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nvironment and partnership were the keynotes of ORSTOM's work in I99l.

In the run-uptotheinternationalconference in Rio, 3 number of initiatives were taken on the liEnvironment and development" front. For example, an incentive operation on "Dynamics and utilization of renewable resources" was created, major programs were launched on iiHealth and Environment"and"FallowinginWestAfrica", and the "Long-term Savanna network" was set up. A compilation of papers on aridity and a synthesis of work on the region around the Mare leursi (region of Burkina Faso) in the Sahel were completed, and publications included two compilations on Hshing and small-scale sea Hsheries and a special issue of Cahiers des Sciences humaines devoted to pastoral societies and development. All these publications reflect the thoroughly systematic, holistic and multi-disciplinary nature ofORSTOMls development research, and its close relations with the societies and environments it studies. 50 the new global concern for environmental issues in development did not catch ORSTOM unawares - rather, it meant legitimation and recognition of the Institute's existing approach.

Also much in evidence in I99I was the second keynote feature of ORSTOM's work: its emphasis on collaborative research. The guidelines in the "Projet dlEtablissement de llORSTOM" or PEO (ORSTOMls Strategic Plan) on greater openness towardspartnersintheNorthandSouth took concrete form in a number of initiatives that have worked a thorough change in the Institute's relations with the outside world. The most significant move in this direction was the llPartnersl Forum" held at the Ministry of Research in Paris. The Forum brought together about a hundred scientists and research managers from sub-Saharan Africa, at the invitation of France's leading research

institutes and with support from the Third World Academy of Science and the African Academy of Science. The Forums conclusions constitute a commitment by Frances overseas developmentresearch communityto full cooperation with the scientific communities of the South. For a strong scientihc corps in these countries, with fully-lledged membership of the international scientihc community, is both a powerful tool and an indicator of development; to help such a community emerge and grow strong is to aid development.

It is vital to integrate this Southern scientific community into the major

environmental research programs:
one knows how important the inter-
tropicalzoneisforglobalenvironmen-
tal issues. Collaborative research here
finds one of its best justifications.
avoiding both an excessively local
approach that would be too fragmen-
ted and circumstantial, and an overly
global approach that would be inope-
rative.
These are by no means new ideas; we
have put them forward often enough
in the past. Northern governments
and research bodies and the interna-
tional institutions must now apply
them more systematically, undertak-
ingjoint research programs with their
partners, providing research-based
training in research and supporting
Southern researchers in terms of both
working resources and publications.
ORSTOM, for its part, is continuing
and expanding its support for the
scientific communities and institu-
tions of the South. For example, the
oceanographic centre in Abidjan is
now under Cote lvoire management
and the ORSTOM centres in Bangui
and Brazzaville are being upgraded.
Scientific appraisals have been made
of the work of hfty-seven Southern
researchers working with ORSTOM
under contracts of association. The
External Relations Service has been
evaluating ORSTOMs various part-
nership research formulae: four hun-
dred collaboration contracts or agree-
ments of one kind or another have
been signed, while nearly five hundred
trainee researchers and foreign post-
graduates working on theses have
been given research training. All these
measures help to pave the way for
cooperative development.
With this new awareness, this new
recognition of ORSTOM’s specific
tasks in the scientific arena and the
appropriate methods ofapproach, the
need to make efficient use of scientific,
technical and administrative resour-
ces becomes even more evident. This
is why ORSTOMls scientific work and
its administrative structure in France
have been reorganized. This has been
done in a spirit of optimism, Ermly
directed towards partnership, open-
ness, a welcoming approach - for a
pioneering policy will always be fragile
unless supported and shared. For the
future, ORSTOM has every hope of
successfully involving the French and
international research communities
even more closely in scientific coop-
eration for development.
ln the front line of ORSTOM’s work,
however, are its workers in the field.
The whole Institute stands solidly be-
hind them, for it is they who, day by
day, share with their partners the
hardships and uncertainties of non-
development situations.

In this report of ORSTOMls activities in I 99 I . we cover three aspects ofthe lnstitute’s work: its approach to environmental issues, grounded in nearly hfty years of research in tropical regions, its cooperation with Southern scientihc communities and its contribution to applied development research.

Michel Levallois
Chairman
Board of Trustees

Gerard Mnter
Director General I

ORSTOM IN BRIEF

RSTOM - the French Institute of Scientific Research for Development in Cooperation - is a State-owned public service body under the joint authority of the Ministries responsible for research and for cooperation and development.

With a budget of nearly one billion francs and a staff of 2.500 based in forty establishments. ORSTOM conducts research into intertropical environments in thirty different countries.

I .500 ofthe staff are senior and intermediate scientific and technical grades. of whom:

- six hundred are French expatriates spending several years in Africa. Latin America. the Caribbean. Asia or the Pacihc, working in national, regional or international research institutes or in ORSTOM's own establishments:
- five hundred are intermediate technical staff from Southern countries;

v about a hundred are foreign researchers working directly on ORSTOM research programs. under contract.

ORSTOM offers its partners programs and findings on four keynote themes:

7 Environment and major ecosystems.

,_ Agriculture in fragile tropical environments.

- Health and environment.
- People in changing societies

The Institute also offers expert appraisal. diagnosis and survey services to public and private sector bodies, be they French. foreign or international.

ORSTOM provides training for young researchers. French and non-French. through its research programs.

Training may take place in the field. in ORSTOM's own laboratories or in those of its Northern or Southern partners. It takes several forms:

- supervising trainees on research grants or training/professional placement contracts (150 a year):

playing host to student trainees (300 a year):

- providing university teaching and thesis supervision.

ORSTOM has five multi-disciplinary scientific departments:

Earth/ocean/atmosphere (Terre. ocean, atmosphere - TOR)

Continental water (Departement Eaux continentales - DEC)

Environment and agricultural activities (Milieux et activites agricoles - MAA)

Health (Departement Sante - DES)

Society/urbanization/development (Societe. urbanisation. developpement - SUD)

These departments between them run forty-one research units.

Programs are designed and set up
at departmental level. and carried out
by teams from the research units.
The inter-disciplinary nature
of its research themes and methods
is a hallmark of the ORSTOM
approach.
Seven Scientific Committees
make regular assessments of progress
in the programs and researchers’
careers.
These committees cover more than
forty disciplines. grouped as follows:
- Geology, geophysics
, Hydrology. soil science
- Hydrobiology, oceanography
- Botanical sciences
, Biology and biochemistry as applied
to man
- Social sciences
_ Communication and engineering
sciences.
The Scientific Council
is the body that guides and evaluates
ORSl’OM’s scientmc policy.
It gives its opinion not only on the
research programs but also on the
dissemination, transfer and utilization
of results and Hndings: it therefore
examines policy on STl. training and
application of results.

ENVIRONMENT: OBSERVING, UNDERSTANDING, ANTICIPATING

nvironmental issues have always been a central thread in ORSTOMis research work. Starting from the naturalist’s descriptive approach to natural environments and the basic task of cataloguing resources, the Institute has gradually shifted its stance to take account of the relations between societies in developing countries and their environment. For today, the tropical countries must find a way to handle both rapid development and rapid population growth - a combination which is leading to severe disruption in the relations between societies and their environments. This also makes it essential to involve these countries fully in the search for technologies and forms of development that will be consistent with maintaining environmental quality for the planet as a whole.

ORSTOM has been gathering data of various kinds for many years. It has a thorough practical knowledge of changes in tropical natural environments under the impact of climate and human activity; and it has a long-standing experience of cooperative research. This makes it the first-choice scientific partner for many Southern countries.

In collaboration with other scientific institutes in France, Europe and the Third World, ORSTOM is also involved in international programs in the intertropical zone.

The lnstitute’s work hinges around certain unifying themes that are of major international concern or match demand from partners in the developing countries.

The climate

Human activity - particularly when it involves the emission of substances that alter the physical and chemical properties of the atmosphere - has a marked effect on the evolution of the climatic system, and resultant changes to the global radiation balance can lead to warming of the earth’s surface. These changes have complex consequences which, with current knowledge, are difficult to forecast. Disturbances to the hydrologic cycle, linked with a rise in temperature, can provoke changes in biosphere patterns: rises in sea levels, changes in the distribution of major ecosystems, and aridification - or, conversely. an increase in humidity in certain areas. etc.

I The big international programs

The increase in awareness of the risks to be taken over the next few decades and their socio-economic consequences has led to the implementation of large-scale international research programs

aimed at gaining a better understanding of climatic variation and its impact on environments and resources: The World Climate Research Program (WCRP) and the International Geosphere-Biosphere Program (IGBP).

- The WCRP is tackling two basic questions: to what degree can the climate be forecast. and what effect do humans have on climatic evolution? Within the context of the PNEDC program (Programme national de la dynamique du climat), which coordinates French research on these themes, ORSTOM is participating in the following sub-programs:

I TOGA (Tropical Ocean and Global Atmosphere) is studying exchange and interaction between the ocean and the atmosphere in tropical areas. ORSTOM and IFREMER (lnstitut frangais de recherche pour llexploitation de la mer) are responsible to TOGA’s international data processing center for subsurface observations.

I WOCE (World Ocean Circulation Experiment) is setting up a model of ocean/atmosphere patterns to study global ocean circulation patterns and long-term climate forecasting.

I GEWEX (Global Energy Water Experiment) is to commence in I995 and will be concerned with the hydrologic cycle. The program will study the transfer of water and energy in the atmosphere and on land and sea surfaces. The aim is to forecast changes in the distribution of the world’s water due to climatic change and human activity. One project in this context is the HAPEX-Sahel experiment (Hydrologic Atmospheric Pilot Experiment in the Sahel) which is being coordinated by ORSTOM in Niger.

-The IGBP, setup by lCSU, describes, analyses and models the basic processes governing interactions between the geosphere and the biosphere; it also assesses the effect of human activity on their evolution. Scientists have proved that the biosphere plays a decisive role in the evolution of the entire system. Emissions of greenhouse gases, deforestation of tropical areas and all types of pollution have a substantial impact on environmental change. ORSTOM is involved in a range of programs on this theme, including the JGOFS (Joint Global Ocean Flux Study), which is studying the carbon cycle in its ocean phase.

I National and bilateral programs

Over the last few years, ORSTOM has been collaborating with its French and Southern partners to initiate a range of research projects on the relationship between the climate and the environment.

_ IGBP Ecosystems Program: part of this

program is to examine the impact of climatic changes on the functioning of several large ecosystems and the influence they have on the global environment. Three major projects have been set up:

I The SALT project (Savanes a long terme), mainly being conducted in Africa, in which ORSTOM is collaborating with several French and African laboratories. This program is examining the ways in which savanna regions are effected by disturbance from natural or human sources, their role in the interchange of water vapor and carbon dioxide with the atmosphere, and the incidence of these interchanges on regional climate.

I The ECOFlT project (Changements globaux, ecosystemes. paleo-ecosystemes des forets intertropicales) commenced in I992 in the wake of numerous earlier studies. This program, which involves Africa and South America. brings together research teams from France and other countries. It is assessing the impact of climatic variations on forest ecosystems in intertropical regions from the last glaciation through to the present time. The forest regions have been transformed by the variations in temperature (4-5: F) and precipitation that have taken place over the last I0.000 years. Knowledge of these processes will make it possible to develop and validate forecasting models for the evolution of these ecosystems over the next few decades.

I The PEGI project (Programme d’e’tude de la geosphere intertropicale) is studying the evolution of ecosystems

in intertropical continental regions. Part of the research on the major river basins (Zaire. Amazon) is aimed at estimating the outflow of solutes and sediment from the continent to the ocean. This work will make it possible to assess the effect of climatic variations on soil erosion and leaching and the long-term consequences on land use in catchment areas.

I Climatic environment and water resources:

Water is critically important in intertropical regions. Accordingly. ORSTOM has spent a great deal of time working on continental hydrology and is running a large number of meteorological and hydrological stations in many tropical catchment areas.

ORSTOM is also contributing to the maintenance and monitoring of hydrological networks in several tropical countries. In addition. the Institute has developed a satellite teletransmission system to collect real-time data and to render the measurement stations self-regulating: the long series of hydrometry and rainfall measurements taken in West Africa are unique climatic records. The collection and critical study of the quality of this information. carried out by the international Water Assessment project. provides a more reliable basis for work aimed at understanding changes in climate and water resources.

Biological diversity

The exploitation of natural resources. the transformation of landscapes and the destruction of certain ecosystems has led to the disappearance of a large number of plant and animal species in tropical countries. These factors also increase awareness of the need to conserve mankind’s natural heritage. evolved over millions of years, so that it can be passed on to future generations. Destruction of the environment also means the loss of still untapped or undiscovered resources.

The reduction in biological diversity is affecting the way in which ecosystems function.

The issue of biological diversity has attracted the interest of biologists all over the world. ORSTOM’s research seeks to gain a better understanding of tropical diversity: enumerating species. mapping their distribution, studying their relationship to ecosystems and human activity.

I Cataloguing and distribution mapping of species in tropical environments

The purpose of current work on deep-ocean benthic flora and fauna in the Pacific. continental aquatic and forest flora in Africa and the Amazon.

and terrestrial environments in New Caledonia. is to define the factors responsible for biological diversity - those related to the present environment and those stemming from the biogeographical past.
Some of the research projects are aimed at identifying species of economic interest. Examples of this are the "Extractivism" program in the Amazon (see page 23, "Utilizing wild forest products: extractiuism") and the program on "Natural substances of biological interest". which is identifying animal and plant products, on land and in the sea, that will be of interest to chemists and pharmacologists.
Similarly. research on the genetic diversity of fish will enable high quality strains to be selected. with a view to developing fish farming systems based on native strains.
In each case, a detailed knowledge of the different species is essential to the development of plant and animal resources in tropical areas.

I Biological diversity and ecosystems

Although not the only prerequisite. biological diversity is essential to enable given species or ecosystems to adapt to environmental change.
Several key questions need to be answered in order to gain an understanding of how biological diversity affects the way in which ecosystems function:
- Do certain species have a greater influence on the structure of biological systems and the way in which they function. or do all species play an equal role?
-What is the influence of biological diversity on the stability of the systems. particularly when they are disturbed?
-What is the relationship between biodiversity and the biomass. and between biodiversity and the productivity of the systems?
ORSTOM’s programs. which compare results between the different continents, are essential in order to answer these questions.

I Human activity also "creates" biodiversity

In the natural environments they inhabit, human beings transform and develop the physical space, exploit resources, pollute and introduce new species.
Human intervention thus has an impact on the global environment, including climatic warming and changes in biological diversity.
Research in this field is being carried out on a long-term basis. mainly through "observatories" which assess the scale and modulation of changes as they occur.
The knowledge and data accumulated

by ORSTOM over the years are
now being put to valuable use,
and their application will be intensified
over the coming years.
The issue of biodiversity has brought
to light a new set of problems which
warrant work in two previously almost
untouched fields:
-the economy, since it is essential
to measure the monetary value
of biological diversity so that it can be
taken into consideration by
decision-makers:
-the protection of biological diversity
by means of scientific and technical
conservation programs and the
application of the appropriate financial
and legislative measures.
Ecosystem management
"Environmental problems should be
seen as a new phase in the long
history of man’s relationship with
nature" (I).
Research in the tropical environment
field is aimed at bringing into use
as much land as possible in the most
intensive way possible while
maintaining the potential for natural
resource renewal. Accordingly.
(I)M. Jolivet. A. Pave.
"L’environnement. questions
et perspectives pour la recherche".
Enuironnement. n 3 (Saint-Malo Seminar.
October 8-9 l99l), p. 28.

the priority is not to keep these environments in reserve, but to avoid the disastrous consequences of over-exploitation and to propose initiatives aimed at re-establishing damaged ecological systems.

I Understanding how the major ecosystems function

Research carried out by ORSTOM on large tropical ecosystems has led to an increased understanding of how they function.

Detailed studies were carried out in the Sahelian region, Lake Chad, the Senegal River and the Mare d'Oursi (Burkina Faso). Since research in the field of sustainable development must simultaneously cover physical, biological and human problems, these studies involved specialists from different disciplines.

Research will be continued on:

- understanding the dynamics of resources in tropical river valleys and how they function;
-the history and dynamics of arid environments;
-the marine environment and resources (deep ocean, coastal waters, lagoons).

I Utilization and integrated management of ecosystems

Landscapes reflect the climate and are also an expression of the culture of the societies that have worked the land and shaped the landscape over long periods of time.

To understand how its inhabitants have used a given space, it is necessary to study the overall relationship between different aspects of the landscape. This approach is necessary since it is important to know how farmers or fishermen perceive and use their environment, so they can be offered suggestions on how to change their habits and adopt new techniques.

People move from one place to another, techniques and economies evolve and the need for more arable land grows as populations increase. Change in a society is accompanied by changes in the space around it; nomadic stock breeders lack space in areas that have been intensively cultivated or - in the Sahel zone - diminished by aridification. An increase in production leads to over-grazing and reduced herbaceous cover, deterioration of the soil and the acceleration of desertification. Analysis of the principal factors causing these changes has given rise to proposals for conservation and rehabilitation measures such as the replanting of appropriate plant varieties (see page 23, "Rehabilitating desertified areas north and south of the Sahara").

