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FIRST EVALUATION MISSION OF THE PROGRAMME FOR STRENGTHENING THE AGROMETEOROLOGICAL AND HYDROLOGICAL SERVICES OF THE SAHELIAN COUNTRIES AND ESTABLISHMENT OF A CENTRE FOR TRAINING AND APPLICATIONS OF AGROMETEOROLOGY/ OPERATIONAL HYDROLOGY (AGRHYMET)

REPORT

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1. PURPOSE OF THE MISSION

The purpose of the mission is to assess the progress made towards achieving the aims of the AGRHYMET Programme in the preparatory phase for the first period from 1 June 1975 to 31 March 1978.

In particular the mission examined:

(a) the quality of the contributions and the supervision, in order to suggest possible improvements;

(b) the quantity and quality of the results of the Programme, and also the use made of these results with a view to recommending improvements or changes in order to facilitate achievment of the immediate and long-term aims;

(c) the nature and magnitude of supplementary contributions (external and CILSS) in order to carry out the Programme in the best possible way and to suggest changes or possible additions in the long-term aims.

This first mission, requested by the Advisory and Co-ordinating Committee, is composed of four members:

- Mr. Allah Rabaye - Director of the Chad Meteorological Service, representative of CILSS;
- Mr. E. Dahman - Responsible for courses on water management at the IHE (International Institute for Hydraulic and Environmental Engineering) at Delft, Netherlands, representative of the Netherlands;
- Mr. N. Rosenberg - Professor of agrometeorology at the University of Nebraska, representative of the United States;
- Mr. J. Tetefort - Director of research at ORSTOM, Paris (France) representative of UNDP and head of the mission.

Dr. D. Rijks, Co-ordinator of the AGRHYMET Programme, accompanied the members of the mission during their visits to member countries of CILSS: Chad, Mali, Senegal, Gambia, Mauritania, Upper Volta and Niger.

The itinerary, use of time and list of persons met are given in an annex to this report (Annex I)

Mr. Pittavino of the Department of Meteorology of ASECNA Headquarters at Dakar, representative of France, joined the mission at Niamey on 5 April to attend the meeting there and to take part in drafting the evaluation report.

Messrs. R.H. Foote, Director of the Technical Co-operation Department, WMO, Geneva, A. Diallo, Chairman of the Executive Committee of the Programme, M. Challons, Resident Representative of the UNDP in Niger and Djemba Yumbula, Assistant to the Resident Representative of the UNDP in Niger, attended the meeting held in the UNDP office at Niamey on 10 and 11 April.

2. IMPLEMENTATION OF THE AGRHYMET PROGRAMME

2.1 General

Before presenting the report on this evaluation mission it would appear necessary to recall the origin, basic aims, objectives and the various phases of the AGRHYMET Programme.

(a) Origin

The AGRHYMET Programme in the Sahel originated from a resolution adopted in September 1973 at Ouagadougou by the Ministers of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS) at their first meeting. This resolution requested that national Meteorological and Hydrological Services be developed and that a Regional Centre for training and applications of agrometeorology/hydrology be created.

In response to this request and to ECOSOC Resolution (LIV) 1759 (May 1973), a joint UNDP/WMO/FAO mission was organized. This was undertaken from May to August 1974 in the CILSS countries, on the basis of a preparatory mission organized in 1973.

The joint mission broadly outlined the long-term needs of the national Meteorological and Hydrological Services and of the Regional Centre as regards their structure and expansion, focusing attention on their making an attractive contribution to the social and economic development of the Sahel.

(b) Basic goals

In requesting that the Meteorological and Hydrological Services in their countries be strengthened and that a Regional Centre be created, the Governments concerned were anxious to overcome one of the serious shortcomings in their institutions which had been brought to light by the recent long drought in the Sahel.

The drought served as a sharp reminder of the extent to which production in agriculture and livestock rearing, and human activities in general, depend on the hazards of the weather and climate in the Sahel, a zone situated on the boundary of the monsoon rains of West Africa and therefore an area of highly variable seasonal and annual rainfall.

The social and economic future of the Sahel will largely depend on rational use being made of this renewable but limited and variable resource constituted by the seasonal and annual rainfall and also of the natural resource which the climate constitutes.

In order to rationalise the distribution of water to meet these many needs, it is necessary:

(i) To have a day-to-day overall picture of the state of the water resources in the CILSS countries. Such a picture will be obtained through observation, at a network of stations, of the components of the hydrological cycle, through collection and processing of these data in a co-ordinated fashion between the Regional Centre and the national Services;

(ii) To keep governments, administrations and the population informed of the hydrometeorological situation by issuing warnings, advice, bulletins or other documents, through national centres, and in another form ensuring that the best practical use is made of the information by the user;

(iii) To provide those responsible for planning with the agrometeorological and climatological data and studies necessary for land-use planning, water supply management and crop selection, the fight against animal and plant diseases, the fight against losses following harvesting and for the fight against desertification.

The importance of agriculture and livestock rearing in the CILSS countries requires the information thus issued to emphasize the use of weather and climatic condition studies in plant and animal production, i.e., by definition, the applications of agrometeorology including agroclimatology, and hydrology.

(c) Objectives

In order to achieve the above-mentioned objectives the CILSS has approved a strategy for the development of meteorological and hydrological activities on the national and regional scales known as the AGRHYMET Programme. The main objectives of the AGRHYMET Programme are:

(i) To strengthen the national Meteorological and Hydrological Services and all their requirements, in order that they may play their full part in development. These requirements are various: qualified personnel, equipment, networks and national centres suitably equipped with facilities for making observations and telecommunications, data processing and storage, calibration and maintenance, buildings, the position of the Service within the State Administration, organizational structures, co-ordinated programming activities directed towards application, contact with users, investment and operational budget;

(ii) To establish and operate the Regional Centre for training and applications of agrometeorology/operational hydrology. The tasks entrusted to this Regional Centre are shown on the following pages. To some extent, this Centre will act as an Agrometeorological and Hydrometeorological centre for the Sahel integrated into the major programmes of

WMO, particularly the World Weather Watch (WWW), the meteorological applications and environment programme and the hydrology and development of water resources programme. It should be able to make full use of the infrastructures for surface and upper-air observational networks, special networks for climatology, radiation, agrometeorology, rainfall and hydrometry, for telecommunications as well as meteorological satellites, installed to monitor atmospheric conditions, with particular attention being paid to the region in which the West African monsoon develops.

(d) Phases of implementation

In order to implement this Programme, provision is made for three phases :

(i) the present preparatory phase from 1975 to 1980;
(ii) an initial operational phase from 1981 to 1990;
(iii) a regular operational phase from 1990 to 2000.

