating mechanism.

(b) *Material and financial difficulties*

Until 1972, the operating budget of the national science and technology policy-making body was scarcely 6 million F. CFA. This situation did not allow for its swift development, but was remedied very rapidly after December 1973 with the creation of the General Delegation for Scientific and Technological Research. The considerable effort made since that time continues and the SERST receives at present adequate operating funds.

But Senegalese scientific and technological research is still heavily dependent on outside resources (nearly 30% of its operating budget for the implementation of its research programmes comes from foreign sources). This situation is not reassuring for the continuous development of the national science and technology potential. The authorities should be aware of this weakness and allocate more local funds to this vital structure of the national economy.

(c) *Difficulties in increasing the human potential*

The last survey of the human resources potential for science and technology research (1975) showed that only 30% of research personnel was Senegalese. Such a situation cannot effectively contribute to making scientific and technological knowledge part of the national heritage, capable of reaching the different social groups, as well as acting as a catalyst for economic development. Only to the extent that nationals undertake the stocktaking and systematization of scientific and technological knowledge can the expected benefits of the latter for development be operationally ensured. Technical assistance may be used to achieve this objective.

Favourable conditions for recruiting national researchers should be created. Appropriate training opportunities and the offer of more favourable working conditions should be used to attract them (application of the status for researchers already prepared).

4. Future prospects

At the present stage of development, Senegal possesses a functional science and technology policy-making body capable of formulating and effectively implementing a national science and technology policy.

The national body has institutes to execute scientific and technological research under its direction and an adapted research programming system which also covers the research institutes under the direction of other ministries.

The Interministerial Council for Scientific Research (CIRST), the deliberating and decision-taking body with respect to science and technology policy, is functional and meets annually to take all decisions likely to contribute to the improvement of the conditions necessary for the development of the national scientific potential. Moreover, the national science and technology policy-making body of Senegal enjoys the continuous support of Unesco.

Finally, there is a real political will in Senegal to make science and technology instruments of development. All these advantages provide encouraging prospects for scientific and technological development in Senegal.

However, a number of problems, of which the national authorities are perfectly aware, need to be resolved. These include:

1. The closer association of the scientific potential of the University with national scientific and technological research. The University possesses more than half the human potential capable of conducting research programmes, but due to lack of means, this potential is under-employed; conciousness of this situation must be increased in order to remedy it.
2. *The national human resources:* ISRA has the greatest number of national scientific researchers (60% Senegalese nationals in 1980). The national average appears to fluctuate at present around 40% Senegalese nationals for the entire scientific research sector. The objective of the Sixth Plan is to raise the proportion of Senegalese in scientific research to 75%.
3. *Material and financial resources:* The public authorities make considerable efforts to finance research. The Sixth Plan devotes 11 billion F. CFA to science and technology research (1979-84).

Nevertheless, research remains highly dependent on outside resources. 30% of scientific and technological research expenditure comes from abroad. The Government should redouble the effort which it has already made if it wishes to ensure the reliability and continuity of its ongoing research programmes.

4. *Inventory of the national science and technology potential:* The last exhaustive inventory dates from 1975. An up-to-date inventory is urgently needed: the lack of it would deprive the SERST of the necessary factual data for planning the development of the national science and technological system. This will also deprive it of the means of controlling the implementation of the policies, plans and programmes of which it is the prime contractor.

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Sierra Leone

A. Geopolitical and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* Situated on the Atlantic Coast of West Africa, Sierra Leone is bordered on the north-west to north-east by Guinea and on the south-east by Liberia.
2. *Area:* 71,740 sq. km
3. *Population (1979):* 3,400,000 (projected to reach 6 million by 2000).*
4. *Average annual rate of population growth (1970-1979):* 2.5%.*
5. *Date of independence:* 19 April 1961.

II. ECONOMIC INDICATORS

1. GNP per capita (1977): 243 Leones
2. External trade:
   Export (1977): 162 million Leones
   Import (1977): 246 million Leones
3. Currency: Leone (4.12 FF in 1977)

III. NATURAL RESOURCES

1. Mineral resources

Sierra Leone is well-endowed with natural resources. There are substantial deposits of minerals such as diamonds, iron ore, bauxite, platinum and rutile—all of which are presently exploited and exported in their raw state. The government has issued licences to entrepreneurs prospecting for gold, and recent preliminary investigations indicate availability of off-shore oil.

But the mining sector (especially diamonds and iron ore) occupies a dominant position, usually accounting for some 60% of total earnings from exports.

The sector has diversified recently with the introduction of largescale bauxite mining and attempts to commercialize rutile deposits.

2. Agricultural resources

The economy of Sierra Leone is predominantly agricultural. Some 80-85% of the active labour force is engaged in the sector and the country's principal agricultural exports include palm kernel, coffee and cocoa. The country also has abundant water, forest, wildlife and fish resources.

IV. INDUSTRIALIZATION AND PROBLEMS OF DEVELOPMENT IN SIERRA LEONE

The modest industrialization effort consists mainly of light industries requiring the importation of most or all of their raw materials and technical management and those of the building and construction sector. In both cases, value-added is very low since most of the inputs are imported. Investment in the industrial sector remains at a low level and the limited indigenization policy has not stimulated any striking response on the part of indigenous entrepreneurs. Of particular significance to this study is the fact that the sector is mostly based on imported and often inappropriate technology.

The greater part of the modern sector of the economy including most of the mining sector, the manufacturing sector and the organized retail and wholesale sector are under foreign ownership, management and control. In fact, one particularly striking feature of Sierra Leone's economy is its almost total dependence on foreign capital, technology, entrepreneurship and technical management manpower, even twenty years after political independence.

According to the country's only Development Plan since independence, even as at 1974, "the essentially dualistic economic structure...has remained virtually unchanged with a high productivity exports enclave mining sector coexisting alongside a low-productivity semi-subsistence agricultural sector. This lack of integration in the economic structure has accentuated rural out-migration and increased urban unemployment, inequality of income distribution and price inflation".**

The challenge of development in Sierra Leone is, therefore, to raise the autonomous productive capacity of the economy, especially in agriculture and agro-based industrialization, to bring about a higher level of economic and financial self-reliance and self-sufficiency and to raise the standard of living of the masses. The 1974/75-1978/79 Plan attempted to address this challenge by placing its emphasis on the following:

— expansion of agricultural output, especially food production,
— expansion of manufacturing in absolute terms and as a share of GDP with a strong concern for maximizing the use of local resources,
— development and diversification of the mining sector (higher export earnings, higher national participation and the establishment of mineral processing industries),
— development of infrastructural facilities and social services, with a strong emphasis on the rural sector.