It is now possible, through improved river and land management, to regenerate soil that has been temporarily laid waste by salinization:

this has already been achieved in Casamance (Senegal) (see page 2 I. nLand development in the bottom-lands").

I Utilization of renewable natural resources

The formation, availability and renewal of resources depends on how communities use them, the part they play in human activity, and the way in which they are shared or appropriated. As soon as exploitation is intensified. it is essential to guarantee the renewal of resources by organizing appropriate modes of management. Research in Madagascar is confirming the need to approach the problem on a national level. The problems of renewable natural resources are centered around two concepts: their variability, and reactions to this variability.

-Variability depends on a large number at factors: climatic changes, economic constraints, the heterogeneity of environments, changing needs etc.

-In reaction to this, new strategies and new ways of running the production systems are adopted and the relationship between societies and their resources changes. ORSTOMls programs on the management of fresh water resources and the management of continental and marine aquatic resources are all aimed at dealing with the problem.

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Health and environment

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Endemic diseases and public health conditions are related to environmental changes due to social factors. Land development for agriculture. industrial installations, new technologies. the extension of crop farming, the growing use of pesticides. industrial residues and polluting urban waste all contribute to environmental degradation and changes in living standards.

Parasitic disease epidemics develop as a result of social and agricultural practices. Some diseases, such as onchocerciasis. schistosomiasis (bilharzia) and malaria are associated with water. Two programs have been launched by ORSTOM on the theme of "Water and Health", one in South Cameroon, in areas where forest and savanna meet. the other in the Sahelian part of Senegal, where darn construction has enabled irrigation networks to be set up, creating conditions favorable to intestinal schistosomes. Pesticides are needed to control these outbreaks: but pesticides can pollute the natural environment. Current research on biological pesticides has contributed to resolving this problem (see page 20, TA biological insecticide against mosquitos").

The urban environment

Rapid urbanization is a major phenomenon in tropical countries. The population explosion is partly responsible for the expansion of towns and cities, which will soon be accommodating 50% of the population of these countries. For instance. in the year 2025, one in every two Africans will live in urban areas, as compared with l4% in I950. Migration from the countryside is sometimes the farmers response to deteriorating living conditions in rural areas; they seek supplementary incomes in the cities in order to reduce their dependence on farming. The term "urban environment" includes all aspects of living conditions in towns and cities:

-infrastructures and basic community services - water supply, drainage, treatment of waste water, garbage disposal etc.;

-housing conditions and access to transport;

-risks associated with human activity. pollution and dangerous industrial activity, automobile accidents, etc.:

-the development of new social relationships exposing certain groups to greater hardship, especially children, adolescents and the elderly; the increase in violence and insecurity;

ethe huge rise in urban pandemics such as AIDS.

The city maintains a close relationship with rural and peri-urban environments. To the detriment of arable land. the cities spread and the requirements of city-dwellers (fuelwood in particular) accelerate the deterioration of the land. Environmental contamination (by waste water. unrestricted waste tips, etc.) destabilizes the peri-urban environment. and downgrades health and living conditions. ORSTOM carried out its initial research on these problems in Central America. where urbanization is far more advanced than in other developing regions.

Information systems

Environmental problems must be approached with up-to-date methods for information collection and processing. and ORSTOM is a leader in many fields:

#The Institute was one of the pioneers in applying remote sensing systems to the study of terrestrial and oceanic ecosystems and their evolution. Units for receiving and processing satellite images were installed in Senegal. Niger. French Guiana, Reunion and New Caledonia, as part of a system that also includes specialized laboratories (Bondy, Lannion, Quito, Mexico) and a network of mini units.

-The flow rates of water courses can now be assessed in real time by a satellite teletransmission network that measures river water levels at stations equipped with Argos and Meteosat beacons.

aThe processing of local information called for the development of data processing systems capable of describing and managing spatial elements. Geographic information systems (GlSs) have now opened up new possibilities in qualitative mapping. ORSTOM quickly became involved in GIS development with its tiSavane" software program. Now, the computerized urban information package Atlas informatise’ de Quito enables research in the social sciences to be used for the management of urban space.

-ORSTOM has accumulated a "memory bank" on intertropical environmental research. consisting of publications and databases, all available to the Institute’s Southern partners.

Nevertheless. over the next few years. a great deal of effort must be put into installing data banks and user-friendly systems that will enable these large quantities of difficult to access information to be exploited. Only then will the results of environmental research be really put to work and cease being a confidential inventory.

he emergence of new scientific problems relating to the evolution of ideas and knowledge, access to new

systems for collecting and processing information, and concern for the imminent future of our planet are all factors that call for renewed efforts in environmental research applied to intertropical regions and the mobilization of other Northern and Southern scientific organizations. I

TOGA,
a worldwide ocean observation network

The Tropical Ocean and Global Atmosphere program is part of the second strand of the WCRP. set up by the WMOT ICSU and the IntergovernmentalOceanCommissmn.ltisdue to complete its work in I 994. Its aim is to study the possibility offorecastingyeai-to-year varia tions in the climate and to define ocean obser- vation systems that would enable such fore- casts to be made. On this timescale. exchanges betweenthewarm surfacelayeroftheocean and the atmosphere are decisive, So TOGA has set up a global tropical ocean observation network. the first worId-wide ocean observation net- works

Jointly with the United States, Australia and Japan, ORSTOM IS managing a network of sta- tions along shippingroutes inthethree oceans. measuring the temperature and salinity of the surlace layers.

IntheAtianticORSTOM hasmstalledasystem for measuring the level of the ocean surface In the Equatorial PaCiHc. it is involved in a progiani to study El Nino. as part of an international network measuring currents and temperatures by means of instruments mounted on fixed buoys. ORSTOM handles maintenance and runs a line of buoys along the I 659E meridian, This Willenable ORSTOM to start playingapart in the COARE experiment in 1992-93. working from its Noumea center. COARE is deSIgned to gain an understanding of the exchange mecha- nisms between the ocean and the atmosphere in the western equatorial Pacific, the world’s biggest warm water reservoir. whose fluctua- tions play an essential role in global climatic variability. For this research. ORSTOM will have the use of two ships. its own A(is and IFREMER’s Noroit, which will cruise the region for three months.

(RU IA TOGA Program)

WOCE,
afullsetofdataonocean circulation

TheWOCE programispartoftheWCRP’sthird strand. It is studying long-term Climate trends and is obserVing the response of the climatic system to a possible reinforcement of the ’igreenhouse effect’ caused by increased levels of radiatively active gases (carbon dioxide. methane. etc.) in the atmosphere

On the timescales underconsideration, ranging from ten to a hundred years. it is the ocean that determines the pace of Change in the climatic systems It does so through general ocean circu- lation. which is much slower than the circula- tion of the atmosphere. Ocean Circulation must therefore be taken into consideration in its entirety and a model constructed,

This is the aim ofWOCE. whose objective is to supply Within a few years (I990- I 996). a full

description of the entire ocean, using available resources: satellites, oceanographic vessels. fixed and drifting buoys. various types offloat, etc.

Along With partners in the PNEDC. ORSTOM is taking part in oceanographical exercises across the Equatorial Atlantic and along the coast of South America; ORSTOM researchers will be evaluatingthe amountofheattransported from north to south (the I992-I995 program). A WOCE base has now been set up at the ORSTOM Center in Cayenne.

(RU iii. WOCE Program)

HAPEX Sahel,
evaluating water and energy
exchanges between ground
and atmosphere

The exchanges of energy. water and carbon dIOXIde that take place between the land surface and the atmosphere have an impact on the Climate. Studies at present largely rely on com- puter simulation and analySIs of water vapor exchanges between sod. vegetation and atmos phere. Piecsse knowledge of these exchanges would open up new prospects for research into the relations between climatic trends and changes in the planet’s vegetation cover. But the global data needed to extend this work on a planetewide scale are not available. Experimena tal field studies are therefore necessaryto gather such data Pilot studies have already been car- ried out in the temperate zones. in France and the United States. and these now need to be extended to the tropical regions. This is the aim of the HAPEXeSaheI program, initiated by the Joint seientific committee of the WCRP.

Through its work on processes connected with the vegetation, HAPEXshould makea contribution to the IGBP.

An experiment is being run in the region around NiameyThis is a region where the vegetation is retreatingand groundcoverdiminishing,factors which could lead to a drop in rainfall which would, in turn, have a negative impact on farming activities

The experiment is to last at least one rainy season and willcoveralargearea-about I0.000 kmz. Observations will concern climate (rainfall especially); surface states and changes in surface states as monitored by satellite; vegetation, with surveys and intensive observation of two or three predominant vegetation types: and the influence of these three elements on trends in the hydrologic balance.

ORSTOM is managingthe operation, and about twenty of the Institute’s researchers are involved, alongside researchers from Niger. Europe and America

(Interdepartmental HAPDCSahel Program: RU IB, 28. 2E. 3D. 3/)

JGOFS,
measuring carbon dioxide
absorption by the ocean

ThelnternationalGeosphere Biosphere Program was originally an initiative ofthe lCSU. Its aim is to study interactions between the physical and biological environments which. between them. control the overall evolution of the planet. The program’s main ocean study strand is the JCOFS, which is evaluating flows ofcarbon and associated elements from the ocean surface to the deep ocean floor, in order to measure the ocean’s capacity to absorb part of the carbon dioxide released into the atmosphere.

In the Pacihc, ORSTOM is using satellite-borne instruments to measure CO2 and chlorophyll levels in surface waters along some shipping routes(ECOA)andin oneparticularocean zone. the Equatorial Pacihc (FLUPAC),

(RU /K. 1605 Program)

ECOFIT,
the influence of the climate
on forest ecosystems

ECOFlTis a partofthe IGBP’s "Terrestrial Ecosystems" strand. and its aim is to studythe impact ofclimate change on intertropical forest ecosystems. The partner institutions are CNRS. ORSTOM and MNHN, and researchers in a variety ofdisciplines are involved. coming from Brazil, Cameroon, Congo and France The intertropical forest ecosystems are not in some original, static state from which one might deducetheirfutureevolution.Someofthecharacteristics that condition the way they function are inherited from changes that have taken place in the past. Evidence ofthese changes-climatic or man-made changes dating from past de cades, centuries or millenia # is to be found in the "archives" of today’s sediments, soils and vegetation,

In order to gain a better understanding ofthese past changes, to clearly identify their impact on how these ecosystems function today, and to situate them in relation to global changes. the ECOFlTprogram has dehned threeobjectives: to identify the biological and geochemical indicators of the present ecosystems. to analyse the

relationship between these indicators and climatic variations on the scale of several years. andtoreconstitutetheirvariationsoverthe past ten thousand years (since the last ice age). The findings will help in modeling tropical ecosystems and predicting their response to different climatic disturbances: sudden climate changes, recurrent drought. or briefanomalies with disastrous effects. such as hie.
(RU IC. RU 3H. ECOFITProgram)

Transport of mineral and organic matter in the major river basins

Initiated by ORSTOM in collaboration with a number of its scientihc partners, the PECl/GBF program is drawing up a global balance sheet of transportand dischargeofsolutes and sediment in major rivers. Research is under way in three major river basins in dry and humid tropical zones: the Congo. Amazon and Niger.
In three countries (Congo, Cameroon and the Central African Republic) within the Congo-Zaire basin, the hrst program is taking measure ments of solute and sediment discharge of the Congo-Zaire river into the Atlantic, in order to Hnd out the relationship between export of matter. hydro-climatic phenomena and biogeodynamic processes
The second program is being run in the Amazon basin. in Bolivia and Brazil. as part Ola study of theFlndean partofthe basintoevaluateerosion. sedimentation and the transport of solutes and sediment in the Rio Amazonas and its main affluents (SolimOes. Negro. Madeira etc). towards the Atlantic, The analysis results will be compared with findings in the Congo-Zaire, which also flows into the intertropical Atlantic.
The third program is EQUANIS (for Environnei ment et qualite des apports du lleuye Niger au Sahel). This concerns Mali and Guinea, where inventories have been drawn up of the hydroclimatic regimes olthe Niger river and its main tributaries. with special studies offluctuations in mineral and organic matter in the rivers
Independently of the GBF project. an interdisciplinary study ofthe Senegal river has been set up with EEC funds This is EQUESEN (for Environnement et qualite’ des eaux du lleuve Senegal). This program is studying solute and sediment transport in much the same way as the PEGl project.
(RU 2A GBF Program)

Knowledge and management of water resources, a region-wide issue for Africa

To be abletoimprove planningand utilization of water resources in sub-Saharan Africa, where arid and semiearid zones are expanding, local operators and national decision-makers need access to reliabledata on hydrologyand climate. The World Bank has therefore taken the initiative of financing. jointly with the FAC (French Ministry of Cooperation), an assessment ofthe quantityandqualityofthe hydrometeorological data currently being produced on sub-Saharan Africa This is the Water Assessment Project, covering the surface hydrology, hydroclimatology and hydrogeology aspects. An assessment is being made of the situation regarding data gathering.processinganddisseminationineach of these fields.
The work has been organized around the big

river basins that involve a number of countries (the Nile. Zambezi. Senegal. Niger, Chad and Congo/Zaire, etc). The specific issue of Madagascar and the Indian Ocean islands is being handled separately.

A large number of regional institutions and financial and scientihc partner organizations have collaborated on this project. lts hndings will make it possible to identify the main shortcomings and to propose priority programs to make up for them.

Assessing the state of the art

ORSTOM was made responsible for the surface hydrology and hydroclimatology strands for sixteen countries of West and Central Africa. and this work involved more than thirty French and African scientists. An survey was made of existing data on the sixteen countries. its availability and its quality, and a synopsis is now available of work carried out in the region by ORSTOM and French and British consulting hrms (BCEOM - Societe francaise dlingenierie, SOGREAH. Motto E; MacDonald. etc). Besides this, more than a hundred proposalsfor national research orengineeringprojectsandfourregion-wide projects have been elaborated, with a view to extendingthe data gathering. processing and dissemination networks Several hundred stations are to be equipped for satellite teletransmission covering the entire African continent. (Continental Water Department. Water Assessment Project)

Tropical flora

Most of the Institutes work on llora is done by the HBiological diversity and forest systems"

research unit, which is currently continuing its cataloguing of tropical flora.
La Flore des Mascareignest La Reunion. Maurice. Rodrigues. is a joint publication by the MSlRI. ORSTOM and the Royal Botanical Garden. Kew. UK. An ORSTOM scientist is coordinating the work of some forty Dutch. American, French. British and other botanists The fourteen vol umes already published list I I8 families and a hfteenth volume is in progress.
ORSTOM is also supervising the Flora of the Guianas, Guyana. Surinam. French Guiana, in collaboration with institutions in the Nether- lands. Germany. France. French Guiana. the USA, Surinam, Guyana and the UK
Some 240 families of Phanerogams have been identified: Pteridophytes, Bryophytes, Algae, Fungi and Lichens are also covered. Twelve families of Angiosperms have already been published, one family of Pteridophytes is now completed, and a second has been partially published
La Flore de la Nouvelle-Caledonie et De’pendances is being produced by the MNHN’s Phaneroga- mia laboratory with ORSTOM’s assistance. Sixteen instalments have been published. covering the Pteridophytes, Gymnosperms and thirty-lour families of Angiosperm.
ORSTOM is also taking part in a regional pro- gramtocataloguethe flora oftheSeychelles:the studies of Dicotyledons (90 families) have now been completed. and publication of the corre- sponding book is now under way
With the MNHN’s Phanerogamia laboratory, ORSTOM is making regional inventories with a view to publishing a flora of Vanuatu and a Floristique et phytoecologie de la Polynesie frangaise.
(RU 3H. Program on "Floristic inventories and editing of tropical flora")
Conserving the genetic heritage of the plant wodd
The developing countries are following in the steps ofthe industrialized countries. where the expansion of agriculture has been very largely responsible for the extinction of many local species and biological diversity in the plant world has shrunk to a dangerous extent.
In association with CIRADORSTOM isrunning several programs to identify and conserve ge netic resources among cultivated tropical plants. primarily in Africa, Since the 19605. the Institute has been paying particularly close at- tention to food crops: cereals. fruit, vegetables. roots andtubersiand have been collectinglocal cultivars and related species
Rice. millet, sorghum and okra
ln eleven countries of Africa. in Madagascar. India and Australia, 4.000 original rice samples have been collected.
Millet and sorghum have been collected on behalf of the IBPGR in twelve countries in the Sudano-Sahelian zone of West and Central Africa. in India, about 3.500 local cultivars are being conserved. with duplicates in Canada’s gene bank.Work nowunderwayinthe Sahelian zone, Mauritania and Sudan concerns wild mil- let strains.
The same ORSTOM/IBPCR program is working on okra e a vegetable that is not widely known in Europe but is very popular in West Africa and

India. 3000 cultivar samples have already been gathered through the program’s exploratory work.

Coffee

More than 2,000 volunteer coffee strains were collected in Africa and Madagascar during the I9605. at which time the search for wild Arabica coffee bushes in Ethiopia was also launched. Acclimatization trials on this species have been run in Cameroon. Madagascar and COte d’Ivoire and. since I 975. a search for wild coffee strains has been going on in seven countries ofAfrica, A unique collection ofvolunteer coffee seedelings from tropical Africa, including 8000 original genotypes belonging to about twenty different species, has been gathered together in COte d’lvoire.