2.2 Management of the Programme

In order to ensure the efficient management of the Programme, two committees have been established and meet regularly:

(a) the Executive Committee of the Programme, consisting of the Directors of the Meteorological and Hydrological Services of participating countries and also representatives of CILSS and WMO;

(b) the Co-ordinating and Advisory Committee, consisting of representatives of donor countries and organizations - including UNDP and CILSS - and of FAO and WMO.

The Executive Committee is responsible for the overall participation of governments of the Sahel countries in the implementation of the Programme, as defined in the project documents. It acts as a co-ordinating and implementation committee for the governments, WMO acting as executive agency.

A Director, nominated by the CILSS, is responsible for the local operation of the Centre, in particular for the management and supervision of all contributions, either in the financial or personnel fields, made by the CILSS and its member countries.

The Co-ordinating and Advisory Committee plays an advisory and co-ordinating role in regard to the international contributions, financial and other which are necessary for the implementation of the Programme which is at present financed by direct contributions from UNDP, the United Nations Sahelian Office and the following countries: United States of America, Netherlands, Belgium, Switzerland and France.

2.3 Evaluation of the Programme

Under the standard procedures of the UNDP, projects are subject to periodic evaluations which are known as tripartite reviews. These reviews take place once a year. They include representatives of the recipient governments, the UNDP and the Executing Agency. Following the review, a report is prepared which serves as a basis for the future activities of the project. The AGRHYMET Programme being also financed by other sources than the UNDP, donor countries and organizations may participate in these reviews if they so wish.

It is also foreseen to organise periodically evaluation missions with representatives of CILSS, UNDP, donor countries and WMO. These missions will visit the Programme area, the installations set up under the Programme, analyse the progress achieved and problems encountered during the implementation and will prepare recommendations as regards the follow-up activities of the Programme. The terms of reference of these missions are prepared by WMO and reviewed by the two Committees of the Programme.

2.4 Preparatory phase - first period from 1 June 1975 to 31 March 1978

This phase, which has the support of FAO as associated agency, with WMO as executing agency, comprises:

(a) seven national components for strengthening agrometeorological and hydrometeorological activities in the aformentioned member countries of CILSS. Since the end of 1977 the Programme has been extended to an eighth national component (Cape Verde Archipelago);

(b) a regional component at Niamey (Niger): the "Regional Centre for Training and Applications of Agrometeorology/Operational Hydrology".

2.4.1 National components

(a) Specific objectives

These objectives are approximately the same in each of the member countries of CILSS, i.e.:

(i) long-term

The objective is to ensure that the greatest possible contribution is made by the sciences and technologies of meteorology, in particular agrometeorology, and hydrology to the economic growth of the country. This will be achieved by providing the countries with Meteorological Services endowed with a strong agrometeorological component, and Hydrological Services operating in perfect co-ordination and directing their activities towards the major problems of development, particularly in the field of the rational use of climatic resources, rainfall and surface water available for agriculture, livestock rearing and forests;

(ii) short-term

The immediate obectives are:

- to improve and strengthen the meteorological and hydrological observing networks;
- to make the networks operational for data collection, processing, storage and their dissemination in a form which can be directly used by agricultural and rural users;
- to recruit and train personnel necessary for operating the Services satisfactorily.

To these common objectives, the following should be added for Gambia:

(i) long-term

- services for navigation on the river Gambia.

(ii) short-term

- supplying agrometeorological data and studies for development projects having priority, in the field of selecting and improving crops and varieties and establishing a methodology for such studies;
- providing a small laboratory for the analysis of soil moisture.

(b) Activities

In each country, the experts, usually assigned for two years (24 months), have undertaken the following activities with a view to achieving the immediate objectives of the first place of the AGRHYMET Programme:

Activities	Place	Duration
- preliminary visit to all the stations in the country (synoptic, climatological, rainfall and hydrometric) to determine the equipment to be replaced or installed	within the country	3 months
- planning networks for determining the exact number and sites of new stations	HQ of the Services	2 months
- preparing lists of equipment necessary for the networks and for the central services	HQ of the Services	1 month
- planning the work of existing personnel in consultation with the Directors of Agrometeorological and Hydrological Services	HQ of the Services	1 month
- defining the work programmes and organising the Meteorological and Hydrological Services		Throughout the project
- collecting data from the national network monitoring and checking	HQ of the Services	Throughout the project
- setting up a system for transmission capable of ensuring the dissemination of agrometeorological and hydrological forecasts, in collaboration with the various users such as Ministers of Agriculture, livestock, rearing, etc.	HQ of the Services	Throughout the project

Note: The meteorological and hydrological activities are carried out side by side. Certain hydrological activities have been sub-contracted during the first period of the preparatory phase.

2.4.1.1 Chad

A. Contributions

A.1 Personnel

(a) International personnel

Provision was made for 24 man/months of experts in agrometeorology. An expert agrometeorologist has been assigned to the national project since 1 April 1976. He lives at N'Djamena; he also ensures that there is co-ordination with the hydrologists.

The sub-contract for overhauling certain hydrometric stations, for the management of the network and for supervising trainees during their practical training during the rainy season has been given to the Bureau de l'ORSTOM at N'Djamena for an initial period of two years; this sub-contract has been extended until the end of 1978;

(b) National personnel

All staff from the ASECNA Meteorological Service were to be assigned as counterpart staff to the project:

1 meteorologist (Class II)
19 meteorologists (Class III)
67 meteorologists (Class IV)
30 non-professional staff

There was no Hydrological Service in 1975, but the government had made arrangements to assign the following staff to the project:

1 senior technician
2 drivers
1 secretary
1 mechanic
50 observers

In addition, all the fellows, were to be taken on by the government and assigned to the project as soon as they returned from training. The government has in fact assigned :

(i) to the national Meteorological Service

1 meteorologist (Class I)
11 meteorologists (Class IV)

(ii) to hydrology

3 senior technicians (after training)
7 non-professional staff

ORSTOM has paid allowances to persons making scale readings.

Since 1 January 1978 the government has been paying allowances to observers at all climatological and rainfall stations in the country (111 observers).

A.2 **Fellowships**

The following plan for training was adopted in 1975:

(i) in agrometeorology

2 fellowships for 2 years (Class I)
5 fellowships for 2 years (Class II)
6 fellowships for 2 years (Class III)
2 fellowships for 6 months, instruments

(ii) in hydrology

1 fellowship for 2 years (Class I)
2 fellowships for 1 year (Class III)

This training was provided by the Centre at Niamey and abroad. Two hydrometric staff were to be trained locally, and likewise meteorological observers.

A.3 **Consultants**

There is no financial provision in the first project document for visits and missions by consultants.