B. The place of science and technology within the national development plan

I. MAIN DEVELOPMENT OBJECTIVES

The Plan deals with "Development Strategy, Objectives and Policies" and explores problems of the development of agriculture and industry, of import structure and export potential. Essentially, the same set of development priorities noted above is being proposed for adoption for the next plan period (1981/82-1985/86).

II. PLACE OF SCIENCE AND TECHNOLOGY WITHIN THE PLAN

There is no specific mention of science and technology policy and no indication of efforts to determine or plan for S & T implications of the various objectives in the first plan 1974/75-1978/79. The need to evolve national S & T policy appropriate to development priorities and to plan the implementation of such policy, as part of the national planning process, is well recognized in the preliminary document on the 1981/82-1985/86 Plan.***

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* World Bank: Accelerated Development in Sub-saharan Africa: An Agenda for Action, Washington D.C., 1981, Table 33 of the Statistical Annex.

** Draft Memorandum, "Development Strategy for Sierra Leone during the Second Plan Period", Ministry of Development and Economic Planning, April 1981.

*** Sierra Leone Government: National Development Plan, 1974/75-1978/79, Ministry of Development and Economic Planning, Central Planning Unit, Freetown, August 1974, p. 1.

For, *inter alia,* it is proposed in that document that a "National Body on Science and Technology Development" be set up "to assist in formulating integrated science and technology policies which are consonant with the national development priorities", to identify the demand for technological skills and recommend suitable training programmes and, generally to promote the training of scientific and technological manpower and the advancement of national scientific and technological capacity. In effect, the first concrete attempt to work out and co-ordinate S & T programmes in the context of national development planning is awaiting the establishment of a national S & T policy-making machinery, the long-delayed evolution of which is considered in the next section.

C. The structure of the national scientific and technological system

There has been, for a long time, a general recognition by the Sierra Leone Government of the need to apply science and technology for national development. There has also been protracted official interest in establishing a suitable S & T policy-making machinery for the country. But the fact is that, as Sierra Leone's national paper to the 1979 Vienna Conference puts it, "What makes the situation in Sierra Leone particularly critical is that a statutory machinery, a focal point, for the formulation of scientific and technological policy has yet to emerge from the stage of conception to that of concrete reality".*

There have been several initiatives to determine the nature of a suitable institutional S & T policy-making machinery for Sierra Leone. The Education Review of 1974 proposed a Science Research Council for the country. Subsequently, there were two commissioned studies on the subject. In October, 1976, at the request of the Sierra Leone Government, Unesco sent Mr Graham Jones, there on a 6-week mission (14 September-30 October 1976).

That mission held discussions with the Ministries of Finance, Development and Economic Planning, Education, Social Welfare and Rural Development, with one research institute and with relevant departments at both Fourah Bay College and Njala University College. It undertook an assessment of "the country's institutional potential in the field of science and technology" with a view to advising the government "of possibilities of defining a national science and technology policy as an integral part of the overall development policy" and designing institutional mechanisms appropriate to Sierra Leone to allow the government to deal with scientific and technological questions at a national level in a systematic and rational manner and to mobilize existing scientific and technical manpower into this process. The mission explores, specifically, the idea of a "National Council for Science and Technology for Sierra Leone".**

The main recommendations of the Unesco/Graham Jones study mission were as follow:

— The immediate establishment of "a broad-based governmental Advisory Committee with wide-ranging responsibilities in the field of national scientific and technological development" (Recommendation No. 4 p. 30) which should serve as "an embryonic version of the eventual Council".
— The eventual establishment (after an unspecified interval) of a "National Council on Science and Technology, served by a small but well-qualified secretariat and supported by *ad hoc* specialist committees in selected fields" (Recommendation No. 6, p. 31).
— The Chairmen of the *ad hoc* Committees should sit on the Council whose secretariat should be located at the office of the Minister of Finance Development and Economic Planning who, at that time, was also the country's Vice-President.
— Membership on the Council and the *ad hoc* Committees was to be "honorary".

The other commissioned study, undertaken at the request of the Sierra Leone government by the UN Economic Commission for Africa (ECA), was a follow-up to the UN Conference on Science and Technology for Development (Vienna, 1979) at which Sierra Leone presented a paper. The mission of Dr Fayi Elliot of ECA, was originally "to study the feasibility of establishing a National Body on Science and Technology for Development".

According to the mission report, on his arrival, Dr Elliot was asked "to assist the Sierra Leone Government in the preparation of a final study on the organizational and financial structure of the National Council on Science and Technology***. At the conclusion of the one-week mission (16-23 August 1980), Dr Elliot recommend, *inter-alia,* the establishment of "The Science and Technology Development Commission" with "financial and administrative autonomy legally conferred on it by Parliament but with effective links to the Central Planning Unit of the Ministry of Development and Economic Planning".

The financial stability of the Commission was to be assured through regular annual budgetary appropriations, through its revenue-earning activities and through such external resources as may accrue to it within government approved frameworks. The Commission will, *inter alia,* be responsible for the formulation of integrated S & T policies in consonance with national development priorities, the co-ordination of national S & T efforts and activities, including external relations, rationalization of the acquisition and adaptation of foreign technology, promotion of the national climate for invention and innovation, monitoring of national S & T potential and capacity, and the development of the STS sector in the country. A three-tier structure was proposed for the Commission by Dr Elliot.

The National Committee on Science and Technology established in March 1978 to assist the government in preparing the national paper for the 1979 Vienna Conference still stands and has met several times to determine what recommendations it would make to government, using the UN/ECA-Elliot mission as a basis. The thinking of the Committee regarding the status and structure of an S & T policy-making body in Sierra Leone is contained in the guidelines it gave to UN/ECA-Elliot mission.†

According to the Ministry of Development and Economic Planning Official who is handling this subject, the National Committee has already completed its study of the recommendations and introduced a number of modifications. A cabinet paper has also been submitted on the subject and the creation of the Council is awaiting the reaction of the government and the response of the international source of funding is being explored. Meanwhile, there is an allocation in the 1981-82 Budget for preliminary work on the S & T Council.

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* United Nations: National Paper Submitted by Sierra Leone to the UN Conference on Science and Technology for Development, Vienna, Austria, August 1979. UN Document A/CONF.81/NP 88, P. 4.

** Unesco, "Science and Technology Policy Machinery" by Graham Jones, report prepared for the Government of Sierra Leone by Unesco, p. 38, including appendix.

*** See pp. 2-3 of UN/ECA; "Proposals for the establishment of a Science and Technology Development Commission in Sierra Leone, Report prepared by Dr Fayi Elliot, 1980.

† "Guidelines on Measures for setting up a Science and Technology Council in Sierra Leone" prepared by the National Committee on Science and Technology, July 1980.