Alongside this work. a process of reflection has been embarked upon on in situ preservation of coffee varieties in forest reserves. Other collections are being kept in held conditions on agricultural research stations, in partner countries in Africa. Unlike the great majority of other species which ClRAD and ORSTOM reproduce and keep in cold storage in seed form (30,000 samples), these coffee collections, with the exception of just a few species, cannot be duplicated in France. However. research at CIRAD. CNRS and ORSTOM has now devel oped suitable technology for conserving this species. Duplicates ofa few hundred strains are being stored on an experimental basis.

(RU 3A Major Program on Genetic Resources)

New Caledonia:
the greening of the slag heaps

New Caledonia. one of France’s overseas territories, isthe world’sthird biggestnickelproducer. with four million tonnes mined every year. ORSTOM, the local authorities and the SLN have launched a research program to rehabilitate old mine sites using local wild species from among more than a thousand that have been catalogued in the mine areas. Given the high levels ofheavy metals in the island’s soils only species native to the island are suitable for recreatingthevegetation cover. Moreover. elsewhere in the Pacihc where exotic species have been introduced into island ecosystems. they have run wild to a destructive extent, and this danger must be kept to a minimum.

The specific constraints of these environments have been identihed: the bare ground constitutes a very unfavorable biotope for vegetation to establish itself spontaneously: water availability is poor, nitrogen, phosphorus. potassium and calcium are lacking. magnesium levels are too high and nickel has toxic effects.

About twenty herbaceous and woody species have been selected for their suitability in New Caledonia’s environment. Particular attention has been paid to Casuarina sp. which can fix nitrogen by bacterial symbiosis The germination process of many species has been studied and mastered and techniques for taking successful cuttings from shrubs have been developed.

An agreement has been signed between ORSTOM. ClRAD-CTFT and the local authorities. to put these findings into practical application and launch operations for re-establishinga sustainable. protective plant cover that inte-

grates well with the landscape and respects the diversity of each ecosystem,
(RU 3H. Program on "Rehabilitation o/degraded areas in New Caledonia")

Optimum ecological conditions for pelagc fish

One third of the world’s catches of coastal pelagic llSl’l occur in zones of upwelling, where nutrienterich water from the deep ocean comes to the surface. These zones are mainly found in tropical and subtropical regions. The upwelling is unstable, and the tonnage caught is irregular since it depends on how many young Hsh survive the larval stage. in which mortality rates are very high.

ORSTOM’s oceanographers have shown that there are certain optimum environmental conditions that favor the survival of young pelagic hsh to the adult stage. A correlation has been found between annual survival rates and the intensity of the wind that engenders the upwelling. Survival rates are highest when wind speed is around 5-6 meters per second. Below this speed the upwelling does not become well established: with higher wind speeds, the sea begins to foam and the plankton colonies are broken up by turbulence

The findings of this research. carried out at the CRODT in Senegal. earned ecologist Philippe Cury and physicist-oceanographer Claude Roy the I99I Philip Morrist Science Prize for Life Sciences.

t The Philip Morris Science Prize Association is fostering French applied technology research.
(RU /l. Program on UFisheries and Climate")

Protecting Madagascarls ecological heritage

Madagascar’s natural heritage is exceptionally rich, with I 2.000 plant species and over 80% of its vertebrates being specihc to the island. This ecological capital is in danger. despite the measures alreadytaken. because the topography, the climate and the ruggedness of a large part ofthe island leave it exposed to many natural hazards. In the Center and East ofthe island, heavy rains lead to flooding and soil erosion every year. while the South and West suffer drought and food shortages. Population growth has not been paralleled by a signihcant rise in production. and human activities are destroying the environment: the forest is over-exploited, more and more forest is cleared for ricecropping, bush tires are common. there is over-fishing of both freshwater and sea species, etc

In collaboration with the CNRE. ORSTOM is taking part in threejoint programs being run by teams of Malagasy researchers, on:

-urbanization and the crisis in the island’s production systems:

-the functioning and dynamics of the mangroves in the western part of the island;

-surface water and underground water circulation in the Hautes-Terres region (PEC for Programmes eaux continentalesl

Biodiversity in freshwater and estuary fish

Over the past ten years or so. aquatic ecology researchers have turned away from such concepts as "a system in equilibrium" or "a homogeneous environment". Now. the emphasis is on the heterogeneity of all environments and the rich variety of species they contain. the role of disturbances, the importance of historical factors in structuring populations. the role of complexity in the functioning of a system. etc.

Research carried out by ORSTOM goes beyond merely cataloguing the whole rich range of species in all their genetic diversity; it considers their functional role, the reasons why their conservation is important, and their reactions to natural or man-made changes in the environment.

Cataloguing and evaluating biodiversity

ORSTOM’s research programs on genetic diversity among tropical fish in West Africa concern species that can usefully be farmed: tilapia. cathshes : Heterobranchus sp. and Chrysichthys spp. ORSTOM’s partners in this work are the MNHN (Paris), the University of Montpellier. Tervuren Museum (Belgium) and the CRO in Abidjan,

ORSTOM and theTen/uren Museum havejointe ly published two collective works. CLOFFA (Catalogue of African Freshwater Fish), and a Fauna of West African fresh and brackish water fish. The same work is under way in South America, in Manaus (Brazil) and Guiana particularly.

Origin and maintenance of biodiversity

Past climatic variations have produced major fluctuations in aquatic ecosystems. Geological events have also helped by isolating different fauna or bringing them into contact. In periods of drought. the existence of refuge areas has enabled fauna to survive and later recolonize. Research on the biogeography, history and

changing composition of faunal communities has been carried out in West Africa and is to be extended to Central Africa. Some interesting findings have emerged from work in the Amazon.

A good deal of information about reproductive cycles has been gathered by studying the biological strategies developed by different organisms Work is now under way on the behavior of breeding stock and the development of juveniles,

Continental water in Lower Guinea

In Guinea. ORSTOM and the CRHB are working on a joint research program on the aquatic fauna of the country's continental waters. The country possesses some very large estuaries with huge areas ofmangrove, breedinggroundsforsomeIittle-known species. Little research has been done on this resource and little use is made of its potential: however, provided the rapid developmentofminingandfarmingactivities do not disturb these fragile aquatic environments. they could contribute to seIf-sufhciency in food.

Most of the species have been identihed: a book on the local fauna and a reference collection are now nearing completion.

(RU 2C. Program on "The role of the physical and biological environment on fish resources in Lower Guinea")

Intercontinental comparisons

ORSTOM is studying the influence ofenvironmental factors on the biodiversity and range of species in aquatic communities in Guiana. Guinea and the Amazon region.

With river-dwelling hsh, the hydrology and morphology of the river bed are often regarded as factors in the structuring 0fthe hsh communities. Research has been undertaken in Guinea and Guiana to elaborate modelsthat will explain and predict the composition ofthese communities in accordance with the characteristics ofthe environment.

Based on work already carried out, it is now possible to compare environments with closely similar characteristics but on different continents. where species have been evolving and adapting to local conditions. independently of each other, for the past I 50 million years. This type of intercontinental comparison should rer veal the similarities and differences between fish populations in different river systems and conw vergences between their strategies for utilization of space and resources.

Ultimately,ongoingresearch will lead to models ofhow fish communities function and enable us to predict how they will be affected by disturbances connected with the utilization of a water resource or its live resource contents

Water and health

Agricultural and agro-industrial land developments bring extensive Changes to the environment. To study the impact ofthese Changes on the health of local communities, ORSTOM has set up programs combining biology. medicine. agronomy, the humanities and the social sciences.

Studies carried out on the fringes between the forest and the humid savanna (along the lower

reaches ofthe Sanaga river in South Cameroon), and in the Sahelian zone in the lower and mid Senegal valley (the EEC’s "Espoir" program) are providing opportunities to see how two heavily water-consuming crops, one a food crop (rice) and the otheracash crop(sugarcane),canaffect four vector-borne diseases: malaria, schisto-somiasis, Bancroft’s hlariasis and relapsing fevers

Rainled rice cropping generally leads to no change in the health status of local communia ties, but deforestation can lead to an increase in the population of malaria-carrying heliophilic anopheles mosquitos, Irrigated rice growing. on the other hand. is more dangerous. as it facili-tates concentrations of anopheles (which are also carriers of hlariasis) and so multiplies the risk of disease,

In areas where malaria rates are stable, vector density has little impact on the number and severity ofclinical cases, merely constituting an annoyance for the population and forcing peo-ple to use mosquito nets. But in areas where malaria rates are unstable, deadly epidemics can occur.

Irrigation canals also facilitate the proliferation of molluscs that are intermediate hosts to the bilharzia (schistosomiasis) parasite. and the extension of rice farming also leads to rapid proliferation of rodents responsible for serious bites and relapsing fever.

Industrial cultivation of sugar cane involves considerable use of immigrant labor. and this fosters dissemination of new pathogens.

All this research is useful for the fight against

disease hazards connected with changes in man’srelationship with his environment. Apart from the development of a bilharzia vaccine. health education is indispensable for the fight against this disease, This raises the question of adapting the capacity of the health services in these areas
(DES. Major Program on "Water and Health")
The great endemic diseases:
relations between a society
and its environment
The onchocerciasis research carried out by P. Richet, father of the epidemiology of river blindness. lies behind a good deal ofORSTOM’s work on the ecology of the simulid. the insect responsibleforthisdisease.Thisresearch hasled to a vast onchocerciasis control program launched by the WHO in West Africa.
The success of this exercise. carried out over an area of l,300.000 kmg. has won international acclaim.
Itwasthoughtformanyyearsthatonchocercia-sis was responsible for the depopulation of the valleys. and this assumption long remained an obstacle to evaluating the role of vectoreborne diseases in land management systems, There are indeed vast uninhabited spaces alongWest Africa’s main water courses. while the areas between seem over-populated. But it has not been scientihcally established that there is al-ways a causal relationship between onchocer-ciasis and low population density in the stream valleys
ORSTOM has therefore developed some new research into the link between health and environment. with a large number of partners #French. European and. especially. sub-regional African institutions (the OCCGE and OCEAC). Medical entomologists. geographers. parasitol. ogists and doctors are studying the ecology - including the human ecology - of these par-asite diseases and the role of man’s land use systems in their development. This work has shown that epidemics of parasite diseases are linked to the ways in which human societies organize their physical and social space A shift from an endemic phase to an epidemic phase points to a mis-match between the environ; ment and the management system employed,
This being so. the question arises as to the origins and consequences of epidemics in the distant or more recent past Onchocerciasis only became a serious social problem in the secondquarterofthiscenturyThe placeswhere it erupts most often are former centers of infec-tion ofsleeping sickness and areas where exten-sive farming systems have spread The old agrii cultural techniques, in which trees. cattle and crop farming were combined. allowed high population densities in farming areas and so protected the populations from serious river blindness epidemics, since transmission of the disease was diluted among a larger number of individuals.
Sleeping sickness spread when relations be-tween scattered human settlements intensified and closer contacts developed between man and tsetse fly. following the changes in lifestyle. production and environmental management that occurred during the colonial period, It was in this way that trypanosomiasis epidemics

depopulatedthevalleysofSudan.sohelpingthe spread of onchocerciasis.
A better knowledge of the history of a disease enables us to identifythe health risks connected with development and changes in the relations between rural societies and their environment.
A particularly close watch must be kept on valleys freed from onchocerciasis. to make sure that the gains achieved by success in the hght against river blindness are not wiped out by an explosion of sleeping sickness.
(Health Department, MajorProgram on "Environment and Health")

The town in all its aspects

In tropical countries where more than half the population are towndwellers (40% in Africa. 70% in Latin America). the urban environment raises specihc problemszconsumption olenergy and resources. output of waste. pollution. health problems. vulnerability to technological and natural hazards, the problems of spatial organization. These problems are accentuated by very rapid urban growth: many towns in the South are growing at a rate of 4% a year. doubling their populations in less than twenty years. Land planning and infrastructure building cannot keep pace with population growth: the great megalopolises look like perpetual building sites and suffer from all sorts of malfunction.
ORSTOM has been working on urban environmental problems for many years now, on both the land development side and on the question of how space is shared between human and other populations , plants, mammals, insects. bacteria viruses etc

In Africa

In Pikine. Senegal. ORSTOM has been studying relations between health and the urban environment so as to define the relations between environmental hazard factors (population density. drinking water. nuisance factors). social factors (living standards. housing etc) and cul tural factors (representations ofdisease. education, etc).
This work has revealed some paradoxes regarding health and urban development in African towns: for example. while the geography of malariaisstilltiedtothe ecology ofthe mosquito access to treatment depends on social segregation. On the other hand, children’s nutritional status is related to the extent to which traditional family structures have been maintained.
The combination ofthese various health indicators maps out a new kind of geography of the town. and the studies carried out have immediately operational applications in public health, particularly for working out prevention and health planning strategies.
In five of Africa’s major. fast-growing cities 7 Conakry, Ouagadougou. Yaounde. Ibadan, Nairobi - urban environment and urban expansion have been analysed with the help ofremote sensing techniques. making up for some major mapping information gaps on these sites.
This work has shown how the vegetation is retreating around Ouagadougou as a result of urban expansion and growingdemand forwood for fuel. building and carpentry. In Conakry. it has revealed the fragility of the mangrove ecosystems. endangered by woodcutting and

newly-established rice helds which are threat-
ening to destroy the traditional coastal fishing
grounds around the town.
In West Africa’s towns, access to land owner-
ship is a major issue for the city’s development.
Town management and the organization of ur-
ban development zones are intimately linked to
land userights and practicesStudieson theland
ownership question are under way in Abidjan,
Dakar. Ouagadougou and Bobo Dioulasso.
In Latin America
Many studies of urban environment manage-
ment have been carried out as part of the
"computerized Atlas of Quito" project in
Ecuador. (See "An urban information systemfor
city management". p. 21). Particular attention
has been paid to the risk of volcanic eruptions.
rare but deadly. and to disturbance ofthe drain-
age network. The appropriate response to the
volcano hazard is to set up plans for evacuation
and education of the population. As to distur-
bance ofthe drainage network. this is the result
of land development decisions taken long ago
and still in force today.
In the land development sphere, a multi-discia
plinary study has been carried out in Chalco. a
satellite town of Mexico City where environ-
mental problems have become serious owingto
recent urbanization of a swampy area without
the necessary drainage infrastructures.This lack
ofappropriate measures has led to an accumu-
lation of waste water. pollution of the ground-
water and a shortage ofdrinking water. In the
socio-economic study of problems arising from
spontaneous urbanization, this urban hydrolo’
gy study thus proved a very important element.
(RU 5F, "Towns. space, developments": RU 25.
Program on "Modellingsur/ace runoff in the Chal-
CO Valley")

PARTNERSHIP
AN ESSENTIAL ELEMENT

Development research issues must be addressed by national researchers. The existence of thriving scientific communities in the countries of the South is more than a sign of sustainable development: without them, no such development is possible. Scientific cooperation is not an end in itself. Like any other form of technical cooperation, it should last just long enough to flourish into a real partnership. for without the partnership principle no meaningful scientific activity can exist at the international level. This shift has already taken place in most of the Latin American, North African and Asian countries where ORSTOM is working. and a similar process is under way in sub-Saharan Africa. The success of ORSTOMis Strategic Plan for the coming years depends on deep-seated change in the Institute’s attitudes and procedures to build the partnership principle into its scientific activities, financing policy. recruitment policy. evaluation and STI.

ORSTOM’s scientific cooperation must not be judged merely in terms of its expatriate ratio - the ratio of staff members working outside France to the total number of permanent staff at the Institute or in its scientific departments. Rather, ORSTOMis activities should be evaluated in terms of the number of collaborative programs being run, the number of non-French researchers that are really involved in these programs, and the number of young researchers that have been trained or are currently in training. Young scientists from France or other countries in the North must not take precedence over young scientists from the South. however legitimate the desire to train or employ them may be. The Institute must share its skills and information with sister organizations in the South - such as the Third World Academy of Science, the African Academy of Science or Africa’s CODESRIA - in an effort to overcome national. cultural. linguistic or even continental segregation. which isolates and marginaIizes research in the South. To monitor its cooperation policy more closely, ORSTOM’s Board of Trustees has asked the External Relations Service to assess the implications of a policy that is designed not to replace or supplant efforts in the South but as a scientific objective in its own right - an objective that is as important for the North as it is for the South. All those involved in the development and cooperation process will benefit from a better understanding of those implications.

PERMANENT DIALOGUE

ORSTOM maintains a permanent dialogue with the political and scientific authorities in the countries where it is active. with a view to promoting joint research programs and research training and providing support for scientific institutions and scientists from the South. ORSTOM researchers are working in twenty-three countries outside France, under scientific cooperation agreements that indicate how research programs should be selected and conducted and that govern relations between researchers and research institutes or universities. with particular reference to training. Further. these agreements specify how results and STI should be used. and provide for follow-up by consultative committees. which meet regularly.

In I991. framework agreements were signed with Senegal and Guinea. and eight consultative committee meetings were held. either in Paris or in the respective host countries.