A.4 **Visits by personnel from the Centre and from WMO HQ**

Details of, and the frequency of these visits are given in Annex II

A.5 **Equipment**

Technical and scientific material and vehicles, to the value of US $139,000 has been received, whereas the initial amount was US $149,000.

The equipment is suitable and sufficient to cover needs, and was ordered in good time. Deliveries have been spread over 1976 and 1977. The material received is sufficient to strengthen the old meteorological network and to set up the new synoptic, climatological and agrometeorological stations for which provision is made in the first project document. The same applies to the hydrological network. The vehicles at present in use make it possible to travel from station to station and check the networks.

A.6 **Land and buildings**

No building or particular premises have been allocated by the government for the Services coming under the national Department of Meteorology. Since 1 January 1978 both the Department and its Services have been together in premises provisionally loaned by ASECNA.

Funds are expected (donation of US $50,000 by the Netherlands) for the construction of a provisional building, separate from that belonging to ASECNA, and talks have been started with that body with a view to obtaining a suitable site.

Funds for the premises of the hydrological brigades at Moundou, Sahr and Abéché still have to be found.

A.7 Funds received

(a) UNDP

The total amount of the budget allocated and used for the years 1975, 1976 and 1977 and the first quarter of 1978 was US $ 453,372.

(b) Government contribution

For the same period, the government contribution for the operation of the national Meteorological Service and for the project is estimated at 13 million FCFA, i.e. approximately US $54,000.

B.1 Results

Organization of the Services

In 1975, there was no national Meteorological Service. In practice, meteorological services were provided by ASECNA which is under the Ministry for Transport, Posts and Telecommunications (see organisational diagram in Annex III). ORSTOM undertook the management of the hydrological network.

In 1978, the hydrogeological, hydrological, climatological, and later the agrometeorological services were grouped together under the national Meteorological Department, this latter being attached to the Ministry of Agriculture (see organisational diagram in Annex III).

On 31 March the national personnel assigned to the project comprised:

1 meteorological engineer (Class I), counterpart of the expert
2 hydrological technicians
11 Class IV meteorologists
9 non-professional staff
111 part-time observers

B.2 Personnel, trained and being trained

(a) Hydrology

Three hydrologists trained at the Centre in Niamey returned to Chad in 1977. From 1 January 1978 two were assigned to the Hydrological Service to be in charge of two brigades which will be operational from June 1978. The third went to Lausanne in March 1978 and on his return to Chad, which is expected on 31 December 1978, should undertake direction of the Hydrological Service under the national Department of Meteorology.

Due to lack of candidates, the second fellowship has not yet been used.

Two technicians (Class III) are finishing their training at the Centre in Niamey and will be ready to take up duties at the end of 1979.

The limnimetric observers have been trained continuously. There has been no training for assistant hydrologists.

It should be noted that a rural engineer is also following a post-graduate course in hydrology at Lausanne this year.

(b) Agrometeorology

A works engineer (Class II) and three technicians (Class III) are completing their training at the Centre in Niamey and will be posted to the climatological service. The engineer will be responsible for this service attached to the national Department of Meteorology.

Three other technicians undergoing training will become available during the course of 1978.

Training of observers (Class IV) which should have been done locally, has not been possible.

B.3 Meteorological and hydrological stations

Due to problems of a jurisdictional nature which have arisen between ASECNA and the national Meteorological Service, instruments for the synoptic network worth about US $60,000 and received in December 1977 have not yet been installed.

Two new agrometeorological stations have been set up, one at Dougui to meet the needs of an agricultural station responsible for producing millet, sorghum and maize seeds, the other at Mandé (Lai) for a rice growing project under OMVSD (Office de Mise en valeur de Sategui-Doresia) (Development Office of Sategui-Doresia)

Strengthening of the climatological and rainfall stations started in September 1977 and will be actively pursued in 1978.

As a result of the sub-contract, it has been possible to put 54 limnimetric stations into good working order, 13 of them being equipped with a limnigraph. No new stations were set up during the period. 42 accessible stations are checked regularly.

B.4 Land and buildings

From 1 January 1978, provisional loan by ASECNA of a building for the Agrometeorological and Hydrological Services. The building is in good condition but in order to be operational some repairs are necessary. It is situated near the telecommunications centre belonging to ASECNA (aerodrome).

B.5 Information disseminated and manuals published

A meteorological bulletin containing a general weather forecast and details of rainfall and temperature, is disseminated twice daily by the ASECNA Meteorological Service.

Readings for the river Chari at N'Djamena are disseminated by the national Department of Meteorology daily.

Rainfall data for 1976 and 1977 have been collected and analysed under the project. In 1977 a note concerning the hydrometeorological situation was published in collaboration with OMVS.

The Department publishes Hydrological Yearbooks for Gambia in collaboration with OMVS. These yearbooks are kept up to date.

Furthermore, such information has been supplied to various organizations and bodies directly concerned with agricultural development, such as NIMAM, FAO, OMA, OMVS, the services of various ministries, etc.

3.6 **Plans - studies and meetings**

The various needs of the services were studied when preparing the second project document for the years 1976, 1977 and 1978.

Since the Services for the development of agriculture, livestock rearing and forests are grouped under the same ministry, the setting up of a national coordinating committee is not necessary. The needs of all the services must such meets to coordinate the work programme. Furthermore there is a technical committee on the fight against drought within the ministry and the Director of the national Hydrometeorological Service is a member of this committee.

The Director of the national Hydrometeorological Service is also Chairman of the National Committee for the International Hydrological Programme.

6. **Conclusions**

Unfortunately, many difficulties peculiar to this country have meant that it has not been possible to:

(a) completely restore the old meteorological network which has deteriorated during recent years before the effective start of the project;

(b) set up a sufficient number of stations oriented towards agrometeorology in order to meet the needs of development in agriculture, livestock rearing and forestry;

(c) appoint and train all the personnel for which provision is made in the first project document;

(d) consequently it has not been possible to collect and process the agrometeorological data and disseminate them in a form which can be used by the rural population.

However:

(a) The Government of Chad, aware of the importance of the role to be played by agrometeorology and hydrology in the development of the country, set up, in 1975, a National Department of Meteorology grouping together the services of climatology and hydrology and later of agrometeorology and the user services within the Ministry for Agricultural and Pastoral Development and for the Prevention of Natural Disasters. It is certain that new arrangements, strengthened by the facilities mentioned in the second project document, will make it possible to actively and effectively pursue the AGRHYMET Programme until 1981;

(b) the project has had the merit of convincing the public authorities that agrometeorological and hydrological studies will provide considerable assistance to the agricultural development of the country;

(c) the mission is convinced that due to the considerable effort which has now been agreed by the Government of Chad, it will be possible to make up for lost time.