D. Aims, scope and functions of the national science and technology-making machinery

As already noted, Sierra Leone does not yet have a specific S & T policy-making body as such. What exists and, the working and general impact of which are being considered in this section, is an amorphous system whose unco-ordinated components have had some bearing on science and technology in the country, especially since independence.*

In general, S & T activities in Sierra Leone, though uncoordinated seem to have been addressed to four principal objectives:

— training of S & T manpower,
— development of S & T knowledge through research and experimental development,
— survey and determination of the country's natural resources and implied development potential, and
— agricultural expansion through S & T addressed to production of high-yielding varieties of crops, disease control, storage and the improvement of agricultural techniques and practice.

The projects in pursuit of these objectives have been mostly concentrated on the agricultural sector and have been well summarized in Sierra Leone's national paper to the 1979 Vienna Conference. These projects include an intensive rice and vegetable production programme, the Gambia-Mattru Oil Palm Project, integrated agricultural development projects, the World Food Programme Inland Swamp project, sugarcane project and fruit canning project.

The Rokupr Rice Research Project expanded its activities in applied research, training and extension work to increase productivity of rice-farms and to stimulate farmers in the acceptance of better methods of farming. A land resources survey project was initiated, and has completed aerial photographic mapping of the country and is progressing with oil survey and land capability classification. Land reclamation work is being undertaken in the seed multiplication project, and an adaptive crop research and extension programme is planned by the Ministry of Agriculture and Natural Resources, Njala University College and USAID.**

Not much research and development work is being done on industrial problems, not even in such areas as food processing, agro-based industry, low-cost housing, building materials, pharmaceuticals and drug development, etc.

The principal institutions concerned with scientific research and experimental development include:

— Ministry of Agriculture and Natural Resources (Agricultural Division—Animal Husbandry Station; Veterinary Research Laboratory; Forestry Division; Fisheries Division);
— Rice Research Station, Rokupr (in collaboration with the West African Rice Development Association, WARDA);
— University of Sierra Leone (Fourah Bay College in the basic and applied sciences and Njala University College in agriculture particularly)
— Some other ministries (especially, Mines and Lands, Trade and Industry, Transport and Communication, Health and Energy and Power):
— Professional associations.

E. Resources of the science and technology policy machinery

The resources available to S & T activities have also been limited to what was available for science education, training and research, within the appropriations to these institutions, excluding professional associations. These resources have been meagre by almost any standard and, particularly, when related to the enormous needs of Sierra Leone for S & T development, though their magnitude remains hard to determine.

F. Impact of the national science and technology policy-making machinery

The impact on economic and social development of what S & T activities there have been in Sierra Leone during this period (since 1961) has been very limited. Such activities were almost entirely addressed to the agricultural sector but there has not been any definitive gains in that sector; if anything, there has been a decline in both agricultural productivity and output—and a high and increasing, though unknown, proportion of the country's foreign exchange earnings goes to the importation of food and raw materials for the infant industrial sector.

Several problems account for the limited development of S & T in Sierra Leone and for the limited impact which S & T activities have had on the country's economic and social development. It would appear that the most important of them have been:

— the absence of a consistent development strategy and of overall planning, at least until 1974,
— the absence of a national organ for the formulation of S & T policy,
— shortage of high-level scientific and technological manpower,
— acute lack of data for policy formulation and planning in all sectors,
— inadequacy of the existing science-education system (curriculum, courses, orientation, institutions and resources),
— dependency-increasing import-consumption patterns,
— ineffective arrangement for tapping the potential benefits of international co-operation in a co-ordinated and systematic way, and
— predominance of foreign firms at the centre of industrial development activity.

Notwithstanding these present problems, however, the prospects for development of Sierra Leone's S & T potential seem bright. The recent reviews of the situation have identified most of the major obstacles; there is definite official concern that there has been too much foot-dragging in this matter and that there is need for some decisive concrete action.

Most critical of the measures now in the pipeline is the establishment of a national S & T policy-making organ which the Sierra Leone national paper for UNCSTD aptly calls "the institutional brain of the whole system, co-ordinating and controlling all scientific activities". Ideally, such a body will have planning, programming, promotional and evaluation functions. It will also develop and co-ordinate the work of a system of research institutes and R & D establishments and liaise with the educational system in respect of S & T education and training.

Once created and suitably endowed, that organ will work out even more effective solutions to the other problems.

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* The information supplied here has been distilled from various sources dealing with recent and current efforts to promote the development of S & T and their application in development.

** Sierra Leone UNCSTD National Paper, *op. cit.* p. 6.

Togo

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Republic of Togo is situated on the Gulf of Guinea. From its 51 km Atlantic coastline it extends northwards for about 600 km between Ghana to the west and Benin to the east to its boundary with Upper Volta in the northern savannah.

Date of Independence: 27 April 1960

2. *Area:* 56 600 sq. km
3. *Population (1980):* 2,560,000
4. *Average rate of population growth per annum (1970-79):* 2.4%*
5. *Rural population:* 80%

II. ECONOMIC INDICATORS

1. GNP (1980): 260,000 million F. CFA
2. External trade:
   — Exports: 24,910 million F. CFA (1976)
   — Imports: 44,420 million F. CFA (1976)
3. Rate of school attendance: 63.7%

III. NATURAL RESOURCES

1. Relief and drainage

Togo consists of a plain in the south and some fairly high hills in the centre. The highest areas are found in the Atakora ranges in the north. There is a 50 km coconut belt along the coast. There are two river basins:

— the Oti river in the north, with its source in the Atakora ranges, runs through 300 km of Togo territory;
— the Mono river (500 km) is in the south.

The Lome port is one of the most efficient ports in West Africa and operates on a 24-hour basis also serving Togo's land-locked neighbours—Niger, Upper Volta and Mali.

2. Mineral resources

The main mineral resource of Togo is phosphate. In fact, the Akoupane phosphate deposit is one of the three largest in the world. There is the likelihood that Togo may have iron ore and even uranium.

3. Agricultural resources

Well over 80% of the population live in the rural areas and derive their livehood from agriculture, including animal husbandry. The country has fertile land. Crops cultivated include cocoa, coffee, cotton, millet, sorghum, rice, a variety of fruits, and vegetables.

The primary sector of the economy which, according to the 1981-85 Plan, accounted for some 28.1% of GDP in 1980, is dominated by agriculture. Even then, agricultural productivity has remained low and methods of production have remained mostly traditional.

IV. INDUSTRIALIZATION AND PROBLEMS OF DEVELOPMENT

The secondary sector is dominated by mining and manufacturing activities, the latter in the following industries: food processing, beverages, textile and garment, non-metallic minerals, metal-works and chemical industries.