The Chairman, the Director General and the Head of the External Relations Service visited ten countries of Africa. Asia. Latin America and the Pacific Region in I99I.The September l99l Partners' Forum was one of the milestone events in this ongoing dialogue.

The meeting brought together some IOO researchers and scientific managers from sub-Saharan Africa. ln-depth discussions highlighted the objectives and methods that cooperation between the Institute and the other French research organizations should follow if they are to meet the expectations of their partners from the South. who are eager to play a more active role in international research into development and environmental management.

More specifically, they expect their partners from the North. and ORSTOM in particular, to:

_conduct collaborative research in a spirit of true partnership.

- provide research training for young scientists.

-support the scientific communities and institutions of the South.

SHARED RESEARCH

Shared research implies joint research programs - i.e.. research programs that are selected and conducted jointly by researchers from the North and researchers from the South - as well as equal access to satisfactory working conditions. equal recognition of scientific work carried out on a collaborative basis and fair distribution of the economic and financial benefits of research applications. ORSTOM has made significant progress in this difficult area over recent years, increasing the number of collaborative projects and endeavoring to ensure that the collaborative approach is

systematically adopted. These programs are conducted either in associate research institutes where ORSTOM researchers are working on secondment (Mexico. Brazil, Thailand. Indonesia, sub-regional centers in West and Central Africa working on major endemic diseases in Senegal. Cameroon and Madagascar) or in ORSTOM's own centers with the active involvement of associate researchers (Congo. Central African Republic. Mali. Burkina Faso and Senegal). ORSTOM has signed contracts of association with I I l non-French researchers and. for the first time this year, fifty-seven of these researchers. whose contracts were due to expire. underwent scientific evaluation by the Institute's official Commissions. Associate researchers have the same scientific back-up as ORSTOM researchers and have access to the most advanced equipment (satellite image processing stations. computers and software in Dakar. Niamey and Noumea. computerized documentation. particularly through the HORIZON data base. and the RIO dedicated electronic mail network).

Various types of initiatives allow associate researchers to disseminate their findings through publications and conferences, meetings and seminars organized either in their own countries or internationally.

RESEARCH-BASED TRAINING IN RESEARCH

This approach is the second mainstay of ORSTOM's scientific cooperation strategy. In I99 I, 288 young scientists from the South came to work in the

lnstitute’s laboratories and with its research teams. Including French trainees and grantees, a total of 480 young scientists came to ORSTOM in l99l. which is a remarkable achievement considering that the full complement of researchers and technicians from the Institute’s scientific departments. expatriate staff and local recruitment agents included, number only LSZS.

SUPPORT FOR SCIENTIFIC COMMUNITIES IN THE SOUTH

The third mainstay of ORSTOM’s scientific cooperation strategy involves direct support to countries in the South, and particularly in sub-Saharan Africa. that wish to build an autonomous. national and sub-regional development research potential of international stature. In l99l, this kind of support led to a change in status for a number of uORSTOM Centers" (the Abidjan oceanography center in C6te d’Ivoire, the Bangui center in the Central African Republic, the Brazzaville and Pointe-Noire centers in Congo, and the Boussoura oceanography center in Guinea).

The Institute has agreed to review the Financial and statutory situation of its 740 agents and technicians recruited overseas and to provide training to increase their skills and efficiency as members of their respective teams and laboratories.

ORSTOM and CIRAD helped to set up CORAF, and the Institute is taking part in CORAPS uDrought Resistance" (R38), "Cassava" and "Agro-Forestry" networks. The participation of ORSTOM and its associate researchers in the 055, the networks on "Clay", "Laterite", "M(aga-Tchad" and "Long-Term Savanna", and the creation of new networks on nitrogen fixation. social change under structural adjustment, and urban integration are all part of the Institute’s contribution to moves to open up Southern research and encourage South-South scientific cooperation.

Finally, ORSTOM has provided technical assistance to the research administrations in Mali and Burkina Faso. helped to renovate or create national documentation services, and trained documentation specialists in Madagascar, Cameroon and Togo.

I Agreements with partners and regional priorities

ORSTOMTS Strategic Plan speCIfies the Instr tute’s regional pnontles for the next ten years The top priority ITT thls pian IS Africa where ORSTOM has acquired a substantial corpus of knowledge and experience and has forged solid relationshlps Wlth national scuentlfic com-mumttes.

The African priority Involves extending ORSTOM’S actIVItIes to North Africa and the

Engltsh-speaklng countries. In January I99I.
the Instutute Signed a tripartite SClentliIC coop?
eratlon agreementwuththeNatlonalAgronom-
IC Research Institute and the Hassan ll Agro-
TTOTTTIC and Veterinary Scrence Institute In
Morocco.lnTunIsiatheCBSandORSTOM have
formalized then working relationships through
an agreement involvmgjoint research Into the
biologicaltreatmentoffoodmdustry waste (see
"Reducmg pollution from OiIVE oil waste",
page 25)
In Latin America. ORSTOM is contunumg to
develop its contacts at the iHStItUtIOTial level In
Chills two agreements were SIgTTEd With the
universities ofAntofogasta. and a delegation In
Santiago was set up at the end of I99 I. The
Institute has also signed an agreement with the
Sugar Producers Association tn Colombia. her-
alding renewed ORSTOM involvement In thlS
country after a seveneyear period of absence
ORSTOM has decided to expand its actlvmes In
ASIa from extstlng platforms in IndoneSIa and
Thailand. NumerousmismonsmSoutheastAsxa
have started to work on specific collaborative
initiatives and an agreement has been Signed
with the IRDDM in Vietnam
The twentyeight ORSTOM delegations have
been asked to act as contact pomts and forums
forthelrrespective nationalselentihccommum-
ties with a view to encouraging Jount research
programs. reseatCh-based training in research
and faculltatlon of soence, and to prowde sup-
port in matters relating to documentation. ITT’
formation technology and STI.
I The Partners’ Forum, conditions
for sustainable research in Africa
The"PartnersForum’lheldinParisinSeptember
I 99 I , brought together more than IOO African
scientists and ZOOORSTOM researchers. selen-
tlsts and Institutional representatives from the
North.
Forum debates and discussions were an oppor
tunity for scientists from the North and the
South and representatives of administrations.
financing institutions. donors. etc. to express
IhCIT views on the real conditions needed for
sustainable research In Africa. the priorities that
should be adopted to achieve that goal. and the
obstacies to overcome.
The meeting reached a consensus on several
strategic proposals. equivalent to a charter,
Wthh the different parties have agreed to apply:
Greater. more lasting support (hnancial. social
and scientific) for Institutions and researchers
from the South. combined with ngorousevalua-
tion; additional financing could be provided by
SDQCifIC funds or foundations.
Desegregation of regional scientific coopera-
thTT through the development of networks
(such as the CORAF networks), broad-based
programs (the fight against onchocerciasis is a
model) and observatories (like the 088 or the
observatories on social Change and innovation
1n Cameroon).
eBetter coordination between research insti-
tutes and imancmg bodies The SPAAR and
France’sComite nationaldecoordination pourla
recherche au service du de’ueloppement already
promote consultation between hnancing insti-
tutions and benefiCIarIes.
The Forum was also an opportunity forORSTOM

to strengthen Its ties w1th African institutes OCCCEand OCEAC.andtoforge newiinkswith the Third World Academy of Science and the African AcademyofScience. The EEC, theWorid Bank.CGIARWHOandresearch organizations from different European countries (Belgium, Germany. the Netherlands. Portugal. United Kingdom. etc.) were represented at the Forum and took part In the discussmns.

FtnaHyt the Forum enabled ORSTOM to consol-tdate its collaboration with other French re-search bodies (CEMACREF. CNRS, IFREMER, INRA INSERM) and the N605.

I UTIS, advanced technology serving West Africa

The UTIS satellite Imagery processing unit is based at the CRODT In Senegal and is runjoint-ly by ORSTOM and ISRA Although the U’HS was ITTItlaHy desngned to provide support for oceanography research in Senegal, applications very quickly emerged in other areas such as rainfall estimation and monitoring of the Saheiian Climate and Senegal’s rnain rivervaileys. The unit has a broad array ofadvanced techno-logy equipment. including microcomputers, a Sun workstation. a Meteosat/PDUS (Primary Data User’s Station) receiver. a Micropericolor system and a SPARC workstation,

Remote sensing is the most widely used ocea-nographic technique for studying the coastal upwellings where nutrient-rich cold water rises to the surface. Large numbers of pelagic iish -- sardines and similar species - live and re produce in these waters (see "Optimum ecolo-gical conditions for pelagic fish", page IO). In addition,surfacetemperature mapstransmitted in virtually real time are valuable sources of Information for tuna seining fleets. Finally. the CRODis oceanographic ship the Louis Sauger

is planning a series of operations. combining remote sensing and direct measurement techniques. to analyze ocean currents off the coast of Senegal

The UTIS also offers interesting applications in climatology and rainfall estimation. The flow of humid air that generates the African monsoon is an important factor for rainfall in the Sahel. This flow is partly dependent upon the Sainte Helene anticyclone. and the longitude of this anticyclone could affect the size of the flow of humid air- a theory conhrmed by data from the Meteosat water vapor channel and the Reading weather center. The good rainfall the Sahel has enjoyed in the last ten years seems to be linked to stronger flows in the lower layers and an intensification of the Walker cell (a meridional circulation cell).

lnaddition,thesoftware usedlorrainfallestimaetion by satellite (EPSAD has been improved Rainfall can now be monitored in real time. and the software can therefore be used to determine sowing dates or identify areas where late or insufhcient rainfall will be a significant handicap for rainled crops.

The UTIS is contributing to the CRODT study in the Saloum River region. where meteonoceanic change has modified the ecosystem: reconhguration ofthe mangroves. break in the offshore bar at the river estuary. heavy coastal erosion etc.

Two SPOTscenes- one taken at the end ofthe dry season, the other at the end of the rainy season -will provide a better understanding of the processes involved here. Satellite image processing is also being used by the Campus program to study the Senegal River valley.

In I991, researchers at the UTIS played host to thirteen trainees and numerous visits from managers of scientihc bodies in other countries.

I HORIZON and SESAME, two valuable information access aids

ORSTOM created the HORIZON bibliographic data base for its researchers and their partners from the South. HORIZON contains 33.000 references (in print and retrospective), more than 4,500 ofwhich were added in I 99 l . Nearly 2l,000 publications have been recorded on microhche to simplify access to the source documents listed in ORSTOMis bibliographic data base.

In association with CIRAD, INRA and BDPA. the Institute created the SESAME CD-ROM system. which is a data base on agriculture. and more specihcally, tropical agriculture. The network has been extended to cover documentation at institutes in Cameroon. Madagascar, Chad and the Sahelian countries (RESADOC)

The second version of SESAME was released in I991 and includes 66.500 bibliographicentries, a large proportion ofwhich are not listed in other data bases. SESAME can be accessed in English or French and uses bilingual software and key words. The software (CTI) has been simplified to streamline access to the data base,

I RIO, an international communication network

ORSTOM has set up an electronic mail system known as RIO (for Reseau informatique de (ORSTOM) that interconnects the laboratories of fifteen countries and provides them with

access to the major international research and higher education networks With RIO. scientists working in laboratories across the world can exchange information and conduct joint research programs,
The RIO network uses public telecommunications networks and relies upon affordable work stations running application software that is in widespread use in university and research circles. Ultimately. the network will help to bring scientific communities from the South into closer contact with each other and with their counterparts in the North,

I Training and partnership formulae

Training courses

Between I984 and I99 I . the numberoIFrench and noanrench trainees who followed courses in ORSTOM'S researchfacilities and laboratories rose from I70 to 358.
This increase is a reflection of the Institute's determination to pursue its efforts in the trainingarena, In addition, largenumbers ofstudents attended courses run by local establishments.

Non-French researchers receiving ORSTOM training: breakdown by geopolitical area

Region	Number of researchers	Number of months
Black Africa (French-speaking)	2I8	2. l 345
Latin America	89	4 l4
North Africa	47	I965
Asia/Pacrlic	I8	6l,5
Subtotal	442	28065
Notth America/ Europe	l9	65.5
TOTAL	46I	2.872

More than halfofthe I94 non-French trainees that followed courses in l99l were from Black Africa. Courses were held in their own countries, in France (Bondy. Montpellier) or in another country in the South. Hall of the French trainees chose to follow their training with research teams outside France, primarily in Black Africa.

Research grants

Research grants are managed by ORSTOM deapartments and enable non-French students to prepare university theses In l99l. 87 grants were allocated, mostly to scientists from Black Africa Burkina Faso and Senegal have a particularly dynamic approach to researcher training.
French students, supervised by ORSTOM staff, are eligible for research grants from the French Ministry of Research.

University teaching

ORSTOM has increased its scientific cooperation and teaching activities with universities in France and elsewhere Existing relationships were formalized through numerous partnership agreements. including twelve framework agreements and eleven collaboration contracts Researchers also consolidated a direct involvement in teaching and student followeup.
particularly for DEA degree courses, and contin ued to sit on thesis assessment committees.

Training/professional placement contracts

These contracts apply to professional training programs that meet the needs of all research disciplines. all levels ofqualihcation (researchers

and technicians), and all types oftraining (basic training, skill updating). Eight countries had already signed protocols covering this kind of training (Cameroon. Congo, Ecuador, Niger, Vladagascar. Central African Republic, Senegal and Venezuela). Three others (Peru. Burkina Faso and Guinea) signed in I99 I .

ORSTOM training financing

Type of collaborative training	FF ’000
Support for laboratories running training courses	876
Grants lor training courses	385
Teaching support	237
Programmed training courses	510
Research grants	2,460
Trarning/professronal placement contracts	I ,200
Contracts ol assocration	3.330
Short-stay collaboration	2.800
TOTAL	I L798

Contracts of association

Contracts of association are financed by the French Ministry of Cooperation and Develop ment and enable young researchers from the South to take part in joint programs with ORSTOM and to benefit from financial assist- ance and guidance from research teams. A total of III researchers. ml of them from Black Africa. signed contracts ofassociation in I 99 l a

Short-stay collaboration

Short-duration visits (less than six months) are designed for experienced researchers and pro:

mote cooperation at the highest level. Guest research teamsand scientists from alldisciplines lend their specialist skills to selected programs. In l99l. ORSTOM facilities played host to about Hlty visiting scientists, mostly from Latin America

I Cdte d ’lvoire: two scientific community support strategies

C6te dtlvoire takes over management of the Oceanographic Research Center (CRO)

Oceanographicconnections betweenORSTOM and COte d’lvoire date back to the mid- I 9505, when two ORSTOM oceanographers were sent to work at the IFAN facility in Abidjan. In I 958. they were seconded to the oceanography dee partment at the Ministry of Agriculture. which laterbecamethe CROeone ofthe cornerstones of oceanographic research on the West African seaboard (with the CRODT in Senegal).

In theory. ORSTOM was merely responsible for the management of the CRO. but in fact it was an ORSTOM center in an lvoirian setting. In I99I. there were twenty lvoirian trainee or senior researchers working there,

The end ofORSTOM’s management contract in I99l was a timely opportunity to transfer all administrative responsibilities and supervisory roles to the Cote d’Ivoire authorities. ORSTOM is still closely involved in the CRO. both scientifically and financially, and new cooperation proceduresswillneedtobeintroducedinthe near future. The CRO is now a Tnational public establishment". directed by an lvoirian researl cher and enjoying the same degree of independence as ORSTOM. The two organizations are looking forward to working together on an entirely equal footing

The new institutes internal structure and procedures (particularly for local technicians) are gradually being finalized. This transitional period will end in I992. and new cooperation procedures can then be formally introduced.

The Petit-Bassam center and the restructuring of social science research

Seven university institutes are involved in social science research in Cbte d’Ivoire, most of them focusing on a single discipline or topics Researchers also have extensive teaching duties! At the same time. the ORSTOM center at Petit-Bassam. which was set up with some difficulty in the mid- I 9605, has been pursuing multi-disciplinary research on selected topics of major importance. Over the years. a handful of lvoirian researchers have broken ranks and joined the ORSTOM center

This combination olconcentration on the one hand with dispersal and compartmentalization on the other was a worrying situation. A number of restructuring projects have foundered in these very specific institutional waters. In April I99 I. however. a group of French and lvoirian researchers attending the l’journeles de Bingeruille" seminar decided to tackle the problem from a different angle,

They chose to rework the scientific structure of the research initiatives belore addressing the institutional issues The T’inter-disciplinary 50a cial sciences group" they set up defined a research program based on clear priorities. Since then. seminars, conferences and round table

discussion groups are held periodicallytoreview ongoing research projects. There are plans to produce a regular newsletter,

The Petit-Bassam center is now "neutral" territory and plays a unifying role as well as organizingthe conferences and seminars. For the time being, therefore. there is every reason to keep the center open. its primary objective today being to help social science research in C6te d'Ivoiretorestructure by sharpeningitslocuson a few priority programs.

I International collaboration on agronomy

ORSTOM has developed numerous collaborative programs with IARCs in the CGIAR network, In association with CIRAD and INRA the Institute has signed two framework cooperation agreements with IITA and IBPCR. Similar agreements had already been signed with six other centers. Forms ofcooperation range from exchanges of genetic material and scientific publicationstoresearchersecondmentslorcollaborative programs.