Furthermore, it is to be noted that:

(a) the ORSTOM sub-contract has been carried out as planned and the hydrological network is operational;

(b) the government has always sent the planned number of trainees to Niamey, except in the case of the first Class III agrometeorological course;

(c) processing and dissemination of hydrological data can start as soon as the hydrologists at present under training take up their duties.

2.4.1.2 Mali

A. Contributions

A.1 Personnel

(a) International personnel

24 man/months of meteorological experts were provided for. An agrometeorological expert took up duties on 28 October 1975; he ensures that there is co-ordination in the field of agrometerology. From 29 October 1977 financing has been undertaken by the national IPF.

A WMO/ORSTOM sub-contract was included in the contributions to ensure technical advice, management of the network and provision of qualified staff. This contract was completed on 30 August 1977.

(b) National personnel

In 1975 the ASECNA professional staff comprised 2, 6, 22 and 105 meteorologists, Classes I, II, III and IV, respectively. The Hydrological Service had 4 engineers, 5 senior technicians and 9 hydrometric staff. Some of these have been assigned to the project.

Furthermore, all the students, after their training, have been taken on by the government and assigned to the project.

In agrometeorology, trained personnel, numbering 21, have taken up duties. In hydrology the number of staff has remained constant. ORSTOM has paid allowances to persons taking readings.

A.2 Fellowships

In order to train the necessary additional personnel, provision has been made, for the period 1975-1977, for a sum of US $63,900 (UNDP contribution) and 11,880 FM (Mali contribution). It was necessary to train:

5 meteorologists (Class II), two years each
6 senior technicians in agrometeorology (Class III) two years each
2 instrument specialists, 6 months each
1 hydrological engineer, 1 year
1 senior technician in hydrology, 1 year

This training was provided at the Centre in Niamey and abroad.

A.3 Consultants

No provision was made in the first project document to finance visits and missions by consultants.

A.4 Visits by the personnel of the Centre and WMO HQ

Details and the frequency of these visits are given in Annex II.

A.5 Equipment

The project has received meteorological and hydrological instruments, pneumatic boats, a Peugeot 504, four Land-Rovers, a Renault R.4 and office equipment for a total sum of US $175,000, whereas the initial amount to be provided was US $158,000.

According to information received from the Hydrological Service, there is not sufficient scientific material available to equip all the existing brigades.

A.6 Land and buildings

The agrometeorological section of the project has been installed in provisional premises pending the construction of new buildings, while the hydrological section is occupying suitable premises in the Department of Hydraulics and Energy, however it does not have its own storage facility.

A.7 Funds received

During the period under review, the funds used by UNDP amounted to US $415,781, against 10,870,000 Mali Francs for Mali. The funds agreed by Mali were mainly used to pay staff, strengthen stations and disseminate data.

B. Results

B.1 Organization of Services

There is a clear distinction in the organization of the two Services. While meteorological services are operational, hydrological services seem to be suffering from a lack of co-ordination at the project level.

An Agrometeorological Service does indeed exist in Mali; it is only necessary to extend it gradually. With regard to the Hydrological Service, such a service does exist, but it seems to be under-employed. On the other hand, the impact of the project on the development of the national Service has hardly been felt.

B.2 Personnel, trained and being trained

The following have been trained:

2 agrometeorologists (Class I)
2 senior technicians in agrometeorology
17 agrometeorological observers
1 technician in radiation instruments

The following are being trained:

4 senior technicians in agrometeorology

In hydrology it would seem that not all the fellowships provided have been used. On the other hand, the staff of the Service has been increased by the engineer and two technicians, but there has been a loss of three hydrometric staff during the period.

B.3 Meteorological and hydrological stations

One agrometeorological station was set up, and the other strengthened. In addition 9 climatological and rainfall stations were strengthened. In hydrology, it seems that 10 stations have been overhauled and 6 new stations installed. The ORSTOM representative considers that the credit for the increase in the allowances to persons making scale readings (from 2,000 to 8,000-12,000 FM per month) is due to the AGRHYMET Programme.

B.4 Land and buildings

To date, the government has not yet undertaken the construction of the buildings for the national Meteorological Service. The government is looking for financial aid from friendly countries. Four synoptic stations within the country require new buildings. Also the hydrological brigades have no premises at the sub-stations.

B.5 Information disseminated and manuals published

150 user services have received 10-day bulletins and annual summaries of the weather. There are long delays in the publication of Hydrological Yearbooks.

B.6 Plans - studies and committees

A programme of agrometeorological activities for future years has been prepared and submitted to the Technical Committee for food and oleaginous crops. It will have to be approved by the National Committee for Scientific Research for implementation. This programme comprises the kind of assistance which can be provided by the AGRHYMET Programme to agricultural production, on the one hand, and the research and studies which will have to be undertaken to achieve this objective, on the other.

The national Hydrological Service is studying the development of four catchment areas.

C. Conclusions

(a) The National Meteorological Service, strengthened by the contributions of the AGRHYMET Programme, has made appreciable progress towards adapting the meteorological network to the needs of agricultural development. The engineering and technical staffs are well trained and adequate to undertake the activities of the first phase. However, a considerable effort will still have to be made to train agrometeorological observers and assistant hydrologists (Class IV);

(b) There is close collaboration with the user services but little has been done at the farmer level. The agrometeorological station at Sotuba on the experimental sites of the Institute for Agronomic Research in Mali is funtioning well and fulfills all the required conditions for supporting agricultural developments;

(c) The national Meteorological Service having considerably increased its staff, the present buildings are inadequate to meet present and future needs;

(d) There is a well constituted Hydrological Service, but implementation of the AGRHYMET Programme contributions has not yielded the results which has been hoped for. Meteorology and hydrology are sufficiently closely linked for the AGRHYMET Programme to achieve its objectives fully.

2.4.1.3 **Senegal**

A. **Contributions**

A.1 **Personnel**

(a) **International personnel**

The WMO meteorological expert who had been posted to Dakar since 1973 was transferred to the AGRHYMET Programme in April 1975, i.e at the time the programme was set up. Up to the present time he has taken part in all the activities contained in the project document, in the two fields of meteorology and hydrology. Initially, provision was made for 2 years (24 months) of expert services for the project. An extension of 3 months has been set against the funds provided under the heading of "consultants". Funds for this expert are at present provided by the national IPF.

The sub-contract providing for the overhaul of the hydrological network and for the supervision of technicians under training at Niamey during their practical training has been entrusted to ORSTOM. One engineer and some hydrometric staff took part in the implementation of the project, working part-time. This sub-contract came to an end in August 1977.