The economy has experienced considerable growth since 1966. For example, GDP has risen from 53,000 million F. CFA to 260,000 million F. CFA between 1966 and 1980, a 390% increase. But, at the same time, the performance of the agricultural sector has been disappointing, the country has become even more dependent on imports, not only for capital goods but for a wide variety of consumer items, including food items. Accordingly, measures in the 1981-85 Plan include those aimed at expanding production in agriculture and manufacturing, with a view to establishing a more self-reliant economy.

V. POLITICAL SYSTEM

The government now in power is a military, presidential one with a one party system. There is a parliament.

B. The place of S & T within the national development plan

I. MAIN OBJECTIVES OF THE NATIONAL DEVELOPMENT PLAN

The Republic of Togo has had four Five-Year Economic Development Plans since 1965. The main priority objectives of the current one (1984-85) can be summarized as follows:

— rural development (including agricultural development)
— industrial development,
— mineral and energy development,
— public health development,
— development of communication infrastructure, and
— development of cultural and tourist resources.**

The above are the objectives to which planning is being addressed and the ends to which appropriate S & T development policy must be related.

II. PLACE OF SCIENCE AND TECHNOLOGY WITHIN THE DEVELOPMENT PLAN

The concern of the government of Togo in the domain of scientific and technological research has been to promote appropriate research and to ensure its effective utilization in such a way as to accelerate the country's economic and social development. This concern dates back to 1965 when the National Institute of Scientific Research (INRS) was created.

Research in agriculture and in the extractive industries received notable attention in the country's second quinquennial plan. Similarly, in the third quinquennial plan (1976-1980), which emphasized the objective of economic self-reliance even more strongly, clear recognition is given to the need to develop science and technology potential, as a basis for agricultural modernization.***

The fourth quinquennial plan (1981-85) continues the emphasis on agricultural modernization and includes projects to enhance agricultural productivity and output and to expand the agro-industrial sector.

The critical role which S & T must play in the pursuit of these objectives is obvious. Yet, there had been no attempt to formulate any systematic national S & T policy as an integral part of overall national development policy or, prior to 1979, to link up technological research with development activity in various sectors.†

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* World Bank: Accelerated Development in Sub-Saharan Africa: An Agenda for Action. Washingtron DC, 1981, Table 33 of the Statistical Annex.

** Plan de développement économique et social (1981-1985), pp. 33-36.

*** See particularly Plan de développement économique et social, 1976-80, p. 188.

The inter-ministerial Committee (Comité interministériel de recherche pluridisciplinaire de technologie appliquée) was set up in September 1979 to advise government on the development of technological research and development, including transfer of technology processes and problems.

As at the time of this study, no further steps seem to have been taken towards establishing a framework to devise a comprehensive national S & T policy or to integrate such policy with overall national development strategy. Togo is one clear case in which the need to train a cadre of science/technology policy administrators is very urgent.

C. The national S & T policy-making machinery: evolution and present structure

The National Institute of Scientific Research (INRS), the body which, in law, is charged with the responsibility of co-ordinating all scientific research being done in Togo ("le rôle de la co-ordination") was established in March 1965. This was done within the context of the country's first quinquennial plan (Decree 65-48 of 18 March 1965) and the institute was placed under the direct authority of the Head of State. For purposes of administration, INRS was originally made a part of the Ministry of Youth, Sports, Culture and Scientific Research. Subsequently, in 1979, it was reassigned to the Ministry of National Education.* In spite of efforts so far made, the co-ordination of S & T in Togo is far from being operational.

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body

1. *Official designation:* Institut national de recherche scientifique (INRS)
2. *Postal address:* Place des Nations Unies,
   B.P. 2240
   Lomé, Togo
3. *Legal and administrative status:*

In law, INRS is responsible for co-ordinating all scientific research in Togo. The institute consists of the following:

- Bureau of Exact Sciences and Technology, with 2 sections:**
  - — African Medicine (medical plants)
  - — Geophysics (energy, water, minerals, etc.)
- Bureau of Human and Social Sciences, with 4 sections:
  - — Demography (fertility, family planning, cultural values and demography)
  - — Ethnology (religion, divination, magic, philosophy)
  - — Sociology and Socio-economics (authenticity and ideology, mental illness, women, education, etc.)
  - — Linguistics (national languages).

In its 1980 report, INRS lists 25 agencies with which it collaborates. These include:

- African Cultural Institute, Lomé
- University of Benin, Lomé
- Bureau of Applied Nutrition, Lomé
- Bureau of Agriculture, Lomé
- Togopharma Laboratory, Lomé
- National Institute of Hygiene, Lomé
- National Bureau of Mineral Research, Lomé
- Centre for Construction and Housing, Lomé
- Directorate of Agronomic Research
- General Directorate of Planning, Lomé
- University Bureau of Statistics, Lomé
- Project for the Development of Forest Resources, Lomé.

Most of these agencies participate, through their own programmes, in determining what now goes on in the form of S & T activity in Togo. But such activities do not derive from any national S & T policy as such and are not subject to any systematic co-ordination at the national level. Though INRS is, in law, responsible for such co-ordination, in fact, it has not been discharging that responsibility nor does it seem equipped even now to discharge it.

E. The resources of the main national S & T policy-making body

The table below shows the professional staff position of INRS as at 1980 and 1981.

Staff situation, INRS, 1980/81***

Departments	1980	1981
Geophysics	1	1
African medicine	1	1
Demography	1	1
Ethnology	0	2
Sociology	8	5
Linguistics	3	1
Total (professional)	14	11

For each year (1980,1981), the support staff (administrative/account/secretarial/clerical) numbered 18. For an institute which is expected to continue its own usual activities as an executing research organization and, in addition, to co-ordinate scientific research in all other fields, this establishment is clearly inadequate.

It is also of particular significance that there were no resources provided to enable the institute to carry out the specific function of co-ordination in relation to other research agencies of the country.

F. Linkages of the national science and technology policy-making body with its counterpart organs in sectorial ministries or government departments

Another important component of the S & T machinery of Togo is the Interministerial Committee. It was set up in September 1979, jointly by the Ministry of Planning, Industrial Development and Administrative Reform and the Ministry of National Education and Scientific Research. Its specific function is the co-ordination of R & D and the devising of a more permanent institutional arrangement for continuing that function. There is some link between INRS and the Interministerial Committee, in that the Director-General of INRS sits on the Committee. However, it is significant that he, like the Director of the Directorate of Scientific Research (at the ministry) sits on the Committee not *ex officio* but *ad personam.*

The Committee has a very broadly-based membership, drawn from the two sponsoring ministries, from the School of Sciences†, the Institute of Nutrition, INRS, the Chamber of Commerce, etc. Its deliberations during the last two years have led to

* For detail see Ministère de l'enseignement des 3e et 4e degré et de la recherche scientifique—rapport d'activité, INRS, Lomé, 1980.