Joint programs with lRRI. ICRlSATand CIMMYT cover the analysis ofgenetic resources through research into molecular biology With CIAT, the Institute is conducting a microbiology program on processing cassava and its starchy derivatives.

Concurrent initiatives with llTA and CORAF form the basis ofa largeascale regional research program into cassava production. marketing and processing in West and Central Africa

Finally. ORSTOM is playing an active part with INRA and CIRAD in CORAF'S associative networks: 'TR3S" (see "Land development in the bottomlands". page 2 l). "Cassava" (see "CORAF'S cassava network", page I7) and "Agroeforestry".

Inter-organization credits earmarked in the Insn titute's budget facilitate cooperation between ORSTOM teams and institutes from the North and the South.

Severalseminars have beenorganizedwith partnerorganizations. includingthe Parisworkshop 0n agrolorestry in October I99I, and the meeting on "Biocenose of the main cassava pests and biological pest control". which was held at the IITA center in Cotonou, Benin. in March I99I.

I ORSTOM-WHO: collaborative programs to combat major endemic diseases

ORSTOM has been working with the WHO for a very considerable time, and the international organization relies heavily on the Institute's work and skills in endemic tropical diseases, which is conducted jointly with local researchers in countries of the South

Priority programs are being conducted on ma Iaria. South American and African trypanosomiasis, filariasis. Ieishmaniasis, vector control. leprosy and schistosomiasis, all as part of the special Tropical Disease Research (TDR) program hnanced jointly by the UNDP and WHO. Research teams are focusing on subjects such as the epidemiology of vector-borne diseases. and are developing protocols and specific methods for vector and parasite control. Significant progress has been made in these areas, and regional campaigns. such as the Oncho-

cerciasis Control Program (OCP). have been launched to light these devastating diseases. Researchers from the South are systematically invited to take part in these research initiatives; theTDR programshares ORSTOM’sobjectiveof strengthening the scientihc potential of the countries ravaged by endemic tropical diseases. This same basic principle underpins ongoing campaigns in Cameroon to control mosquitoes in urban areas (see page 20) and to eradicate tsetse flies.

I A European strategy

In 1991, ORSTOM pursued its strategy regard-ing the EEC, developing closer. more diversiHed relations with the Commission (DG VIII. DC Xll and DC XVI) and with the Community’s scien-tific bodies JRC and Eurostat. ORSTOM re-searchers are involved in hfteen DG XII projects as part of the STD Ill program (life sciences and technologies for developing countries):

-rehabilitation of degraded land north of the Sahara: use ofperennial Ieguminous plants and associated micro-organisms to establish multi-layer communities;

7 study of the interface between domestic cy-cles and woodland cycles ofthe parasitecausing Chagas’ disease;

-strategy for vaccination against human and animal schistosomiasis:

7the biologicalandepidemiologicalsignihcance of transmission-blocking immunity and trans-mission-reducing factors in endemic Falci-parum malaria; human factors that influence infection of mosquitoes;

estudy and utilization of diversity in natural populations of hsh farming species in West Africa;

-earthworm populations as an instrument of soil fertility conservation and regeneration in

tropical agricultural systems:
-use of the bactericidal parasite Pasteuria penetrans to eradicate Meloidogyne root nematodes from soil;
#upgrading cassava in Latin America:
#implementation of health and pharmaceuticals policies in the People's Democratic Republic of Laos in a context of decentralization and economic change: global approach to the Laotian health system;
eassessment ofthe danger olreinfestation from woodland loci of T, infestans in the target area of the domesticvector eradication project in the countries of the Southern Cone:
ebiological and medical implications of the clonal structure ofthe parasite causingChagas' disease:
-analysis ofclonalvariability in the parasite, for predictionofthedifferentclinical manifestations of leishmaniasis;
-research and action on the use of the health services in Burkina Faso:
ebiosystematics and adaptive trends in the genus Rhodnius:
-regulation of sexual development in malarial parasites and the design of logical intervention strategies
The Commission (DG XII) has also commissioned ORSTOM to conduct a full-scale assessment of the STD ll program.
ORSTOM has forged or strengthened ties with many partners from European countries, largely throughits permanentdelegation attheCLORA in Brussels. The institute is now conducting collaborative projects with institutes from Portugal, the United Kingdom. Spain and the Netherlands. Dutch trainees have come to ORSTOM and one ORSTOM researcher has been seconded to a German research institute

I CORAF's cassava network

ORSTOM and the DCRST in Congo are joint facilitators of CORAFis cassava network As part ofthis task, the Institute is currently denning a large-scale research and development project on cassava in West and Central Africa. Theprojectfocusesonthethree basiclinksinthe cassava chain - production. marketing and consumption - and on interactions between these three aspects,
The research strand ofthis project is an integral part ofa broader development strategy, the aim being to meet specilic food and nutritional requirements, analyze commercial channels and pricing systems, and identify the role that cassava plays in shaping producers strategies and their responses to the real possibilities of selling their output.
This global, scientifically innovative approach is considered the best response to the priorities expressed by the countries involved in CORAF and to the conclusions of the CGIAR working group on this topic. This inter-disciplinary approach provides a very good complement to conventional sectoral approaches
This project is beingconducted by the ORSTOM center in Togo and the DGRST-ORSTOM center in Brazzaville. Congo. Thirteen English and French-speaking African counties are involved. and the project is a vivid illustration of the effective regional cooperation that is emerging in Central and West African countries.

I The M(Ega-Tchad network

Mega-Tchad is an international research network concentrating on social histow and mm! change in the Lake Chad basin - a vast area of Africa characterized by common traditions and intensive social interactions.

The five countries around Lake Chad are Niger. Chad. Nigeria. Cameroon and the Central African Republic, and the network has some 500 correspondents in Africa and Europe.

The network is run by anthropologists and is open to all disciplines, Inter-disciplinary research is actively encouraged Development issues are progressively taking precedence over cultural and historical concerns.

Researchers from the History Museum at Bern (Switzerland). the University of Frankfurt (Germany), the University of Calgary (Canada) and CNRS (France) have recently joined scientists from the ORSTOM LATAH unit and the CNRS LACITO center in the Me’ga-Tchad network.

I Three exemplary scientific partnership programs

OCISCA in Cameroon

The OCISCA project (for Observatoires du changement social et de l’innovation au Cameroun) is a joint initiative by Cameroons Dschang University Institute. the National Human Sciences Institute (ISH) and ORSTOMThe objective is to revitalize academic practices. pull down barriers between social and agronomic disciplines. and strengthen links between research and development,

The OCISCA project was launched to provide decision-makers with a means of observing social change and analyzing the effects this change is having on the strategies adopted by thedifferent partiesinvolvedinthedevelopment process.

The French Ministry of Cooperation and Development is hnancing the experimental phase of the project (methodology testinnghe OCISCA project has two main strands:

-basic protocol designed to provide, relatively quickly. a global picture of past, present and future (I9805 and I99OS) attitudes. opinions. reactions and behavior patterns in the different socio-economic groups studied:

findividual. coordinated research Initiatives using the same basic corpus of data to provide morein-depthanalysis ofspeCIfic aspects(technologlcal approach, study of agronomic strategies in management of plots. crops and associated species, relations between urban and rural areas, etc). Most of the observatories are in areasthatwere alreadystudied lOeZOyears ago, sothepre-crisissituationinthesedifferentareas is explicitly recorded. This makes it possible to analyze a number of specific parameters of the crisis. such as falling cash crop prices. return migration. the effects of parity differentials between the franc area an the naira area. the emergence of a private sectors etc. There are plans to install some ten observatories in different parts 0fthe country, to enable yearly updating of a complete inventory of current changes in sensitive sectors or sectors that are strategia cally important for development

To back up this research project, the ’TOClSCA networkl’has beenlaunchedtoactasaforum on the crisis that sub-Saharan Africa is currently

experiencing, and to enable the different partners to share ideas and experiences. The network produces a newsletter three times a years (see also "Cocoa and coffee planters in Cameroon: new strategies", page I9).

Development anthropology in Madagascar

The development anthropology team at the University of Tulear is composed of ORSTOM and Malagasy researchers andfocusesonteaching history, geography and social anthropology toyoungresearchers.Practicaltrainingandlong field courses alternate withtheory modulesThe method adopted _ known as the anthropology of social macro-dynamics - involves making large numbers of observation at the local level (ideal for training purposes). which are then Viewed in context, taking account of local or regional history and the geographical background of production systems etc. This form of iiresearch-based training in research" generates the kind of expert appraisals that increasing numbers ofdevelopment institutions, national bodies andinternationalorganizationsareseeke ing. (see "A research team ofanthropologists in Madagascar". page I9),

ILTAB: a biotechnology laboratory for researchers from the South

ORSTOMis Board ofTrustees has signed a cooperation agreement with the Scripps Research institute (TSRI). covering the creation of an International LaboratoryforTropical Agricultural Biotechnology (lLTAB) for developing countries. Based in San Diego, California. the ILTAB brings together twenty-five researchers from France. the United States. Germany. China, Peru. Colombia, Egypt, India. Cameroon. Cbte d’lvoire and Togo.

The purpose of the agreement between ORSTOM and the TSRI is to promote biotechnologies and to transfer those technologies to developing countries for applications related to tropical plant species. ORSTOM has a direct involvementinthesecountries.whiletheTSRlis largely concerned with pure research,
There are plans to develop a tropical plant biotechnology network (TROBIONED to tie in the main laboratories involved in technology transfers to developed and developing countries. The ILTAB is therefore the first link in an international chain that will help developed and developing countries to work together on biotechnologies applied to tropical plant species. Through the network. researchers from the South will have access to some of the most prestigious biotechnology laboratories in the world. The basic aims are to promote:
7 application of basic research findings to workable models:
_ application to tropical species of selected hndings from research into temperate species;
atransfer of new technologies and specific knowledge to developing countries. particularly through traineeships:
etransfer of information to international and national research institutes.

I Cameroon and Togo computerize scientific documentation

Cameroon has commissioned ORSTOM to computerize the documentation centers of the researchinstitutesoperatingundertheauspices ofits Ministry of Higher Education. Information Technology and ScientiHc Research (MESIRES). The server of the "Images" bibliographical data base is already on-Iine. offering access to all users and providing the network of documentation specialists with all the information they require for checking on existing publications before creating new bibliographic entriesl In this way. the scientihc memory bank of the Ministry’s documentation centers has been made available to a broad user base both in Cameroon and in other countries.
Togo. meanwhile, has asked the lnstitutetohelp to computerize the documentation center at the Population Research Unit at the University of Togo in Lome’. A bibliographic data base called POPTOGO already provides a comprehensive record of all existing scientific publications on demography in Togo. I

DEVELOPMENT: THE END PURPOSE

ne of the five strategic keynote themes set out in ORSTOMts I990 Strategic Plan is "knowledge and know-how for developmenti’.

These strategic orientations stem from the conviction that the Institute will retain its legitimacy only if it can clearly show that the results of its work provide answers to the real questions the developing countries have to confront.

This notion of utility or end purpose of development research can be defined in relation to the great priorities facing the countries of the South: managing societies in crisis; providing better nourishment and health care; land planning and development; rational use of natural resources; combating industrial pollution and natural hazards, etc.

However, the first essential for ORSTOM’s research teams is to take a global, inter-disciplinary approach to problems. The study of production systems, land, water and forest management methods or human behavior in relation to illness and disease vectors, the development of prevention methods and treatments, etc., all require an approach combining social science with other disciplines. Thematic and methodological inter-disciplinarity are hallmarks of ORSTOM’s research work.

An inter-disciplinary approach is necessary because it enables one to approach a subject in all its complexity. But this is not enough in itself. If programs are to meet development needs, they have to be defined in close collaboration with the people concerned.

This is why, with ORSTOM projects, partnership begins at the design stage when the aims and content of a program are defined, and continues with the partners carrying out together the operations they have decided on.

To meet the expectations of those involved in development. the local economic and political decision-makers, the international organizations. NGOs, private enterprise, etc.. ORSTOM. more than any other research institute. must make a special effort to transfer the results of its work. This means not only disseminating findings but also finding practical applications, whether in the shape of observation techniques. information useful to decision-makers, or products or processes that may increase crop yields, protect soils.

OF RESEARCH

improve health systems, etc.

To varying extents. all the Institute’s programs are geared towards the ultimate goal of development. But the solutions provided may. in any given instance. be global or

partial, direct or indirect, with immediate or longer-term impact. This section. therefore, presents only those programs which were already, in I99 I, of obvious value for development. I

MANAGING SOCIETIES IN CRISIS

he experience ofthe past two decades has shown that obstacles to development or the driving force of development lie very deep within a society. and that thereis no pointin tryingto relypurelyon technical formulae and financial help. however great, for sustainable development that will respect the needs of the environment. The disruption caused by the drought in sub-Saharan Africa over the past twenty years cannot be attributed to climatic factors alone. It is now recognized that the societies and States concerned, rendered fragile and unstable by rapid population growth combined with cultural, social and political upheavals that have not yet been mastered. have not had the means to respond to these climatic hazards in a coherent way. Societies evolve, social practices are changing. Getting to understand the social and economic rationale at work in each case is. for ORSTOM, an important subject of research. This knowledge can be harnessed in aid of development programs at the design stage, the application stage or the evaluation stage, as for example in southern Madagascar or in Cameroon. where the Institute is a partner in "observatoriesii of social change and innovation.

A research team of anthropologists in Madagascar

In Southern Madagascar, a research team with members from ORSTOM, the CNRE and the University ofTulear has. for several years now, been studyingchanges in the pastoral societies of the "zebu Civilization". The jomt research team(called ERA)iscarryingoutabasicanthroe pological study. while making its skills and knowledge available to regional development projects. ERA includes researchers from the society that is being studied as well as outside ethnologists. The team is analysmg the sponta neous dynamics of Village SOCIEIIES and the strategies of the different parties involved in deCIsion-making processes. from the most offii Cial to the most informal.

The team has developed suitable approaches and methods for studying how Htarget populations" react to development projects and ana ysing the problems and obstacles that arise during implementation of a protect.

Thelirst practical applicationfotERAis skills was n this second area. The ILO asked the team to study and try to resolve conflicts that had arisen when rehabilitated rice fields were allocated to andless peasants. it also analysed the causes of thefailure olanagtieulturalextension operation based around small irrigation networks. Solu- ions were lound In both cases. based on the understanding the team had acquwed in others similatsituationsintheregion andfrom surveys

run by a small number ofpeople who knew the region well.
ERA was then asked to handle the i'socio-economic follow-up" of a major development project financed by the EDF in the southwest of the country (the Fianarantsoa/Morondava/Toliaty triangle).
The SWiss Government Cooperation Agency has also called on the teams skills for a program to rehabilitate an irrigation network destroyed by cyclone Cynthia in the Morondava plainThe task here is to appraise the consequences ofthe massive infux of money from outside into Village economiesthat had not previouslyenjoyed financial resources.
ERA is hoping to expand and develop its research in sapport of development by concentrating on We key subjectarea51health1the sea: water for agriculture: the forest: the town. Between them. these themes cover most ofthe requests received for expert advice. With multie disciplinary teams working on all these topics, ERA could espond to these requests and act as a permanent observer ofsocial Change, combine ing pure esearch with practical problem solving in the service of development.
(RU 521, Program on "Urbanization and the crisis of the production systems in Southern Madagascar")
Cocoa and coffee planters in Cameroon: new strategies
Cameroon is currently going through a severe economic recession, On the international marketsthe prices olcoffee and cocoathe country's two main export products. are in free fall. There are no obvious economic alternativesthe eountryhaslittleinthewayofoilreserveswhlle the development of new products and services (market garden crops. food products. tourism etc) Wlll take time In this situation, cocoa and Arabica coffee remain essential for procuring hard currency, To set up an appropriate

economic policy. nationaI decrsion-makers need to know and understand the strategies by which planters are responding to present changes in their Situation.

ORSTOM. the ISH and the INDR have together set up an i’Observatory of sOCIaI change and innovation" in which psychovsocroIogists. economists. statrstrcrans and agronornists are working togetherv Two permanent observatories have been set up: one in the Village of Yemessoa in the cocoaAproducmgCentraI provr ince. and one in the West provrnce. a Bafou tribal area where coIIee is grown.

Earlier studies had already been carried out in both pIaces. and these made it possible to distinguish between processes connected with long term imbalances and those resulting from the economic conditions of the moment. Folr Iowrng logically from the socral selence monov graphs that used to be a specrality of ORSTOM. and taking an approach very different from the heavyweight statistical surveys run by the World Bank. Observatory researchers conducted some lightweight. multipIe-goal. quantita tive and qualitative studies focusing on the socral management of family responsibilities. forms of solidarity, new economic activities. management oicredit. strategies in response to the freeing of prices, etc.