(b) **National personnel**

1 meteorologist (Class I)
1 " (Class II)
1 " (Class III)
1 " (Class IV)
4 non-professional staff
1 director of studies and programming, part-time
1 head of the Hydrological Division, after additional training, completed in 1976
3 technicians (Class III) after training at the Centre
4 hydrometric staff (Class IV) after training in the field

were posted to the project.

ORSTOM has paid allowances to persons making scale readings.

A.2 **Fellowships**

The following distribution of fellowships was agreed to in 1975:

(i) in agrometeorology

11 Class III, total of 216 months
2 Class II, two years each
1 Class I, two years
2 for instruments, 6 months each

(ii) in hydrology

2 Class II, 12 months each

A.3 Consultants

Three man/months of expert services were provided for in the field of meteorology; these were used for extending the services of the expert in post.

A.4 Visits by the personnel of the Centre and WMO HQ

Details and the frequency of these visits are given in Annex II.

A.5 Equipment

The equipment was ordered in good time and received within reasonable periods. This equipment has been used to strengthen the entire network and to set up new stations. The overall cost amounted to US $131,000, whereas the initial allocation was US $101,500.

A.6 Land and buildings

(i) meteorology

The block at present occupied by the national Meteorological Service belongs to the Government of Senegal. This block was built in 1974 and is situated within the precincts of the airport, close to the ASECNA services. The total area is approximately 1,100 m^2, giving an effective area of 855 m^2 (offices and workshops). It is estimated that the total cost of this building was 70 million FCFA. One floor, i.e. half of the area, is occupied by the national Meteorological Service.

(ii) hydrology

No building has at the moment been allocated to the Hydrological Service which occupies a few offices in the large administrative block in the centre of the town of Dakar. The government has made provision for funds amounting to 20 million FCFA for the construction of a building. The installations for the use of the brigades at St.-Louis, Tambacounda and Ziguinchor should be improved.

A.7 Funds received

(a) UNDP

Total budget :	US $ 363,847
- to 31 March 1978, total funds US $101,500 for the equipment and the rest for paying the expert and fellowships	US $ 295,312, of which
- reckoning from 2 July 1979, amount incurred for fellowships	US $ 68,535

(b) Government counterpart

(i) meteorology

Total budget (personnel, operation purchase of material and maintenance)

- 1974/1975	FCFA	11,384,000
- 1976 (for operation) approx.	FCFA	8,000,000
- 1977/1978	FCFA	23,061,604

(ii) hydrology

No special funds are shown for 1975 and 1976. For the ensuing years there was provision for funds amounting to a total of 131 million FCFA, made up as follows:

- 1977	FCFA	43,000,000
- 1978	FCFA	46,000,000

It would be necessary for the funds to be freely available in good time.

B. Results

B.1 Organization of Services

The two Services for meteorology and hydrology have been attached to the same ministry since the beginning of this year. Up to now meteorologists have been under the Ministry of Transport and hydrologists have been under the Ministry for Rural Development and Hydraulics.

The national Meteorological Service has reached a satisfactory stage of development. As regards hydrology the head of the Hydrological Division has not had time to deal effectively with the three heavy work brigades which have been practically independent for a number of years.

B.2 Personnel, trained and being trained

In the country, at the Centre in Niamey, or outside the member countries of CILSS, which completes the staffs for 1975:

5 meteorologists (Class II)
2 meteorologists (Class III)
21 meteorologists (Class IV)
4 agrometeorologists (Class III)
3 hydrologists (Class III)
4 hydrologists (Class IV)

To this technical staff should be added supporting staff: 9 for meteorology and 1 for hydrology.

Three agrometeorological technicians and two hydrological technicians are at present at the Centre in Niamey.

There has been no specific training for assistant hydrologists, but the Government of Senegal is aware of the importance of such training.

B.3 Meteorological and hydrological stations

(i) meteorological network

This network is up to strength and operating satisfactorily. There are now 144 new rainfall stations, bringing the total number to 240. An agrometeorological station has been set up at Louga. Three climatological stations and three radiometric stations have been strengthened. Some difficulties have been reported with regard to inspections and maintenance of the equipment, due to inadequate transport;

(ii) hydrological network

The brigade at Tambacounda has been operating since the return of one of the two technicians (senior) trained in Niamey. The three other brigades are less operational due to lack of funds for operational purposes.

The network is complete and 12 new stations have been set up; 76 basic stations are operational. ORSTOM is effectively managing the network, assisted by Senegalese brigades.

B.4 Land and buildings

There is no new infrastructure; however a budgetary allocation of 20 million FCFA should be mentioned, for the construction of a hydrological complex comprising offices, workshops, garages and stores.

B.5 Information disseminated and manuals published

The Hydrological Yearbooks are published regularly in cooperation with ORSTOM and also studies on small experimental catchment areas.

431 requests for meteorological information of all kinds (data, studies, advice) usually concerning precipitation, temperatures, humidity, wind frequencies, etc., have been recorded from 1 April 1975 until the present time.

426 requests have been met, to which should be added several requests for data on global solar radiation and for data on Class A evaporation pans.

Climatological summaries are prepared and distributed regularly.

Several operational manuals (technical notes on operational meteorology) are being prepared.

At the national level the principal users are agriculture, development bodies, local enterprises, the Centre for Oceanographic Research at Dakar-Thiaroye.

There are frequent contacts with consultant engineers from various national and international bodies.

B.6 **Plans - studies and committees**

The various needs of the Services were studied when preparing the second project document for the preparatory phase. The national Meteorological and Hydrological Services took part in preparing the fifth Plan for Social and Economic Development.

The AGRHYMET Programme is in close touch with:

- the national Committee on WAMEX (West African Monsoon Experiment)
- the national Committee on IHP (International Hydrological Programme).

At the same time the AGRHYMET Programme is at present taking part in setting up a national Committee of CILSS (CONACILSS) under the auspices of MDRE, and in the work of the Standing Committee on Major Agricultural Products each week.

Activities oriented towards agricultural development are carried on jointly with institutes for agronomical research or organizations for development. The nature of these contacts is essentially as follows: requests for meteorological data of all kinds, assistance in the installation of instruments, attendance of technical and scientific meetings and of working groups, preparing common works of reference, participation in the work of the national Commission for Agronomical and Oceanographic Research, weekly participation in the work of the Standing Committee for Major Agricultural Products, in the work of several UNDP/Senegal/donor countries meetings, for estimating the yield of the 1977 harvest and losses due to disasters, in meetings concerning the use of solar and wind energy for rural purposes, etc.