** It was indicated that, though these divisions are being used, they are still subject to approval and ratification by the Minister.

*** 1980 figures derived from "Rapport d'activité, 1980". 1981 figures were obtained through interviews. In addition of figure 11, there were three research assistants on the staff in 1981.

† L'École des Sciences (EDS) of the University.

the proposal that a Centre for Applied Technology be established to pursue technological research and promote its application in the fields of agriculture, food, renewable energy, industry, environment and health. Final official decision on that proposal is still awaited.

To complete this picture, it is necessary to mention the local units of certain French research agencies. For cash crops like cocoa and coffee there exists a local unit of the Institut de recherche sur le coton et textiles (IRCT). Similarly for food crops and other types of research there are units of the Institut de recherches agronomiques tropicales (IRAT), and of the Office de la recherche scientifique et technique Outre-Mer (ORSTOM). These local research units are controlled and co-ordinated from France but they undertake research for the Togolese government on request, on the basis of intergovernmental agreement and are subject to the control of the Togolese Ministry of Foreign Affairs.

The point must be emphasized that the machinery sketched in this section cannot be regarded as firmly established or as already carrying out the functions envisaged for it in the relevant legislations. In particular, INRS which is supposed to be the heart of the system remains a somewhat powerless organization without the means, especially as far as the co-ordination function is concerned. It does not formulate national S & T policy. Its own programmes are considered and approved by the Ministry. It has no National Research Council to advise it and, in fact, the INRS itself has no special governing council as such.

G. Dynamic assessment of the performance of the national S & T policy-making body

The half-formed S & T policy-making machinery described in the previous section cannot be expected to have made any major impact on the development of the country's S & T potential or on the economic and social development of the country, i.e. agricultural, industrial and processing activities, health technology, etc.

However, a start is being made in two important directions, namely,

— the establishment of practical collaboration between INRS and development agencies (e.g. INRS has recently been commissioned by SOTED, Société togolaise d'études et de développement, an organ of the Ministry of Planning, to do studies on migration, agricultural problems, etc.). But this kind of collaboration is only just beginning.

— The establishment of a collaborative link with the outside world; e.g. INRS has working relationships with bodies such as

- the Institut Fondamental d'Afrique Noire (IFAN), Dakar, Senegal
- the Centre Nigérien de Recherches en Sciences Humaines (CNRSH), Niger
- the Institute of Ethnologie at the University of Abidjan (Ivory Coast)
- the University of Cameroon
- the World Population Council
- the Ford Foundation
- the Rockefeller Foundation
- French institutions
- United Nations agencies.

But again, it must be noted that in the absence of an effective national S & T policy machinery, it has not been possible to take maximum advantage of these and other opportunities for international scientific co-operation.

Many problems have to be tackled if Togo's S & T policy-making machinery is to become truly operational and to begin to register more significant impact. Indeed the INRS is not a powerful organization. It has the co-ordination function in law but hardly any resources to enable it perform that function. One problem, and the one which the management of the Institute consider to be most important, is that INRS has no research funds to disburse. Quite rightly it is believed that finance is very important if INRS wants to co-ordinate and direct the research operations and activities of other agencies.

However, while the administration of research funds may help to strengthen the hands of INRS, one believes that it may be even more important to put greater emphasis on the need to first improve the institute's capacity to administer meaningfully and effectively such funds and the greater power of co-ordination which their planned disbursement would imply. In particular, it is necessary to increase considerably the resources available to the institute (staff, funds, experts advice) both for its own research programmes and for its role as the co-ordinating agency. In particular, it is necessary to train staff specifically for science-policy and research programmes/projects administration.

Of course, the foregoing observations already imply that there is an acute shortage of indigenous scientific personnel and technologists as well as of science-policy administrators and of persons with expertise in the management of research programmes and projects.

Finally, it is significant that Togo does not have a National Research Council which could give INRS necessary advisory support and guide it in the performance of the national science and research policy formulation and co-ordination function.

The country's national paper to the 1979 Vienna Conference shows that there is an official awareness of the critical need to develop S & T potential and to harness it more effectively to the process of economic and social development. It also contains very useful suggestions on the need for further development of science and technology potential in the States of the West African sub-region and of Africa (see pp. 4-17 of the National Document for UNCSTD).

These goals and suggestions cannot be pursued effectively at the national or international level, in the absence of a well-established science and technology policy-making body. The Togolese government is, in fact, well aware of this.

Upper Volta

A. Political and socio-economic setting

I. GEOPOLITICAL DATA

1. *Position:* The Republic of Upper Volta is a land-locked country located in the heart of West Africa. It is bounded to the north-west by Mali, to the north-east by Niger, to the south-east by Benin, to the south by Togo and Ghana and to the south-west by the Ivory Coast.

2. *Area:* 274,000 sq. km

3. *Population:* According to the most recent census (December 1978), the 5,638,203 inhabitants are grouped as follows:

Rural population:	5,127,000
Urban population:	362,000
Semi-urban population:	149,000

- Average density: 23 inhabitants/sq. km except on the Mossi plateau where it is 25 inhabitants/sq. km and 75 inhabitants/sq. km south of Ouagadougou.

With respect to ethnic groups, the Mossis represent 48% of the population, the Fulanis make up about 10% and the Lobis, Dagaris, Mandes and Bobos taken together represent approximately 28%.

The population divided by age group is as follows:

17.3% from 0 to 4 years old
24.9% from 5 to 14 years old
10.1% from 15 to 24 years old

In all, 81.3% of the population is under forty years of age. Age groups over 55 years represent 6.8%. Life expectancy at birth is about 43 years.

The average growth rate of this population is estimated at 1.6% per year.*

II. ECONOMIC INDICATORS

	1970	1975	1980
1. GDP			
At constant prices			
(in billions of F. CFA)	87.6	89.7	93.4
2. GDP/per capita			
(F. CFA)	16,850	16,000	15,000
3. GDP			
At current prices			
(in billions F. CFA)	87.6	103.1	232.2

Sectoral analysis of the economy for the decade 1970-1980 shows:

— an absolute stagnation of agriculture whose results varied with climatic conditions but remain at 1970 level in 1980.
— a decline in livestock breeding which has not recovered from the drought of the early 1970s.
— a weak growth in handicraft and industrial activities.

4. *Evolution of the financial situation:* (in billions of F. CFA)

	1972-74	1975	1976	1977	1978	1979	1980
Receipts:	14.4	16.3	22	29	30.3	34	35
Expenditure:	13.4	20.5	23.8	32.8	32.1	41.7	41.7
Balance:	1	− 4.2	− 1	− 3.8	− 1.8	− 7.7	− 5.2
Deficit/GDP%		3.6	0.7	2.3	1	3.8	2.3

Since independence the budget of the state has been maintained on a rather delicate balance. Until 1974 when the national authorities were avoiding large-scale investment, small budget surpluses were achieved. The small budget surpluses were immediately reconverted into cash reserves. Concern for certain essential social needs since 1975 led the authorities to upset this balance. The dual result was a budget deficit and a progressive absorption of the accumulated cash reserves to more than 9 billion F. CFA over a Five-Year period.