Striving for self-sufficiency

The new economic situation has not had the same consequencesinthe Centerofthecountry as in the West. where Eton and Bamileke com munities have different social and farming systems NonetheIess. points in common have appeared: high population densities. old plantae tions and elderly planters. In the Center. the cocoa growers are trying to keep up cultivation of their cash crop. whereas in the West, coffee growing is in a very dilapidated state,

The planters strategies depend on the level of remuneration for their labor. The cocoa plantations of the Center require little or no maintenance work and therefore reIatively little labor timer andthe plantersinvestverylittlein inputs. So the crop is still worthwhile to the growers. who are inclined to extend their plantations in response to the crisis.

In the coffee groves ofthe West, however. more labor time and inputs are requrred and the response to the crisis has more often been to invest in new economic activrties on the srde: market gardening livestock. fuelwoodi trade, etc. While the average money income Irom farming is about the same in the two regions around CFAF I30.000 a year income from sources other than the plantations is three times as high in the West as in the Centeri

Planter strategies in both regions Will have negative effects in the long run, because both involvea reduction intheuseofinputsand wage labor. The producers are protecting themselves from the crrsrs by retreating into self-sufficteney. whereas the free market poIicy is meant to assist their integration into the money economy or banking on quality?

So it seems clear that. to pull itself out of the crrsrs. Cameroon needs to revive production of coffee and cocoa. whereas Iree-market policres. because they increase input costs. encourage producers to invest less in their plantations

either by developing aIternative activrties or by adopting more extensive production methods.
For Cameroons coffee and cocoa to find a place on the international markets, consrderable investments WIH have to be made to regenerate the plantations and get back to a high-quality product.
(RU SC Program entitled "Observatories on Change and sociaI innovation in Cameroon")

BETTER NOURISHMENT AND HEALTH CARE

I mproving the health status of populations and combating the major endemicdiseases through appropriate prevention and health care policies is a priority issue.
In North Cameroon, ORSTOM is taking part in an onchocerciasis control campaign involving a new drug, ivermectine, and control of the vector on the ground. Also in Cameroon, a harmless, economical insecticide of biological origin has been tested throughout the town of Maroua.
In the Congo, in collaboration with the private development body AGRICONGO, the Institute has set up a complete research and development structure working on ways to intensify production systems. As a part of this collaboration, 3 new, enriched weaning gruel has been developed which should resolve many problems of malnutrition of small children. I

Onchocerciasis control in Central Africa

In the early I 980s. refugees from Chad settled in a savanna area of North Cameroon. southwest of Caroua, where onchocercrasis was endemic. About 80% of the adult population have contracted the disease and 4% are now blind.
In I 986. in view of the risks such migrants run the UN HCR asked ORSTOM to run a survey in the region to identify ways of combating the disease, which istransmitted bya smaII bIackIIy or simulid. the larvae of which live in running water. Transmission occurs only in the rainy seasonandthe stteswhereIarvaecongregateare not in the main river. the Faro. but along the small seasonal tributary streams. So the Chadian refugees cultivating fields alongside these streams run the Iong-term riskofserious lesions of the eye that can lead to blindness
A vector control campaign was therefore launched against the blackfIy larvae in I987 and I 988. Treatments applied during the rainy season reduced the bIackfIy bite rate and the annual transmissron rate to whoIly acceptable levels.
An anti-vector campaign run each year under the same conditions would thus provide effective protection for the local human population and the Chadian refugees
The OCEAC member countries have taken note of the results of the anti-vector campaign and the drug treatment campaign with ivermectine, an anti-filaria drug. and now recommend the use of ivermectine to treat the disease.
This treatment can be combined with an anti-vectoral campaign on an ad hoe basis.
(RU 4E. Program on "Simulid and culicid control")

A biological insecticide

against mosquitos

Inthe bigtownsoftheintertropicalzone,which are growing rapidly wrthout any real infrastructure for drainage and sewage. waste water prowdes many suitable sites for larvae of the Culex quinque/asciatus mosqutto. which is a great nuisance to the inhabitants. Measures against the larvae are still the most appropriate control method. as the breeding grounds are generally easy to identify. accessible. and fairly small (latrines wells, septictanks, gutters. etc). Current methods involve chemical insecticides. but the usefulness of these is limited by their toxicity. the riskofenvironmental pollution and the emergence of resistant strains

One possible remedy is to use biological insecticides based on bacterial toxins. These insecticrdes are a good alternative to chemicals. They are cheaper and are perfectly harmless to the non-target fauna. In the near future they will become one of the best methods of mosquito control.

City-wide experiments

ORSTOM entomologists ran mosquito Iarvae control trials in part of Yaounde and then in Maroua, using Bacillus sphaericus a bacterium whose spores contain a toxin which, once ingested. kills mosquito Iarvae before they can reach the adult stage

Maroua. with a population of some I30.000. lies two hundred kilometres from the nearest big city. at the heart of a dry savanna region where C quinque/asciatus cannot survive. It thus provididealconditionsfortheexperiment.AIIthe infested water points were treated with B. sphaericus.

To check on the efhcacy ofthe treatment and on

possible recolonization by the mosquito of its favorite breeding grounds. nocturnal mosquito trapping exercises have been run once a month since I99I. These will be continued so as to measure the real impact ofthis anti-larvae campaign.

A hlm about this mosquito control campaign has been made, under an agreement between ORSTOM and MN,

The program was supported and partly financed by the WHO’s TDR program. Although this campaign has had the benefit of considerable logisticresources,itspossiblethatasingle.low-cost campaign carried out by local public health services would be sufficient. This is the case in Maroua. where four ofthe ten campaign teams are all-Cameroonian.

(RU 4E Program on "Vector control and research for biological control agents")

A new baby food in the Congo

In the countries of the South, malnutrition mainly affects very young children, especially at the weaning stage.

Surveys carried out in the Congo among mothers of babies under one year ofage showed that most women who breast feed start using baby foods too soon and weaned their babies off them too quickly

Two problems emerged: the low nutritional valueofthe babyfoodsandthefactthattoofew feeds were given per day

The baby foods used are gruels prepared from a commercially marketed paste of fermented maize called poto-poto, or from cassava meal which they prepare themselves. Even when sugar is added, both these foods are very poor in essential nutrients (amino acids, minerals and vitamins) and have too low an energy density (about 60 Kcal per 100 g ofgruel), Fed just once or twice a day, this is not sufhcient to complement a mother’s milk

A local production chain

ORSTOM and the Faculty of Science at the University of Brazzaville, working together. have developed processes to produce a gruel with higher energy density but still liquid enough to be readily acceptable to the baby. The researchers had the idea ofincorporating an industrially produced enzyme which is inexpena sive and easily obtained, This enzyme acts on starch; it reduces its capacity to swell in the course of cooking and 50 makes it possible to include twice as much meal in the gruel to a given quantity ofwater. Cassava meal. enriched with nutrients by adding a pulse flour, has proved particularly suitable for this treatment.

After the first laboratory results, ORSTOM and AGRICONGO, in association with the Congo Health Ministry, developed a production model that took account of supply problems, technological aspects. management problems and how the product might be marketed.

This practical researCh-and-action exercise is to be pursued. with a survey of the impact of the gruel on the nutritional status of the children. The pilot experiment could be generalized as part of the Congois national nutrition policy and later extended to other countries where malnutrition is largely the result ofa shortage of high quality weaning foods.

A seminar on Hweaning gruels in West Africa",

held in May I 991 in Brazzaville, provided a basis for working out a plan of action in this field. (RU4FV Program on "Nutritionalpotenlialoffood products in tropical/Zifrica") I

LAND PLANNING AND DEVELOPMENT

A 5 populations grow and production expands, living space and production space in town and country have to be transformed and developed. To plan and manage these changes harmoniously, local and central government, NGOs and private enterprise need, first and foremost, to be in possession of the facts regarding the present situation.

In Quito, Ecuador, 3 team of researchers took part in the creation of an Turban information system", an aid to global knowledge of the various types of urban data. This has already provided the basis for a computerized atlas of the town.

In rural areas, control of water resources is crucial, and this necessarily involves water engineering schemes. Here again, managers need detailed knowledge of the functioning of existing networks. The days of ill-considered funding of major dam projects is over.

In the Sahel, where the ecological and economic crisis has encouraged development of bottomlands for agricultural use, ORSTOM has been running a program on five bottomland areas to find out more about howthey function and experiment with suitable water development schemes and techniques.

In the Ecuadoran Andes. the Institute has developed a computerized data base, a typology and a model of the economic functioning of traditional irrigation systems. In Brazil. the Institute has completed a study of the creation of small reservoirs (called agudes) for irrigation.

An urban information system for city management

In Quito. capital of ECuador. the population is growingfast as it is in mostThird World towns. The data requrred to enable the authorities to plan and manage this spatial and demographic growth are scattered. often hard to find. sometimes unreliable or simply lacking.

With the Military Geographical Institute. the Panamerican Institute ofCeography and Histoe ry and the Quito town council. a team of ORSTOM researchers has developed a localized geographical information system (ClS) appropriate to the needs of the city’s planners and managers, created an urban data bank starting by collating and analysing available data. and linked up the data with the help of the software package i’Savane" which has been developed for the purpose.

As a result. several tools are now available. The computerized atlas of Quito, consisting of 43 maps, gives a preliminary outline of the situation. The GIS is now operational: a first document-supported version of the software package underpinning the system is available. the data bank has been established. The entire "urban information system" made up of these elements was delivered to the Quito city auV

thorities in October I99 I. The council has decided to make it its main tool for information and planningforthecapitalbecauseitslocalized linking of such divers kinds ofdata as networks. spaces and pornts, enables a finevtuned approach to urban structures and their malfunctions.
(RU 5F Program for a "Computerized Atlas of Quito")

Land development in the bottomlands

Drought. population growth and the deteriora tion ofcertain soils have led the farmers of the Sahel to seek out new land to cultivate, The bottomlands - lowelying seasonal wetlands & are therefore being increasingly brought into cultivation: the chemical makeup of the sorls is good and there is water available. These lands represent an economically interesting alterna- tive for the Sahelian farmers who can thus grow maize or sorghum as a safety-net crop in sea- sons when the rainsfail. In the dry season sheep and goats can be grazed here. or market garden crops can be grown. Agricultural development of these lands is one possible response to the present crisis in the traditional production sys- tems. Even so. effective use of the bottomlands implies water engineering work to protect the land from flooding and to store and distribute irrigation water.

The engineering structures must be technically reliable and manageable by the communities that use them. for the bottomlands are fragile ecosystems and are easily degraded. Rice farme ing has already had to be abandoned in some such areas, eg owing to excess salinity in coastal parts ofCasamance. Senegal. and else-

where on soils that are too sandy to hold water adequately.

ORSTOM has undertaken a practical research and-action program on live representative botr tomland sites in the Sahel. aiming to gain a better knowledge of how they function under natural conditions and the problems currently being encountered. and to experiment to iden-tify appropriate water management structures and techniques. The srtes concerned are in the Sine Saloum and Casamance in Senegal. in southern Mali. and in Yatenga and Comoe in Burkina Faso.

Thisresearchisbeingcarnedoutundertheaegis of CORAF's R35 network. Several assocrate bodies from North and South are involved. working together to develop methods and tools for the research, Factors already being moniv tored or analysed are water balance, highvwater levels and hydraulic head data in several catch-mentbasinsofeachsite.thechemicalcharactere istics of the water, sediment transport and erosion. and the Impact of the development work on water resources and the land tenure structure.

Tools and methods

This research has provided an opportunity to design. develop and test new measuring instrumentsdiagnostictoolsandwater man-agement methods. Several new measuring in-struments have been used1asecond-generation rain simulator: an instrument that measures water conductivity. temperature and height upstream and downstream ofa structure on the same time base: and a data capture unit mease uringEh,pHandtemperature.Three diagnostic tools have also been designed and tested: an expert method for predetermining certain pa rameters of the natural evolution of a water resource: a simulation model for potential yield of bottomland rice crops: and harmonization and poolingofwater resource and flood estimae tion parameters for Casamance. Sine Saloum and Southern Mali.

From experimentation to dissemination of results

In Casamance. a method for managing salt barrier dams has been proposed. The surface runoffwater is stored. then released at low tide with the dissolved salt. Ninety hectares olacrd. sulfate soils in the valley of Diiguinoum. near Ziguinchor. could be rehabilitated in this way. Alongside this, agronomic experiments in rice growing have shown how satisfactory yields can be obtained on degraded sorls.

With techniques for conserving soils and im-proving their fertility coupled with controlled supply of water to the crops. it is now possible toconsidermovingonfromthe pilotphasetoan integrated development project on larger areas. The determining factors for success or failure in these initiatives will then be the socio-economic processes.

(RU 28 Program entitled "Developing bottom-lands in lheSahel: typology hydrological process-es and agricultural potential")

Traditional in-igation in the Ecuadoran Andes

Irrigation has been with us for many centuries. and Will be with us for many more Civilizations have sprung from mastery over water resources

and have died when they were no longer able to manage their water engineering structures adequately

In the Ecuadoran Andes, farmers still use irrigation infrastructures inherited from the past. What were the historical origins of these networks and by what management rules were they operated in the old days? How are they structured and organized today? What are the available water resources and do they meet modern day larmers' demands7 All these are questions gurding the research into the traditional Andean irrigation networks currently being carried out by ORSTOM and the Republic of Ecuador's lNERHls

This research program is particularly important in the current context because INERHI is no longer able. as it was in the past. to build new canals with international funding The country is too heavily indebted, and past schemes have not always proved economically viable. lNERHl needs to move on from an administrative knowledge of existing networks to a detailed knowledge of how they work and their possible malfunctions.

The researchers Hrst task was to define a spatial unit that would provide a meaningful basis for water management initiatives. Having distin. guished between "supply areas" (basic catchment basins with exrsting irrigation schemes) and "demand areas" (where water is needed but not necessarily available), they defined the "analysrs and irrigation action zone" (ZARI) - the area where two catchment basins converge and traditional irrigation systems have developed Based on the ZARI. the water supply and demand Situation can be analysed in detail and further development ofthe traditional irrigation networks can be planned.

Research was then carried out on several ZARIs in order to understand the functioning and possible problems of irrigation systems at every stageolwatercollection.transportsdistribution and utilization. Work has also been done on trends in production systems and the impact of irrigation on crop productivity. Based on a statistical study of local Climatic data. it has proved possible to diagnose the match between water supply and demand in each irrigation network. This work is complemented bya historical study ofthe irrigation systems and the former rules for access to and social management of water by the different peasant communities.

Decision-making aids

A computerized data base and a set of I 250,000 maps ofthe ZARIs now provide precise information on each majorAndeancatchmentbasinAll the data gathered (climatic, hydrologic. spatial, historical. agricultural. social and economic) make up a typology of local situations and the main problems encountered.

To complement these aids. a computerized model of the economic functioning of a ZARI has been developed. With this model one can, forexample, simulate the impact ofa droughtor of the rehabilitation ofan irrigation network. Data banks. maps typology and simulation model Will all be used as decision-making and programming aids for INERHl's forthcoming operations.

A rehabilitation project may be launched forthe

pilot ZARI at Urcuqui. for example. with the Centre international de cooperation pour le developpement agricole, an NGO. in charge of the engineering work.
(RU ZE. RU 2C. Program entitled "Study and functioning of traditional irrigation in Ecuador")

Water resources in the Brazilian Nordaste, the agudes

Across of the Brazilian Nordeste. where the bedrock is crystalline and impermeable, the only type of water supply resource is the small dam known as an agude. 70.000 agudes were traditionally used to provide men and cattle with waters Over the past hfteen years or so. they have also been used for irrigation.

The "small private agudes" project resulted from ten years of collaboration between ORSTOM and its Brazilian partners. primarily SUDENE in this case: its purpose is to develop a methodology for management of these dams. The hnal fruit of the completed project was the publication of a manual for small agudes. entitled Manual do Pequeno Agude. written for local agricultural facilitators and managers.
(RU 25. Program on iiUtilization ofhilldamsin the Brazilian Nordeste") I

RATIONAL EXPLOITATION OF NATURAL RESOURCES

’ ntensive utilization of the planetts natural resources - animal, vegetable and mineral - is not always managed in such a way as to ensure their renewal. So estimating thresholds of irreversibility and. wherever it is still possible, designing ecosystem rehabilitation and restoration programs, are now urgent tasks.

In Senegal and Tunisia, ORSTOM has been working on the rehabilitation of rangelands and eroded areas, suggesting different associations of plant species that can suitably be reintroduced. In Brazil, in central Amazonia, the Institute has been studying iiextractivism" (i.e. the gathering of wild forest products for sale on the market), with a view to introducing certain species into agro-forestry systems, so lessening the pressure on the forest while stabilizing producers incomes.

In the Bolivian Andes, geologists are looking for promising locations for gold prospecting and exploitation.

In the Congo, working with the development organization AGRICONGO, the Institute has set up a complete research and development system to intensify production systems.

Fishing is an important economic activity in many countries, but it is often poorly managed: over-fishing in some areas, under-Iishing in others, inefficient techniques. Several research programs have been undertaken on this subject - in Java, Vanuatu and New Caledonia, ORSTOM is working to develop fishing activities while ensuring that the fish stocks can regenerate.

In the Sahel, ORSTOM researchers and their local associates have perfected rodent control methods for pre- and post-harvest rodent pests.