C. **Conclusions**

(a) **Meteorology**

(i) The AGRHYMET Programme has been closely adhered to and should be continued as planned. Most of the immediate objectives have been achieved;

(ii) The quality and number of documents supplied to services or bodies responsible for development bear witness to the activities undertaken by the Meteorological Services;

(iii) A network of radio links between the principal synoptic and meteorological stations is being installed, to enable the data to be collected and analyzed quickly and disseminated to the various users. The addition of the mini-computer which is planned to take place during the first phase will facilitate the interpretation and application of climatic data to the needs of agriculture in particular;

(iv) The present infrastructure is in good condition and adequate, at least as regards the national meteorological centre whose buildings are grouped within the precincts of the airport close to the ASECNA technical services. At the same time, all the material and instruments contributed by the project have been fully used;

(v) However, it would be appropriate to extend and adapt the climatological network, in such a way as to be of more use for studies on the agricultural potential of the main regions of Senegal. It would be desirable to study relationships between the climate and elements harmful to cultivated crops;

(vi) When, the Hydrological Service, the national Meteorological Service and the ASECNA services become attached to the same ministry, in 1978, co-ordination of activities in the field of climatology will be facilitated.

Hydrology

(i) Hydrology got off to a slower start due to a lack of trained personnel and to insuffient funds being allocated for operational purposes and improvements are therefore necessary. For the time being the Service has no building allocated to it. The Class II and Class III personnel at present under training will probably supplement the present staffs and it will be possible to establish the brigades for operational hydrology which the country needs;

(ii) The ORSTOM sub-contract has been carried out as planned;

(iii) Students have been sent to Niamey in accordance with the plan.

2.4.1.4 Gambia

A. Contributions

A.1 Personnel

(a) International personnel

Provision is made for 24 man/months and 12 man/months for an agrometeorologist and a hydrologist, respectively. The two experts arrived during the first quarter of 1976. The mission of the hydrologist has been extended, thanks to additional funds from the Netherlands;

(b) National personnel

At the start of the project, the meteorological section of the Hydrometerological Department of Gambia had one Class I meteorologist and 21 Class IV meteorologists.

The hydrological section had 7 technicians (Class III), 4 hydrologists (Class IV) and one person for making scale readings.

All these staff, together with the Director of the Hydrometeorological Department were assigned to the project in 1976, i.e. a total of 36 persons. This staff was increased to 72 for the preparatory phase (including boat's crews). The officials trained locally or abroad have been incorporated, on their return, into the Civil Service and assigned to the project.

A.2 Fellowships

There was provision for two fellowships in meteorology: two years training in general meteorology followed by one year in agro-meteorology.

In hydrology, provision was made for one fellowship in civil engineering (4 years) followed by a year of specialization in hydrology; provision was made for another fellowship for training a hydrologist (Class I) in 3 years; in addition two training periods of 6 months had been proposed in the field of maintenance of hydrological and meteorological equipment.

This training was provided abroad.

Training of observers, assistant hydrologists and persons making scale readings was undertaken locally.

A.3 Consultants

No provision was made in the first project document for funds for visits and missions by consultants.

A.4 Visits by the personnel of the Centre and WMO HQ

Details and the frequency of these visits are given in Annex II.

A.5 Equipment

Equipment of all kinds corresponding to a sum of US $158,730 was received by the Department, whereas the initial allocation was US $142,000.

The hydrological material delivered does not exactly correspond to the material described in the project document: the expert hydrologist arrived in time to make the necessary changes to adapt the material to local conditions (tides, intrusion of salt, etc.) A boat for inspection trips and hydrological gauging was received from the Netherlands.

A.6 Land and buildings

The project has been housed in provisional premises pending the construction of new premises.

A.7 Funds received

The government contribution to the implementation of the project was 1,684,934 dalasis in 1975; in 1978 the figure is 5,411,300 D.

The UNDP contribution for the same period was US $ 367,397.

B. Results

B.1 Organization of Services

Since the start of the project, the two Services (Meteorological and Hydrological) have been placed under the same management under the Ministry of Agriculture and Natural Resources. Thus the user services can now take advantage of the contributions of the AGRHYMET Programme.

B.2 Personnel, trained and being trained

An agrometeorological technician has been trained. Four students are undergoing Class I or Class II training. 38 nationals are being trained to become agrometeorological observers.

It was not until 1977 that the United States (USAID), taking over from UNDP, granted two fellowships in hydrology (Classes I and II); the fellows will return during the second phase of the project. The hydrological mechanic was also been trained with the aid of the United States in 1977. The instruments specialist will not leave for his training in the United Kingdom before May 1978.

Training of 16 hydrometric staff and assistant hydrologists has been continued locally; the same applies to the agrometeorological observers.

B.3 Meteorological and hydrological stations

Six meteorological stations have been strengthened and one has been moved. Six climatological stations have been set up and 40 rainfall stations strengthened.

23 main hydrological stations and 6 secondary stations have been set up, 13 of these being equipped with a limnigraph. Measurements of discharge are made regularly using the method of gauging by integration. Samples of water are taken.

B.4 Land and buildings

Premises for meteorological forecasting and the telecommunications centre have been built and are available for use.

The laboratory for water sampling will be installed in a new building which is under construction.

Five offices which are under construction will be brought into use as soon as the telecommunications system is operational.

Two villas should be constructed at the agronomical station at Sapu at a cost of 65,000 dalasis.

B.5 Information disseminated and manuals published

Six technical reports have been published. Leaflets giving agrometeorological and hydrological observations have been published.

10-day rainfall bulletins are published during the rainy season. Monthly climatological bulletins are also published. A draft "Manual for Hydrologists" is now available. Detailed hydrological data are supplied to users on request.

As regards the examination and analysis of hydrological observations, in view of the quantity and quality of the information available it will soon be essential to use a computer. In general, work is slightly ahead of the work plan in the field of applied studies and checking past data.

The analysis of samples of water cannot be completely undertaken in Gambia due to the lack of a laboratory for this purpose. Such a laboratory, for which provision is made under the project for the development of the basin of the Gambia river, is at present under construction.

B.6 Plans - studies and committees

A plan for the development of the Department was prepared in February 1976.

The second project document has been prepared in good time.

The Agrometeorological Service, jointly with the SAPU centre of agronomical research, undertakes studies on the varieties of rice which are resistant to drought, on the development of plateaux and on the optimum dates for sowing ground-nuts at Yundum.

Since the Hydrological and Meteorological Services and the Services for development have been placed together under the same ministry, it has not been considered necessary to set up a Co-ordinating Committee.

Provision of a small laboratory for the analysis of soil moisture: this objective has not been achieved but provision is made for a laboratory in the building under construction.