The new government is introducing an economic recovery policy which promises a better future for the economy of Upper Volta.

III. THE NATURAL RESOURCES OF UPPER VOLTA

1. Network of waterways

Upper Volta has no sea coast. It has no permanently navigable waterway. The only permanent waterways are the Black Volta, the Laraba and the Comoe.

The territory is drained by the hydrographic system of two river basins, that of the middle course of the Niger whose tributaries, the Garonal, Sirba, Gorbi, and Tapoa, are nearly dry during the dry season. The other basin is that of the three Voltas: White Volta (575 km in Upper Volta of a total of 1,025 km), the Red Volta (300 km of a total of 350 km), and the Black Volta (950 km of a total of 2,500 km).

2. Mineral resources

- Deposits being worked: marble at Tiara and antimony at Mafoulou.
- Deposits for which technico-economic studies have been completed:
  — Manganese at Tambao: 13 million tonnes at 54% MnO_2;
  — Phosphate at Kodjari: 25 million tonnes at 25% P_2O_5;
  — Limestone for cement at Tinharassan: 6 million tonnes.

The Upper Volta possess other mineral resources for which technico-economic studies are in progress (nickel, copper, gold, etc.).

3. Agricultural resources

The agricultural sector, including both animal and vegetable production, provides employment for nearly 90% of the economically active population. It provides the principal component of the Gross Domestic Product (GDP), representing 35 to 50% thereof.

Export incomes are derived primarily from agriculture which represents 90% of the total, made up mainly of the sale of livestock (50%) and vegetable products (cotton and oilseeds: 40%).

The importance of the agricultural sector is not the result of a prosperous agriculture but is in fact due to the embryonic state of the industrial and mining sectors.

The agricultural potential is seriously limited by climatic conditions: the north receives 40mm of rain during 40 days of rain over a three and one-half month period, the south receives up to 1,200 mm of rain during 80 or 90 days during a six months period. These averages have been noticeably decreasing since the 1972-73 drought.

(a) *The main crops*

Upper Volta's agriculture consists mainly of food crops including sorghum, millet, corn and rice which form the basis of the population's sustenance.

Mention must be made of several leguminous grains such as the Niébé and the Voandzou (or "earth pea").

The main cash crops are cotton, groundnut and sugar-cane as well as Karité almonds, sesame and market-garden produce and fruits.

Average annual production is as follows (in tonnes):

Millet, sorghum, corn	12,000,000
Paddy rice	40,000
Shelled groundnuts	60,000
Karité almonds	48,500
Cotton seed	55,500
Refined sugar	25,000

(b) *Livestock raising*

Livestock raising is currently one of the most important resources in Upper Volta. Nearly half the receipts from export come from this source. Livestock in Upper Volta is distributed as follows (in thousands of head):

Cattle	2,600
Sheep	1,700
Goats	2,600
Poultry	10,000 birds.

* World Bank: Accelerated Development in South-Saharan Africa: An Agenda for Action. Washington DC. Table 33 of the statistical annex.

IV. THE TRADE BALANCE IN UPPER VOLTA

Upper Volta imports most of its capital goods and services as well as its consumer goods in order to meet its basic needs.

The non-diversification of export commodities, limited to livestock raising (50%) cotton and groundnuts, results in the income being insufficient to cover the cost of imports.

The trade balance has remained structurally in deficit with a tendency to worsen the cover rate of imports by exports:

Cover rate	1970-1974	1975-1980
E/I average	41%	37%

This situation is due to the increased price of imported goods and especially to the oil bill whose share has considerably increased.

V. INDUSTRIES IN UPPER VOLTA

Almost all the domestic industries produce substitutes for imports which are rarely in competition with foreign production because of the land-locked nature of the country and low level of demand.

Light manufacturing industries are the most developed:

The industries are classified in five sectors:

1. Food industries: tobacco and beverages (15 firms in 1978)
2. Textiles and leather: 10 firms
3. Mechanical, metal and electrical industries: 10
4. Chemical and extractive industries: 11
5. Other industries: 17

The food industries sector leads in importance and dynamism; it offers 58% of industrial employment, and accounts for 48% of value added, 57% of turnover and 88% of industrial production.

The entire industrial sector accounted for a little more than 11% of the global value added in 1978.

In 1978, industry employed 7,000 persons or 0.21% of the active population.

The key sectors remain the food, textile and leather industries which obtain raw materials domestically, while the other sectors work exclusively with imported raw materials.

VI. POLITICAL SYSTEM

Since 25 November 1980, Upper Volta has had a new political system. A Military Committee of Recovery for National Progress (MCRNP) now governs the country.

On 1 May 1981, the President of the Military Committee of Recovery for National Progress delivered a general orientation address indicating the fundamental options and plan of action of his government aimed at resolving the major economic problems of the country.

The main objectives of this programme are:

1. "A development based on the elimination of all foreign domination and exploitation of man by man."
2. "A development based, above all, on our own means for autonomous advancement."
3. "A social policy aimed at satisfying the basic needs of the people of Upper Volta and especially of those of the most disadvantaged classes."
4. "The fulfillment of the human being in the individual family, professional and collective setting, by the enhancement of the well-being of culture and national identity."

B. The national development plan and the place of science and technology in this plan

1. Objectives

The draft of the Third Development Plan of Upper Volta for 1977-1981, has never been officially ratified by the Government. The objectives established in this draft Plan can be summarized as follows:

— to improve the living conditions of the most impoverished sections of the population.
— to work towards self-sufficiency in food production.
— to reduce the level of under-employment.

All the programmes and projects of the plan are to contribute to the realization of these three global objectives.

Translated into intermediate objectives, it concerns mainly:

— the increase of agricultural production to supply the country with basic foodstuffs and a marketing policy which guarantees a profitable price for the producer and an equitable distribution in all regions and at all times.
— Improving the skills of the farmers through education and an expanded extension service.
— The encouragement of integrated development in rural areas to make life in the country more attractive and to strengthen secondary centres as poles for regional growth.
— The extension of the communication network, especially feeder roads, in regions with agricultural potential.
— A more balanced geographical distribution of the population taking into account long-term prospects and the development of new land.
— The reduction of under-employment by the expansion of cash crop farms and of industries which absorb manpower, that is by increasing investment in labour intensive projects.
— The processing of agricultural products and mineral resources as far as is technically feasible and economically profitable.
— The training of the people of Upper Volta for activities suited to the country's development needs by means of an overhauled education system.