Rehabilitating deserIiIied areas north and south of the Sahara

Since i985, ORSTOM has been working with the Tunisian institute for the Arid Regions. the Louis EmbergerCenter for Functional and Evolui tionary Ecology (part of the CNRS), iSRA in Senegal and the University ofTuscia. Italy, to assist with desertihcation control and natural resource management projects in arid regions. and to answer some ofthe key questions in this field: Is it possible to reconstruct what human activity has destroyed.7 How can environments be rehabilitated once they have become unproa ductive? How can elements in an ecosystem be restored once they have deteriorated? How and from what activities can human communities live in such rehabilitated areas?

A global approach

A research program on the rehabilitation of grazing land and wind-eroded areas has identihed suitable plant and tree species to reintroduce in degraded areas. in view oftheir drought resistance and adaptability to shifting sands. A second research program, involving in uitro studies in Montpellier and in situ studies in Southern Tunisia. is discovering stable. balanced and reproducible grassland plant communities in which forage shrubs have an important place.

In Northern Senegai and Southern Tunisia. research is continuing on different plant associations. their efficiency and how they function. involvrng species that are specific to each region and also the common species Acacia radianai Through this work. it has been found that there are thresholds ofirreversibility. beyond which it

is pointless to try to manage resources in the best way possible or regenerate ecosystems by means of seasonal grazing bans. Once this threshold is reached. the area must be entirely rehabilitated and other uses found for the land. However. the ’itechnicai arsenal" requrred to rehabilitate andrestorethe degraded areasrs not sufficient, because these operations are very costly and the land concerned is under heavy demographic pressure (2.8% per annum population growth on average). whereas farming activrty is marginal and the societies concerned are undergoing a severe cultural, technical and economic crisis. Any rehabilitation operation musttherefore take the socio-economic aspects into account.

(RU 3/. Program on "Deserti/icaiion control and rehabilitation of desertified land in Southern Tunisia’i)

Utilizing wild forest products: extractivism

The Brazilian term extraiiiuismo covers all gathi eringofwild produce forcommercial reasons: in English. the word ’iextractiuism" has recently been adopted.

With colonization of the tropical regions came the commercialization of charcoal wood from Brazil. incense from Africa. sandalwood from Asia and the Pacific. etc. on the European markets. in the Amazon sarsaparillai cocoa and rubber brought a fieeting moment oiprosperity to the towns of Manaus and Iqurtos before they were ruined by competition from the Asian rubber plantations. Today. extractivism is in sharp decline economicaiiy. but is arousmg renewed interest. Unions. farmers, politicians. researchers and N605 are beginning to defend this type of activity. which protects and helps conserve the forest environment. The Brazilian government has even set up "extractivist reserves". However. this new boost is based more on ideology than firm scientihc grounds.

In collaboration with the Goeldi Museum and the INPA, ORSTOM has launched a multi disciplinary research program on extractivrsm in centralAmazonia.aimedatassessingtheviabila ityofthisactivityandsuggestmgimprovements that will help reduce pressure on the forest by stabilizing small producers incomes. The first strand ofthe research is to catalogue the speCies used, describe the populations oi these species and evaluate theircapacrty to withstand exploitation of the different products. eg. chewrng gum, Brazil nuts. rosewood Oil, palm hearts. etc. The second strand concerns the economic and social role ofextractiuism. How can extractiuism be integrated With the other productions systems 7 crop farming. livestock. arboriculture. hunting, fishing 7 to which it can provrde an income supplement? What resource management and marketing systems are appropriate? What are the relations between the different economic agents involved?

For example. it is now known that. even today, socio-economic relations in the rural Amazon are shaped by the extractivist model. in which the coliector is bound to his boss" through perpetual debt.

The third strand is experimental: a study of the behavior of certain species when brought into cultivation. and identification ofthe best COHdle

tions for storage of seed and germination and growth of seediings. With a view to including these species in agro-iorestry systems,
(RU 3H. "Extractiuism" program)

Gold in the Bolivian Andes, from prospecting to exploitation

Alluvialgolddepositsinthe BolrvranAndes have been worked since precolonial days, Some surface deposits have been exhausted. This raises the question as to whether other deposrts can be found and. ifso. where. A team of geologists is tackling this question. starting from basic research on the origin of these deposits in various parts of the Cordiilera: Altiplano. eastern Cordillera. the sub-Andean zone. the Beni plain. etc.

Reviving gold mining in Tipuani

In theTipuani region oithe eastern Cordillera. as a result of erosion of quartz veins. gold can be found in river bed and river terrace alluvra and in other. older sediments that do not always crop out on the surfaceThe river bed and river terrace deposits. easy to get at. have been exploited intensively for the past twenty years. They are now virtually exhaustedi especially in the Rio Tipuani valley,

By analysing geological and geophysical data, ORSTOM’S researchers have been able to suggest to the miners’ cooperatives new sites for prospecting or exploitation. and to proyide them with additional data to gurde their activities. involved in this work are severai geology students from La Paz Universrty doing their practical work in the region.

Exploring new deposits in Suches-Antaquilla

lh the Suches-Antaquiila region, ORSTOM has a joint research program running With the UN

Fund for Natural Resource Exploration. This is a study ofthe structure ofan alluvial gold deposit near the Peruvian frontier. aimed at identifying those areas worth exploring systematically. Analysisofthe mineralcontentofthe sediments and ofthe gold found in the alluvium reveals the locations where exploitation is possible. This research is continuing in Bolivia and has been extended to Chili and Ecuador. where it will take into account the socio-economic impact of exploitation of the deposits. An international symposiumonalluvialgolddeposits was heldin La Paz in June I99I and yielded a wealth of useful information.

(RU IH. G/SEM/ZIN Program or i'SupergeniC deposits and evolution in the Andean margin")

AGRICONGO-ORSTOM: partnership for research and development

ACRICONGO is a private R&D institute set up by Elf-Fiquitaine attherequestofthe Congolese government. It asked ORSTOM for scientihc assistance. and a protocol forcollaboration was signed in February I 99 l . to enable all concerned to take better advantage of research carried out in the Congo.

The contents ofthe different research programs are defined in specihccollaboration agreements

A 'lfertile soil projects" program is assisting an experimental farmers' group set up by AGRICONGO on the Bate'ke plateaus near Brazzaville, the aim being to popularize a farming system model that combines mixed food crops with tree crops, livestock and food processing (peanut butter. chicouangue - a cassava-based preparation - etc),

Under another agreement, to which CIRAD is also a party, ORSTOM is studying the socio-economic impact of the output from AGRICONCO's rehabilitated farms on the marketing and consumption of vegetables from the market-garden belt around Brazzaville.

In I 99 l , the Institute provided scientific help in defining a survey, elaborating a methodology for it, and for the statistical and computer processing of its results.

An agreement in the human nutrition held concerns implementation of a joint program to study and improve the ways in which cassava is used (see "fl new babyfood in the Congo p, 2/).

(RU 38. program entitled "lmprouing traditional biotechnology processes in the manufacture of cassaua-based products? RU 30 program on "Ferralitic soils and soil/ertility in the Congo": RU 4F, program on "Nutritional potential of food products in the Congo": RU SC, program on Market gardening around Brazzaville)

Fishing in the Java Sea: a potential ripe for development

Every year. a fleet of five hundred large wooden seinevboats lands over 100,000tons of hsh at the four main ports oflava's central provinces France and the EEC have launched a four-year project entitled 'Java Sea Fishery Assessment". to helplocal authorities improve fish supplies to the province. qualitatively and quantitatively, and to increase hshermen's incomes,

ORSTOM is in charge of the project and its international. multi-disciplinary team. The permanent Franco-lndonesian team consists of researchers from ORSTOM and the BPPL (Indonesian Research Institute for Marine Fisheries):

about fifteen consultants, from Indonesia. France (IFREMER) and the UK (Landell Mills Ltd), are also involved,

The study covers fish stocks, hshing methods and the socio-economic systems Stocks are estimated using modern acoustic remote sens-ing techniques combined with socio-economic surveys of catch quantities landed and market organizations This approach provides an un-derstanding of the system as a whole and how it operates. from lish biology via fishing and storage techniques to the informal trading net-works, etc.

Early results provide a basis for formulating proposals for technical improvements to the seine-nets used. modihcations to the hsh stor. age holds so as to keep the llSl'i fresh, and new ways of ensuring hygienic handling and distri-bution practices. Several experiments have been run at sea, testing new techniques with the fishermen and ship owners. Meanwhile. study of the marketing channels has shown how important the informal sector is, especially as regards employment

This programincludesanimportantinformation and training component, to disseminate re-search findings and results to all those involved in the chain: researchers and senior specialists. technicians. administrators. ships' captains. fishermen etc.

The working method developed and the results obtained could be applied to other hshery sys-tems. with a view to better understanding and improved performance

(RU II. Program entitled "Study o/pelagiefisheries in the/aua Sea")

Deep sea fishing in the South Pacific

Population growth and improved small-scale fishing techniques have meant a rapid spread of coastal fishing in the South Pacific, The coastal waters around these islands are shallow and. because there is no continental shelf very nar-row: fish stocks are therefore limited. and over-lishing is already posing a serious threat to the future of fishing, New potential hshing grounds exist in the deep waters around the seamounts. but these can only be exploited on an industrial scale. So the question is how to develop hshery activnties while conserving natural resources and ensuring their renewal. Two research pro-grams, one in Vanuatu for smallescale hshery and one in New Caledonia for industrial fishery, have set out to answer it.

Small-scale fishing in Vanuatu

In I980, the Vanuatu government adopted a policy of supporting small-scale hshermen's associations to help them turn their activities towards the deep waters of the outer shelf. For ten years now. with help from the French For-eign Affairs Ministry, ORSTOM has been work-ing in collaboration with the National Fisheries Service and the hshermen's associations, to study hsh stocks and suggest how best to exploit and manage them.

At the end of I99 l , over I0.000 hshingexpedi-tion data sheets and l30.000 measurements were available Biological studies have been made of four of the main hsh species, and an estimate has been madeoftheannual catch that can be sustained without upsettingthe balance ofthe naturalenvironment.Acompilationofthe

work on available stocks. fishing activities and the sustainable catch potential, will soon be availableThiswillalso makeitpossibletoassess the relevance of national programs to foster deep sea hshing and correctly handle the shift from tradition. coastal hsheries to commercial fishing much farther out at sea.

Industrial fishery in New Caledonia

In New Caledonia. after several exploratory hsh-ing exercises in the seamount zones, a commer-cial operation using trawl lines was launched in I 988. Under an agreement with the New Cale-donia authorities (FIDES), ORSTOM was asked to handle scientihc monitoring of the exercise. This operation did not prove its proht potential. however. and it has therefore been decided to make an in-depth study oflish resources in the region and the different deep ocean hsh species. The first research carried out revealed that the main species in these parts, Beryx splendeus. lives in waters wherethetemperature is 520 Fat 500 m and 430 F at 850 m: that the size ofthis hsh increases with depth: that it breeds in the southern hemisphere summer; and that it feeds on a migrant fauna that rises to the surface waters at night

It has also emerged that the diversity of hsh species in the region is somewhat narrow. Many species are new discoveries, and only some seamounts harbor big enough hsh stocks to justify industrialescale fisheries. Thesetindingswillhelpprovideahrmerscientihc basis for reviving the hshing industry in New Caledonia and alsoin other Pacihccountrieseg. New Zealand. where ORSTOM is working in Close collaboration with several national scien-tlllC bodies.

(RU lj. Programs on "Small-scale fishery in Vanuatu" and iiSeamounts")

Rodent pests in the Sahel

Becauseof its sharp seasonalclimatic contrasts. the Sahel is subject to major periodic fluctuations in the populations ofcertain animal species.

The expansion ofirrigated cropping and agricultural water engineering schemes has encour. aged some species ofrodent that thrive in these newlarmingsystems.sometimesmultiplyingin a spectacular way and competing with the farmer for his harvest.

After twenty years of field observation 7 in Senegal, then later Burkina Faso and. since l992,in Malthhe annualcycleandinterannual fluctuations in these rodent populations have been described. taking accou nt. for example. of a sharp drop in numbers in I972 and a rapid multiplication in I976

Studies of their reproduction. feeding habits, competition and predation have provided an understanding of their population dynamics and resulted in simple forecasting models that can be used in agriculture.

During the I980s. more extensive ecological monitoring in Senegal and Burkina Faso conhrmed these early hndings. In Burkina Faso. ORSTOM’s mammalogists studied the factors that determine the population cycles of the rodents. studying their reproduction and looking for ecological triggers and the different species’ water consumption Characteristics.

Towards a pest monitoring and control network

Having identified the species responsible for the damage and supplied keys for identihcation. the researchers went on to dehne their i’toxicoe logical prohles". Effective, affordable chemical control methods were suggested, involving littledangerforman, domesticanimalsorwildlile.

In collaboration with researchers from the University and local technicians. training drives were organized, with support from regional bodies and the CILSS, which are planning to set up a network for monitoring and control of these rodents. The work in mammalian microbiology is now turning to the issue of bilharzia epidemiology in Senegal and the study olreproduction physiology in Mali

(RU 3C. Program entitled ’Research on Sahelo-Sudanian rodent pests in Burkina Faso")

COMBATING INDUSTRIAL POLLUTION AND NATURAL HAZARDS

ndustrial development brings a host of hazards in its wake: gas emissions, water pollution, accumulation of residues and waste, etc. It is vital to develop less polluting manufacturing techniques and adequate ways of treating industrial waste. ORSTOM researchers, together with their Mexican associates. are running trials and disseminating their findings on the use of biotechnology for waste water treatment and depollution of industrial off-gases. In Tunisia, the Institute is working to develop a biological process for treating the highly pollutant liquid waste from the olive oil industry.

At the present time, ORSTOM is also laying stress in its geodynamics work on volcanic and seismic hazards. ln

Cameroon, for example, the search for the causes of the deadly eruption of carbon dioxide from Lake Nyos in I986 has raised new questions for vulcanologists. In Mexico, the Institute is working on plate tectonics in densely populated, high-risk areas.

Biotechnology at the service of the environment, Mexico

Mexico is suffering more and more severely from the increasing scarcity of water resources and the huge quantities of waste water and off-gases produced by industry, Biotechnology developments may provide effective solutions to some pollution problems,

Since l986, ORSTOM and its Mexican assocrates at the Autonomous Metropolitan University (UAM- I) and the Engineering Institute of the Autonomous National UniversityofMexico (UNAM- I) are carrying out research, running trials and disseminating results on new technologies to treat waste water using anaerobic processes, Recently, this activity has been extended to the depollution of industrial waste gases. The water is treated in pilot anaerobic reactors ofthe UASB (upllow, sludge bed) type. ranging from IOmS to SOmK Alongside this, basic laboratory research is being carried out with two-litre fermenters.

Patents, construction of pilot installations and industrial-scale units. and many nation-wide and international publications, rellect the lively momentumofthiscollaborationandtheusefulness of its results.

New industrial technologies

At the industrial lev". Franco-Mexican technoe logy has enabled the building of a 2,4OOmj UASB reactor for a malt factory and another of 530m for a fiber board manufacturing facility. One of the private firms that have Signed tech? nologytransfercontracts withthejoint research team has now sold various engineering projects for fizzy drinks, protein meal. and breweries. The pilot study on biological methods ofdesulfurizing industrial effluent gas has been carried out for a major Mexican oil company This could lead directly to an industrial application. Research is now geared towards treatment of effluents containing compounds that are not readily biodegradable by the classic procedures and are extremely noxious for the envrronment. The programs are being funded by industry and international bodies as well as the institutions taking part.

(RU 38. Program on "Microbiology ofanaerobic treatment of urban and industrial waste water")

Reducing pollution from olive oil waste

The Mediterranean basin accounts for 90% of world olive Oll output, but the industry produces large quantities of highly pollutant liquid waste. One hundred kg of olives, pressed and processed. produces. on average. a hundred litres of lquld waste. This waste is spread in open. outdoor evaporation tanks which are not very effective and where pollution accumulates from year to year. As this waste biodegrades very little. an ever-increasing surface area ol evaporation tanks is required 7which is increasinglycostly and is not a good solution from the ecological point ofview. The need for a more

effective technology is therefore urgent.
In I986, in collaboration with the Biotechnoe logy Center in Sfax, Tunisra, ORSTOM began work to develop an anaerobic biological process for treating olive oil waste by methanic fermentation This solution would have the combined advantages of depollution and energy production from the methane gas emitted. However. methanization is inhibited by the acidity and phenolic compounds present in the effluent. A pre-treatment stage. using a micro-organism capable ofdegrading most ofthe tannins, phenolic compounds. oils. etc, is therefore essen tial. In I99I, an ORSTOM researcher was seconded to the CBS in Slax to study depollution and methane production from olive oil waste using anaerobic bacteria.

Several biological treatments

Atthefirst stage. an anaerobicfungus hydrolyzes the aromatic polymers and decomposes the aromatic monomers. At the second stage. the fi trate resulting from this preeprocessing is methanized in a digester using the anaerobic li terprocessiThe effluentfrom this isthen given third-stage treatment in an activated-sludge flJidized bed containing particles ololive stone as a medium for the bacteria. This treatment, so far Carried out in the laboratory. reduces the iritial organic load by over 90%.