C. Conclusions

The most important short-term objectives for which provision is made in the first project document have been achieved. The first phase of the AGRHYMET Programme is developing normally due to the fact that it is perfectly integrated into the administrative structures associated with the overall development of the country (agricultural, etc.) Co-ordination of agrometeorological and hydrometeorological activities is excellent and sets a good example.

The good working conditions have made it possible for the AGRHYMET Programme to progress rapidly. The analysis and interpretation of past data now make it possible to give agricultural forecasts, in particular for the cultivation of rice and ground-nuts.

All the stations of the agrometeorological and hydrological networks are inspected frequently and are well maintained. It is certain that the posting of an agrometeorological expert and an expert hydrologist from WMO have largely contributed to the Programme getting off to a good start and this should continue without any apparent difficulties until the end of the first phase.

2.4.1.5 **Mauritania**

A. **Contributions**

A.1 **Personnel**

(a) **International personnel**

Provision was made in the first project document for 24 man/months of expert services in meteorology. An agrometeorological expert took up duties on 1 August 1976.

An ORSTOM sub-contract enabled a full-time hydrologist to facilitate the overhaul of stations and supervision of students during on-the-job training.

(b) **National personnel**

The national Meteorological Service is practically non-existent. The Hydrological Service is represented by a volunteer from French Technical Assistance (Head of Service), replaced each year.

One of the agrometeorological students who had to break off his training at the Centre in Niamey earlier than expected has been engaged as an observer. Since September 1977, 4 assistant hydrologists, trained in Morocco have joined the Service. A draughtsman was placed at the disposal of the project in February 1977, and likewise a young typist who also acts as secretary. For the record, it should be mentioned that there is also a runner.

The senior technician trained at the Centre in Niamey has not been incorporated into the Civil Service.

A.2 **Fellowships**

In the first project document there was provision for granting the following fellowships:

(i) **Meteorology**

2 fellowships for 2 years (Class I)
5 fellowships for 2 years (Class II)
6 fellowships for 2 years (Class III)
2 fellowships of 6 months for training and specialisation in instruments

(ii) **Hydrology**

1 specialisation fellowship for 9 months for an engineer (Class I)
1 specialisation fellowship for training a hydrological technician (Class III) for 12 months

Note: The Class IV hydrometric staff were to be trained in the national Hydrological Service.

A.3 Consultants

No provision has been made for funds in the first project document for visits and missions by consultants.

A.4 Visits by personnel from the Centre and WMO HQ

Details and the frequency of these visits are given in Annex II.

A.5 Equipment

Suitable equipment, comprising various material, was delivered during the two years 1976 and 1977 and at the beginning of 1978. The equipment is adequate for overhauling and operating the existing meteorological and hydrological networks. At the same time it will make it possible to strengthen the two networks by setting up new stations. The overall value of this equipment is US $135,000, whereas an original allocation of US $165,000 was planned. The UNIMOG tractor, for which provision was made in the project document, has not been purchased, due to an unexpected increase in the price at the time of placing the order.

The difficult working conditions inherent to the country make constant maintenance of the vehicles and equipment essential. The cost of this maintenance is much higher than in the other Sahelian countries. Few good workshops and good mechanics are available in the country.

A.6 Land and buildings

An old building with an area of approximately 100 m^2 has been converted to meet the needs of the project. It comprises 3 offices with a meeting room and 2 small stores. Unfortunately the garages and stores are too small for all the equipment and vehicles, most of which are kept in a yard with an area of 1500 m^2 and surrounded by a wall.

Two pieces of land have recently been placed at the disposal of the Department of Hydraulics and Energy, but so far it has not been possible to construct any large building thereon.

A.7 Funds received

As at 31 December 1977 the total funds used for the project amounted to US $441,199.

For the years 1975, 1976 and 1977 the financial contribution by the government amounted to a total of US $12,000 for the operation of the Hydrological and Meteorological Services (payment of salaries to national personnel and maintenance of some vehicles).

B. Results

B.1 Organisation of the Services

While awaiting the setting up of a national Meteorological Service, the agrometeorological section of the project is attached to the Department of Hydraulics and Energy. Contacts have been made with the ASECNA meteorological section with a view to establishing fruitful collaboration. The hydrological section, which was also integrated into the Department of Hydraulics and Energy, was set up in 1972. This section became operational when the AGRHYMET Programme started and through the assignment of qualified national personnel.

B.2 Personnel, trained and under training

As regards hydrology, two senior technicians have been trained at the Centre in Niamey, at the course held in 1975-1977. Unfortunately they have not yet been incorporated into the Civil Service. It should be noted that 4 assistant hydrologists have already been trained at Oran and that 4 more are still under training (fellowships under bilateral assistance, outside the AGRHYMET Programme).

As regards agrometeorology, an agrometeorologist (Class IV) whose level is too low for him to follow Class III instruction, has been recruited as an observer.

The following are being trained:

(i) hydrology

2 senior technicians (1977-1979)

(ii) agrometeorology

3 senior technicians (1976-1978 and 1977-1979)
5 meteorological engineers (Classes I and II) in the USSR.

B.3 Meteorological and hydrological stations

(i) Agrometeorlogy

Three climatological stations have been set up since the start of the AGRHYMET Programme. Apart from that, it has not been possible to undertake any improvements or reclassification of stations. Meteorological equipment has been delivered for installation at three agrometeorological stations set up at agronomical experimental stations. One existing station has been integrated into the project.
12 rainfall stations were set up in 1977.

Maintenance of the network is difficult in Mauritania, and will long remain so, due to the great distances and the severity of the climate. The introduction of radio links with Nouakchott for the main stations will facilitate data collection and make it possible to broadcast advice to agriculturists, livestock breeders and sedentary farmers who are usually grouped in small areas of agricultural development.

(ii) Hydrology

Five limnimetric/graphic stations have been overhauled, on old foundations or on newly constructed sites. Due to lack of funds and sometimes for security reasons it has not been possible to complete the programme of installation.

The hydrometric campaign in the catchment area of the Gorgol during the rainy season of 1977 took place as planned.

B.4 Land and buildings

There has been no new building since 1976. Land, with an area of approximately 10 ha may be allocated by the government for the national Meteorological Service, but it remains to find funds to construct buildings to house offices, stores and garages.

B.5 Information disseminated and manuals published

A Yearbook for the Black Gorgol (1972-1975) has been published.

A daily meteorological bulletin was published during the rainy season of 1977.

A booklet on hydrometric installations is at present being distributed.

B.6 Plans - studies and committees

Two hydrological studies on the region of the Gorgols will be useful for future hydraulic developments in this region.

A rainfall study is being carried out.

Two rainfall studies relating to the 1977 season have just been published.