Under the present conditions, industry should play an important part in the context of rural development oriented towards the needs of the entire population.

The summary of the costs of the projects in the Plan is as follows (in millions of F. CFA):

Sector	Amount
Rural development	62,360.9
Industry	113,287.2
Services	14,570.2
Infrastructure	81,755.5
Social and Information services	31,241.5
Scientific Research	7,904.5
Total cost of the projects included in the Plan	311,120.0

2. Level of development of the science and technology policy and its place in the Plan

Upper Volta is creating its national structure for research. The organizations which are concerned with scientific research in the country are subsidiaries of foreign institutions primarily from the former colonial power. They are: IRAT, IRCT, IHO*, etc. which began their activities during the colonial period. The

* IRAT:Institut de recherches agronomiques tropicales et cultures vivières
IRCT: Institut de recherches de coton et de textiles exotiques
IRHO: Institut de recherches pour les huiles et oléagineux

programmes undertaken by these organizations were at the beginning entirely financed from abroad, but as from 1960, by budgetary allocations shared evenly by France and by Upper Volta within the framework of bilateral agreements.

Thus, there is not yet a real national science and technology policy in Upper Volta, and there is therefore no chapter for S & T in the national budget. The programmes which appear in the Plans are undertaken almost exclusively through bilateral or multilateral co-operation with financial contribution from the Upper Volta.

This absence of explicit, national choice to use science and technology in the development plans is explained by the fact that the financing of research programmes conducted in Upper Volta is 90% of foreign origin.

When, however, research programmes appear in the Development Plan, they have no formal links with economic and social projects. It is as if scientific research constitutes a sector on its own just like the vertical sectors such as the rural, industrial, social sectors, etc.

The research programmes mentioned in the Plan are those undertaken by research bodies such as the CNRS, ORSTOM* and IRAT and departments which have important research programmes such as the Direction de la géologie et des mines (Directorate of Geology and Mines), the Direction des services agricoles (Directorate of Agricultural Services). It should nevertheless be noted that organizations such as those which undertake agricultural research have had their programmes increasingly oriented towards the implementation of the priority objectives of the Plans thanks to the improvement in plants, to experiments with new types of cereals, in order to contribute to the achievement of the country's self-sufficiency food supply, which is one of the major objectives of the Development Plan.

C. Structure of science and technology policy

(a) *Background*

Until the creation of the Ministère de l'enseignement supérieur et de la recherche scientifique** in 1978, it could be said that there was no real science policy in Upper Volta. Scientific research was undertaken by organizations based on bilateral co-operation such as ORSTOM, IRAT, IRCT and IRHO.

Thus, the various bodies concerned with scientific research were scattered across the different ministries to which they were attached without any formal links between them.

The Institut français d'Afrique Noire became the Centre voltaïque de recherche scientifique in 1965. But its scope was limited to sociological, ethnological and botanical research.

Since 1970 it has undertaken a series of actions encouraging the nation's leaders to seriously examine the role and the place of science and technology research by means of seminars and symposia:

1970: Round Table on Science and Technology Research in Upper Volta

1974: Seminar on Science and Technology Research in Upper Volta

1978: Symposium on Science and Technology Policy in Upper Volta

These events culminated in numerous recommendations concerning national science and technology policy whose implementation at governmental level led to:

— the creation in 1976 of a Conseil national pour la recherche scientifique et technologique, CNRST (National Council for Scientific and Technological Research), which became the Conseil national pour la politique scientifique et technologique (National Council for Science and Technology) in 1978.

— The creation in 1978 of a Ministère de l'enseignement supérieur et de la recherche scientifique (Ministry of Higher Education and Scientific Research) within which was created a Direction générale pour la recherche scientifique et technologique, DGRST (General Directorate for Science and Technology Research), responsible for governmental policy-making in science and technology.

The Decree No. 81/0144/CMPN of 5 March 1981 concerning the re-organization of the Ministère de l'enseignement supérieur et de la recherche scientifique marks a crucial stage and indicates a political will to formulate a real science and technology policy in Upper Volta.

The Conseil national de l'enseignement supérieur et de la recherche scientifique is the decision-making body for science policy. The Direction générale de la recherche scientifique et technologique is its executive body.

(b) *Other bodies with a role in science and technology policy-making*

(i) The role of the National University of Ouagadougou

The governmental body having an important part to play in national science and technology policy-making is the University of Ouagadougou. Some of its lecturers undertake research especially in the field of renewable energy sources and in archeology.

(ii) The role of private bodies.

There are no private bodies or professional associations able to participate in science policy-making apart from the international institutions which have headquarters in Upper Volta.

D. Aims, scope, functions and responsibilities of the main national science and technology policy-making body

(a) *Official name of the organization:*

Conseil national de l'enseignement supérieur et de la recherche scientifique, CNESRS (National Council for Higher Education and Scientific Research).

(b) *Postal address:* Direction générale de la recherche scientifique et technologique,
Ministère de l'enseignement supérieur et de la recherche scientifique,
B.P. 7192,
Ouagadougou.

(c) *Legal status and administrative characteristics of the organization:* The body was created by Decree No. S1/0144/EMPN/Pres/ESRS.

(d) The aims of the Conseil national de l'enseignement supérieur et de la recherche scientifique are the following:

— to formulate government policy for higher education and scientific and technological research;
— to take appropriate steps for implementing this policy.

To this end, it is responsible for:

— co-ordinating proposals from all ministerial departments concerned with the development of higher education and technological research;
— defining priorities in establishing new specializations in higher education and in the creation of new structures necessary for the development of scientific and technological research;
— examining, studying and possibly approving new research programmes whch are submitted for its consideration;
— determining the human, material and financial means necessary for implementing identified priority activities;

* CNRS: Centre national de la recherche scientifique et technologique
ORSTOM: Office de la recherche scientifique et technique outre-mer

** Ministry of Higher Education and Scientific Research.

— establishing the list of higher educational institutions entitled to award national diplomas;
— ruling on appeals concerning disciplinary matters with respect to higher education and scientific and technological research staff.

The Council benefits from the advisory services of two commissions created for this purpose:
— a Commission de l'enseignement supérieur et de la recherche universitaire (Higher Education and University Research Commission) responsible for examining, in the first instance, files prepared by the Direction de l'enseignement supérieur (Directorate of Higher Education);
— a Commission de la recherche scientifique et technologique (Science and Technology Research Commission) responsible for initial examination of papers prepared by the Direction générale de la recherche scientifique et technologique or any other competent body. The Conseil national de l'enseignement supérieur et de la recherche scientifique obtains advice from the Conseil consultatif (Consultative Council) and from national and international experts.