The next step will be to run trials with a continuouswprocess pilot plant for biological treatv rrent ofolive waste by this method: this will be a iointexercrseinvolvingORSTOM. theTunisian government, and the EEC’s STD programs (RU 318. Program on "Microbiology ofanaerobic treatment of industrial waste wateri’)

Cameroon: closely observed lakes

On August 2 I st. I986. an eruption of carbon dioxide from the depths ofLake Nyos in western Cameroon caused the deaths of 1.700 villagers in the surrounding area.

This disaster may have been caused by a sudden upsurge of large quantities of carbon diOXide from the depths ofthe lake itseif (the Iimnological hypothesis), or by a mechanism connected with a sudden rise in the hydrothermal activity ofthe region. in which case the sudden emi55ion of carbon dioxide would be volcanic in origin,

Hazards connected with volcanic activity

in I985. before the disaster. ORSTOM had formed a jam research group with MESIRES of Cameroon. the university laboratories of Perpignan and Grenoble, Duke University in the US. and Zurich Polytechnic in Switzerland, to reconstitutethe past25.000yearsofthehistory ofthevegetation and late Quaternary palaeoenvironments of West Cameroon, In particular. this team took geological core samples in Barombi Mbo Lake. which is similar in configuration to Lake Nyos.

ln I987 and I989, because ofthese similarities. ageologicalcoresamplingoperation was undertaken on the beds oftwenty potentially dangerous lakes along Cameroon’s rocky spine - Lake Nyos especially- to hnd out whether the gas came from the depths ofthe bedrock below or merely from the lake water itself,

The observations made support the volcanic hypothesis; the gas came from the underlying bedrock, and it is now possible to identify those lakes and areas that hold a potential danger of carbon dioxide emissions.

Experiments are now under way in Nyos to evacuate carbon dioxide dissolved in the lakes.

(RU IC. Program on "Lakes presentinga dangero/ gas eruption. Cameroon")

Seismic hazards in Mexico

In collaboration with the Institute ofGeophyse ics at UNAM. Mexico. the Earth Sciences Center (UDC. Jalisco, MeXIco). the iPCS and the IPGP (France), ORSTOM has been studying the geo dynamics of the tectonic plates on the Pacific coast of Mexico. the associated earthquake hazard, and its consequences for the safety of communities in the surrounding areas,

An interactive software package calied COA has been developed for rapid analysis of large quantities of seismic data. At the present time it is being used to monitor the Guerrero Lagoon (West Coast of Mexico), It can also be used to identify the Characteristics of the bedrock in populated areas. so as to map the high-risk areas.

(RU IE, Program entitled "Seismic studies in Mexico") I

DISSEMINATION OUTPUT

RSTOM policy involves systematically disseminating its research findings to decisionemakers and other actors in the development process.

Dissemination to policy-makers

At the national, regional and international levels, ORSTOM endeavors to keep decision-makers constantly informed about the Institute’s activities. with aviewto mobilizingthe resources needed to implement effective policies that

meet the needs ofthe countries in the intertrop-
ical zone. ORSTOM maintains contact with the
EEC through the CLORA in Brussels, and with
Land, soil and bedrock
Biomass resources
Human health and nutrition
(Dakar,June 3- l S, I99I)
Social change
(Sally Portudal. Senegal. May 2730. I99I)
(Annaba. Algeria. May 25-30, I99I)
(sevres. September I8-20. I99I)
Information systems
international organizations such as the World
Bank, WHO. FAO and WMO. The Chairman
and the Director General visited the World Bank
in Washington inJuly I99I.
Dissemination to development agents
Open days have been held in most ORSTOM
centers. including Brazzaville. Bamako, Bangui
and Lome’i
ORSTOM and the French cuitural center in
Dakar joined forces to organize a series of con-
ferences with films or slide shows.
Thelnstitute madeapresentationofits activities
at the International Pacihc Science Congress in
Honolulu (May 24-June 4, I99l) and at the
International Development Aid and Coopera-
tion Exhibition (SICAD) in Marseille (October
I4-I7,199I)i
Four debates in the "Le Point sun." series were
organized in Paris on the following topics:
- Rapid urbanization in the Third World: risks
and solutions for the future:
-i’Save Our Soils": soii protection in tropical
regions:
-From cassava to foufou: tropical bioconver-
sion. Productive processing of tropical by-prod-
ucts by fermentation:
_ Makingoptimum use ofaridzones: adaptation
or artihcialization?
Conferences
- International symposmm on alluvial goid deposnts (La Paz. June 3-5. I99I)
- Symposmm on indurated volcanic SOllS (Memo City October 20-25. I99!)
- Tropical soil biology and fertility (TSBF). 6th Seminar (Diamant. Martinique. June 2729
I99I)
- International symposmm on tropical forest palms (lqwtos. Peru, September 18-24. I99I)
v Workshop on nutritional surveillance in West Africa" methodology for nutritional survey
s
, Seminareworkshop on weaning gruels in CentralAfnca(Brazzav1lle,May 2 I .24’ I991)
, Seminar on processes of urban integration and residential. professional and family itin
eraries
, Workshop on the emergence of soentific communities in developing countries
, Mega-Tchad conference on man and vegetation in the Lake Chad basin
SEMINFOR 5 on ’iimplied statistics" (Montpellier. September 24. I99l)

SCIENTIFIC
DEPARTMENTS
ERRTH/OCEIIN/RTMOSPHERE
(TERRE, OCEAN, ATMOSPHERE - TOR)
Aims
To acquire basic scientific knowledge of the earth, ocean and atmosphere 7 some of the elements that make up our natural environment- and interpret this at the local and regional levels that are most relevant to development needs.
Structure
Four pivotal themes:
I Global changes in the natural environment:
I Mineral resources and their origins:
I Global geodynamics and natural hazards:
I Living marine resources: dynamics and use.
TOR Research Units
Eleven research units with twenty-seven main research programs
IA Ocean-atmosphere
IB Continent-atmosphere
IC Intertropical palaeoclimates and surface formations
ID Surface geodynamics
1E Continental lithosphere and global studies
IF Active margins and oceanic lithosphere
IC Structural and geochemical analysis ofsurface materials and formations
IH Geodynamics and mineral concentrations
I I Coastal marine resources and environment
Ij Reef lagoon resources and environment
IK Deep sea resources and environment
CONTINENTAL WATER (DEPARTEMENT
EI-lUX CONTINENTALES - DEC)
Aims
To study continental aquatic ecosystems (a) as biotopes and (b) as water resources whose physico-chemical characteristics need to be known, both qualitatively and quantitatively.
Structure
Two pivotal themes:
I Mechanisms and processes in the functioning of natural and anthropic continental aquatic systems;
I Management and utilization of continental aquatic systems
DEC Research Units
Five reseach units with twelve main research programs and one major program not tied to a research unit
2A Geodynamics of the continental hydroe sphere
ZB Soil/water/piant/atmosphere interfaces: functioning,transferandtransformation processes
APPENDICES
2C Continentalaquaticresourcesandenvironment
2D Tropical brackish water environment and production
2E Study and management ofwater resources
Major Program: Fishery resources in the Niger Inland Delta
ENVIRONMENT AND AGRICULTURAL
ACTIVITIES (MILIEUX ET RCTNITES AGRICOLES - MM)
Aims
To study the relations between agricultural activities. human land occupation and the envia ronment, with a view to sustainable develop-

ment.
Research towards a viable form of agriculture that will be sustainable in the long term means:
- defining the characteristics of natural and cultivated environments:
V acquiring the necessary biological knowledge to master the factors ofproduction and manage renewable resources:
- studying how and why agricultural situations and food resource levels change, in connection with population. social dynamics. technical innovation and farm policy.
Structure
Four pivotal themes:
I Dynamics of natural and anthropically altered ecological systems;
I Knowledge and utilization of tropical biological diversity, as applied to plant breeding. utilization of microorganisms. and pest and parasite control;
I Biotechnology as applied to plant productivity, bioconversion and biological control of pests and diseases:
I Agrarian and social dynamics: characterization of spatial units,
MBA Research Units
Nine research units with twentyefour main research programs
3A Biological bases of tropical plant improvement
38 Biotechnologyasappliedtocropproductive ity and upgrading of agroeindustrial products
3C Pests and parasites in relation to plant and environment
3D Soil functioning. water use. yields modelling
3E Dynamics of human settlements
3C Dynamics of farming systems
3H Biological diversity and forest systems
3I History and dynamics ofarid environments
3J Landscapes: spatial synthesis and analysis of rural environments.
HEALTH (DEPARTEMENT SANTE - DES)
Aims
To study (a) the specific morbidity complexes connected with underdevelopment and tropical environments and (b) appropriate health care systems.
S tructure
Four pivotal themes:
I Epidemiology of major endemic tropical dis eases:
I Diet nutrition and health:
I Natural substances of biological interest:
I Society. population and heaith,
DES Research Units
Nine research units with twenty main research programs
4A Arboviral diseases and haemorrhagic fevers
4B Malaria
4C TrypanosomiaSIs and leishmaniasis
4D Filariasis and bilharzia
4E Vector control
4F Wasting diseases
46 Natural substances of biological interest
4H Health care systems and representations of disease
4I Population and health
Major Program on AIDS
Major Program on Health and Environment
Major Program on Water and Health in develop-

ment situations.
SOCIETY/URBFINIZATION/DEVELOPMENT
(SOCIETE, URBANISRTION, DEVELOPPEMENT
-SUD)
Aims
To study the social and economic systems.
urban networks, migration patterns. regions
and cultural identities of Southern countries
undergoing very profound changes
Structure
Three pivotal themes:
I Culture and economic development:
IThe State. economic and social modernity:
I Networks. mobility. towns.
SUD Research Units
Seven resarch units with twenty-three main
research programs
5A Historical and cultural factors in economic
development
SB Development modeis and real economies
5C Regional dynamics. territories and net-
works
5D Social dynamics, power structures. innovae
tion
5E Migration, labor. social mobility
5F Towns. spatial factors. land development
56 Food security.

BDPA
BRCM
CBS
CCCE
CEMACREF
CGIAR
CIAT
ClLSS
CIMMYT
CIRAD
CLORA
CNRE
CNRS
COARE
CODESRIA
CORAF
CRHB
CRO
CRODT
CTFT
DEA
DGRST
DOM-TOMS
ECOA
ECOFIT

ABBREVIATIONS USED

Bureau de d(&veloppement de la production agricole (France)

Bureau de recherches ge’ologiques et mmkres (France)

Centre de biotechnologie de Sfax (Funisia)

Caisse centrale de coope’ration e’conomlque (France)

Centre national du machinisme agricole. du ge/nie rural. des eaux et des foras (France)

Consultative Group on International Agricultural Research

Centro Internacional de Agriculture Tropical (CGIAR network) ,

Comiw inter-Etats de lutte contre la se’cheresse au Sahel

Centro Internacional de Mejoramiento de Mais y Trigo (CGIAR network)

Centre de coopaation internationale en recherche agronomique pour le dweloppement (France)

Club des organismes de recherche associe’s (Brussels)

Centre national de la recherche en environnement (Madagascar)

Centre national de la recherche scientmque (France)

Coupled OceanAtmosphere Response Experiment (program)

Council for the Development of Economic and Social Research In Africa (Senegal)

Conference of Representatives of Agricultural Research in Africa

Centre de recherche halieutique de Boussoura (fisheries research center) (Guinea)

Centre de recherches oce’ano-graphiques (Abidjan, Cate d’Ivoire)

Centre de recherches

owanographiques de Dakar-
Thiaroye (Senegal)
Centre technique forestier
tropical (CIRAD. France)
Diplbme d’e tudes approfondies
(post-graduate degree)
Direction gen(&rale de la recherche
scientifique et technique (Congo)
French Overseas Departments and
Territories
Echanges de carbone ocean 7
atmosphae (program)
Changements globaux.
etosystemes. pako-ctosystemes
des fonEts intertropicales (French
interorganization program)
EDF
EEC
EHESS
ENS
EQUANIS
EQU ESEN
EPSAT
EUROSTAT
FAC
FRO
FIDES
FLU PAC
GBF
GEWEX
CIS
HAPEX
HCR
IARCS
IBPGR
ICHS
ICRISAT
ICSU
IFAN
IFREMER
ICBP
IITA
ILO
ILTAB
INDR
European Development Fund
European Economic Community
Ecole des hautes eludes en
sciences sociales (France)
Ecole normale supe’rieure (France)
Environnement et qualite des
apports du f1euve Niger au Sahel
(program)
Environnement et qualite’ des
eaux du fleuve Se’ne’gal (program)
Estimation des pre’cipitations par
satellite (software)
Statistical OMce ofthe European
Communities
Fonds d’aide et de coope’ration
(Ministry of Cooperation, France)
United Nations Food and
Agriculture Organization
Fonds d’investissement pour le
de’veloppement ebonomique et
sooal (Ministry for the DOM
TOMS. France)
Flux de carbone dans le PaciEque
(%quatonal (program)
Grands bassins fluviaux
(program)

Global Energy Water Experiment (program)
Geographical Information System
Hydrological Atmospheric Pilot Experiment (program)
United Nations High Commission for Refugees
International Agricultural Research Centers (CGIAR network)
International Board for Plant Genetic Resources (CGIAR network)
Inter-African Committee for Hydraulic Studies
International Crops Research Institute for Semi-Arid Tropics (CGIAR network)
International Council for Scientific Unions
Institut fondamental d’Afrique noire (Senegal)
Institut frangais de recherche pour I’exploitation de la mer
International Geosphere Biosphere Program
International Institute forTropical Agriculture (CCIAR network)
International Labour Och. Geneva
International Laboratory for Tro-pical Agricultural Biotechnology
Institut national de de’veloppement rural (Cameroon)

INERHI
INPA
INRA
INSERM
INSU
IOC
IPGP
IPGS
lRDDM
IRRI
ISH
ISRA
JGOFS
JRC
LACITO
LATA H
MESIRES
MNHN
MSIRI
OCCGE
OCEAC
OCISCA
OCP
OSS
OSU
PEC
lnstituto Ecuatoriano de Recursos Hidraulicos,
Instituto Nacional de Pesquisas da Amazonia (Brazil)
Institut national de recherche agronomique (France)
lnstitut national de la sante’ et de la recherche medicale (France)
Institut national des sciences de l’Univers (CNRS. France)
Intergovernmental Ocean Commission
Institut de physique du globe de Paris
Institut de physique du globe de Strasbourg
Institut de recherche pour Ie de veloppement du delta du Mekong (Vietnam)
International Rice Research Institute (CGIAR network)
lnstitut des sciences humaines (Cameroon)
lnstitut se’ne’galais de recherche agronomique
Joint Global Ocean Flux Study (program)
Joint Research Centre (EEC)
Laboratoire de Iangues et civilisations a tradition orale (CNRS. France)
Laboratoire d’arcMologie tropicale et d’anthropologie historique (ORSTOM)
Ministere de I’Enseignement supaieur, de I’lnformatique et de la Recherche scientifique (Cameroon)
Muse’um national d’histoire naturelle (France)
Mauritian Sugar Industry Research Institute
Organisation de coordination et de coopaation pour la Iutte contre les grandes ende’mies

Organisation de coordination pour la lutte contre Ies ende’mies en Afrique centrale
Observatoires du changement social et de I’innovation au Cameroun
Onchocerciasis Control Program (W HO)
Observatoire du Sahara et du Sahel
Observatoire des sciences de l’Univers
Programme Eaux continentales (Madagascar)
PNEDC
PEO
R35
R10
SALT
SLN
SOGREAH
SPAAR
STD
STI
SUDENE
TDR
TOGA
TROBIONET ’
TSBGF
TSRI
UAM
UNAM
UNDP
UNRISD
URD
UTIS
WCRP
WHO
WMO
WOCE
WTN
ZARI
Programme national d’eltude de la dynamique du climat (France)
Projet d’e’tablissement de I’ORSTOM (ORSTOM’s Strategic Plan)
Re’seau de recherche sur la H&sistance a la se’cheresse (CORAF)
Raeau informatique de l’ORSTOM
Savanes a long terme (program)
Socie/w le Nickel (New Caledonia enterprise)
Socie’te’ grenobloise d’e’tudes et d’applications hydrauliques
Special Program for African Agricultural Research (World Bank)
Science and Technology for Development (EEC program)
Scientific and Technical Information
Superintendhcia do Desenvolvimento do Nordeste (Brazil)
Tropical Disease Research (WHO)
"ropical Ocean and Global Atmosphere (program)

ropical Biotechnology Network
Tropical Soil Biology and Fertility (program)
We Scripps Research Institute USA)
Jniversidad Autonoma etropolitana (Mexico)
Universidad Nacional Autonoma Metropolitana Mexico)
Jnited Nations Development Program
United Nations Research nstitute for Social Development
Unite, de Recherche de’mographique (University of Benin, Togo)
Unite’ de traitement d’images satellitaires (Satellite Imagery Processing Unit) (Senegal)
World Climate Research Program
World Health Organization
World Meteorological Organization
World Ocean Circulation Experiment (program)
Worldwide TeleviSIon Network
Zone d’analyses et de recommandations pour l’irrigation (Analysis and irrigation action zone) (Ecuador)

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