Advocacy for science and technology at the Governmental level, is ensured thanks to the interministerial character of this Council.

In practice, each Ministry and the Ministère de l'enseignement supérieur et de la recherche scientifique are free to place before the Council worthwhile programmes in science and technology and defend them.

In addition, a Centre national de la recherche scientifique et technologique (National Centre for Scientific and Technological Research) was created by Joint Order No. 43/FSAS/MF/CNRST of 13 October 1981 in order to implement national programmes. It groups all government research institutions and units.

(e) *Working methods of the organization*

The main national science and technology policy-making body in Upper Volta was created on 5 March 1981 but has not yet met. It will most likely operate with technical committees according to disciplines and groups of disciplines bringing together researchers and development authorities to decide on programmes and budgets to be initially examined by the commissions of the Council as prescribed by the instrument of incorporation of the latter.

(f) *Co-operation with research establishments and scientific and technological services*

Co-operation between research establishments is handled by the Direction générale de la recherche scientifique et technologique whose Director is also the Director of the Centre national de la recherche scientifique et technologique, which groups most national research establishments.

The Direction générale de la recherche scientifique et technologique aims to:
— implement science and technology policy as defined by the Conseil national de l'enseignement supérieur et de la recherche scientifique;
— promote, co-ordinate and direct the activities of all research institutes and bodies under its jurisdiction;
— supervise and direct all research work undertaken in these institutes and bodies;
— call meetings, as necessary, of the Commission de la recherche scientifique et technologique;
— advise on requests for research authorization made by foreign scientific missions.

(g) *Co-operation with higher education*

Co-operation with higher education takes place through a joint body for national policy in higher education and scientific and technological research.

The fact that the two policies are under the jurisdiction of the same ministerial department shows the fundamental importance which the authorities of Upper Volta attach, at present, to the training of scientists, engineers and qualified technicians, since the success of science and technology policy depends on the numbers and quality of human resources invested in the field of S & T.

This symbiosis also increases awareness in the general public regarding science, thanks to the existence of an appropriate general or vocational education attempting to include science and technology in the daily life and work of the people.

E. International co-operation

(a) Bilateral co-operation

It operates in the context of a set of agreements governing bilateral co-operation between Upper Volta and France (Convention 17/C/60/F of December 1960). This agreement primarily covers the financing of French research bodies working in Upper Volta.

(b) *At regional level*

At regional and sub-regional level, several arrangements allow for the initiation of co-operation depending on the sub-regional body which supervises the specific activity.

The SAFGRAD Project of the OAU/STRC whose headquarters are at Ouagadougou is a concrete example of this type of co-operation aiming to pool means provided by donors for establishing an African research network for food crops in semi-arid zones. Mention may also be made of the Institut du Sahel of Member States of the Conseil Inter-Etat de lutte contre la sécheresse dans le Sahel, CILSS (Permanent Insterstate Committee for drought control in the Sahel), of which Upper Volta is a member.

Regional co-operation is also undertaken at the level of the CEAO, OCAM and WARDA* in scientific and technological research.

(c) *With the United Nations system*

Within the framework of aid to Member States, Unesco co-operates with Upper Volta in the formulation and implementation of a national science and technology policy. This co-operation is considered most satisfactory by the national authorities.

Upper Volta wishes Unesco to finance some of its research projects either directly or indirectly.

F. Own resources of the main national science and technology policy-making body

(a) *Financial resources*

State budgets allocated to the Direction générale de la recherche scientifique et technologique since its creation are as follows:

1979: 35,000,000 F. CFA
1980: 50,000,000 F. CFA
1981: 82,029,000 F. CFA
1982: 102,000,000 F. CFA

The body's main source of financing is the national budget. Outside subsidies usually go to research institutes.

(b) *Human resources*

The Direction générale de la recherche scientifique et technologique operates with seven university graduate members of whom two hold "Doctorat d'État" (State Doctorates) (Senior Lecturers at the University), one PhD one "Docteur de 3e cycle" (Doctorate of the Third Cycle or University Doctorate), one Agronomist/Engineer and a Counsellor in School Administration.

* CEAO: Communauté économique de l'Afrique de l'Ouest
OCAM: Common Afro-Mauritian Organization
WARDA: West African Rice Development Association

The General Directorate employs five technical staff and three general service staff.

(c) *Information resources*

(i) *Survey of the science and technology potential*

Up to the present no surveys of the science and technology potential in Upper Volta have been made. The authorities in Upper Volta are conscious of the importance of such work and are preparing to undertake a survey.

(ii) *Bibliographical information*

The Direction générale de la recherche scientifique et technologique possesses most of Unesco's publications concerning science and technology policy.

Several science and technology documents of various types are available through the documentation services of the Direction générale de la recherche scientifique et technologique.

The Direction générale de la recherche scientifique et technologique has just published a quarterly review called *Energy and Development* containing articles on the scientific activities of the country.

(d) The Direction générale de la recherche scientifique et technologique is located in a centre which has several offices, a documentation room, secretarial offices, reproduction facilities, etc.

G. Existing links between the national science and technology policy-making body and its counterpart organs in sectoral ministries or government departments

The basic link between the sectoral ministries and the science and technology policy-making body occurs at the level of the Conseil national de l'enseignement supérieur et de la recherche scientifique.

The science and technology policy-making body is interministerial and brings together all technical ministries concerned with scientific and technological research.

This horizontal integration allows the ministries which use research results to orient their research programmes according to objectives assigned to their sectors as part of the national development process.

These ministries assist in the determination of priority of national research programmes. In turn, they expect results which will help them achieve their productive tasks.

H. A critical assessment of the performance of the national science and policy-making body

Such an assessment would be premature for Upper Volta. This body has just been created and is in the process of becoming operational.

Nevertheless, professional staff in Upper Volta have been working to make the Government authorities aware of the fact that science and technology act as a lever for the development of the national economy.

Several national events concerned with science and technology (round table, seminar, symposium) as well as recommendations made by these forums have provided the Government with elements for decision-making regarding the process of formulating a national science and technology policy.

Future prospects

In-depth studies on science and technology policy as well as high-level consultative mission sent by Unesco to the Government of Upper Volta have enabled the latter to undertake the task of establishing a science and technology policy-making body on sound foundations.

The Government of Upper Volta has just established a Centre national de la recherche scientifique et technologique which includes all national science and technology research units and institutes in order to group its scientific and technological potential.

Competent national professional staff have been appointed to co-ordinate and develop these structures and mechanisms.

The scientific environment thus created augurs well for the future of science and technology policy in Upper Volta.

This system only requires the necessary human and material means not only for formulating science and technology policy but also for implementing this policy effectively on a continuous basis.

The political will shown by the authorities at different levels constitutes a guarantee for the implementation and success of these objectives.

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