A study relating to the recent years of drought followed by a description of the project is available.

Studies on the water requirements of the principal crops in irrigated regions and on the possibilities for grazing will have to be undertaken. Since dew occurs frequently in the coastal region quantitative measurements will be made.

Proposals for the setting up of a national Meteorological Service are under study.

The second project document for the continuation of the preparatory phase was prepared at the beginning of 1978.

The WMO expert for the project took part in the meetings of the principal directors responsible for the development of agriculture, livestock rearing, hydraulics and forestry to establish a new structure for the national Meteorological Services.

A committee will shortly be established to ensure close collaboration between the Meteorological Service and ASECNA and the Department of Hydraulics and Energy, the governmental counterpart of the project.

C. Conclusions

There is some delay in implementing the first phase of the AGRHYMET Programme due to the difficult times the country has been passing through in recent years.

The effects of drought are much more marked than in the other Sahelian countries and desertification is a permanent threat to Mauritania.

Until the arrival of the agrometeorological expert in August meteorological work was entrusted entirely to ASECNA and was mainly oriented towards the needs of aviation. The hydrological studies were for some specific small areas, without follow-up and undertaken by private companies.

There can be no doubt that the government has a very special interest in these fields. The first results obtained, thanks to the support of the project, in a limited space of time are not inconsiderable and should constitute an incentive for the Programme. The future of the Programme depends on the number and quality of trained technicians and on their being rapidly integrated into the Civil Service. It will also be necessary to find sufficient funds for operating services in the future.

The ORSTOM sub-contract has been carried out satisfactorily.

Mauritania has sent the planned number of students in hydrology to Niamey, but the same is not true of students in agrometeorology.

2.4.1.6 Upper Volta

A. Contributions

A.1 Personnel

(a) International personnel

An agroclimatological expert was assigned to the project from 9 October 1975 to 21 December 1977. Two additional months, beyond the period planned, were financed under the national IPF.

A sub-contract with ORSTOM was entered into to develop the network and supervise training of personnel from Upper Volta. The sub-contractor's staff have been assigned to the project as planned.

(b) National personnel

The meteorological personnel comprises one Class I meteorologist, 3 Class II, 10 Class III, 46 Class IV and 30 non-professional staff. The hydrological personnel comprises 1 part-time engineer, 2 chiefs of brigade, 3 hydrometric staff, 2 chauffeurs, 4 unskilled labourers, 1 secretary and 10 observers.

A.2 **Fellowships**

(i) **for meteorology**

2 fellowships for 2 years (Class I)
5 fellowships for 2 years (Class II)
6 fellowships for 2 years (Class III)
2 fellowships for 6 months (instruments).

(ii) **for hydrology**

2 fellowships for 2 years (Class III)
training of two assistant hydrologists within the country.

A.3 **Consultants**

No provision is made in the first project document for visits and missions by consultants.

A.4 **Visits by personnel from the Centre and WMO HQ**

Details and the frequency of these visits are given in Annex II.

A.5 **Equipment**

Meteorological and hydrological equipment, 1 Peugeot 504, 3 Toyota PU, 2 Peugeot light vans, 1 Range Rover (second hand), 2 pneumatic boats and office equipment were delivered during the period covered by the first phase at a total cost of US $156,000, whereas there was provision for an initial allocation of US $154,000

A.6 **Land and buildings**

Premises have been provisionally allocated to the two sections of the project in buildings belonging to the Department of Hydraulics under the Ministry for Rural Development and to the Ministry of Transport and Urbanism.

A.7 **Funds received**

A sum of US $ 404,063 from UNDP has been allocated and used during the first period.

The Government of Upper Volta undertakes payment of salaries and allowances to the national staff. In 1975 the budget of the Hydrological Service was 2,750,000 FCFA; in 1978 it was 10,000,000 FCFA.

B. **Results**

B.1 **Organisation of the Services**

The department of National Meteorology is under the Ministry of Public Works, Transport and Urbanism.

The Hydrological Service is under the care of the Ministry for Rural Development.

The present organisation of the two Services is such that they are operational and raises no problem as regards co-ordination. Co-ordination will be at the level of the national Council for Meteorology and the National Committee for Water, of which representatives of the Meteorological and Hydrological Services are members.

B.2 Personnel, trained and being training

In agrometeorology, an engineer (Class I) has been trained at Oran and a senior technician has been trained at Niamey. An assistant meteorologist and a typist/punch-card operator have been recruited. 5 Class II agrometeorologists and 4 Class III agrometeorologists are being trained.

In hydrology, 2 senior technicians have been trained at the Centre at Niamey, but one of them did not obtain a diploma. Training of the 2 assistant hydrologists was undertaken locally. The assistant hydrologists are also able to make gaugings. 4 technicians are at present at the Centre for Class III training which will end in 1979. A student (Class II) is under training at Oran. Two hydrological engineers are under training; one in the USSR and the other in Canada. They are expected to return in July 1978.

Since 1975, the increase in staff has been small but considerable progress has been made in the field of training.

B.3 Agrometeorological and hydrological stations

Upper Volta has brought into operation one of the densest national networks of the entire Sahel. There are 120 rainfall stations, 15 climatological stations, 9 agrometeorological stations and 7 synoptic stations. In fact, the agrometeorological stations are operating as climatological stations due to a lack of qualified observers.

The AGRHYMET Programme has made it possible to convert one climatological station into an agrometeorological station and 4 rainfall stations into climatological stations, to set up 3 agrometeorological stations and to install several rainfall stations.

The hydrological network has been put in order thanks to the ORSTOM sub-contract. Most of the network is managed by the national Service; other stations are managed by ORSTOM according to an agreement. The transfer, which will be gradual and flexible, will take place depending on the availability of chiefs of brigade and funds for operation in the immediate future.

The Hydrological Service now has 50 years of rainfall observations, 8 years of hydrometric readings in the Sudano-Sahel area and 5 years for the Sahelian area.

B.4 Land and buildings

A sum of 415 million FCFA has been allocated to construct and equip a two-storey building with additional facilities such as stores garages. This building will be entirely occupied by the national Meteorological Service; it should be ready at the beginning of 1979; the main structural work has practically been completed. A piece of land comprising some 30 ha will serve as an agrometeorological experimental site.

Funds are being sought to accomodate the Hydrological Service. The plans proposed for the buildings have been examined and the mission has suggested some modifications for the headquarters' building, giving an increase in area of about 20%. The HER is able to design and build under state supervision at a favourable cost of 60,000 FCFA per m^2. After modification, the amounts required are 14 million FCFA for the headquarters and 5.4 million FCFA for the sub-station at Bobodioulasso.

B.5 Information disseminated and manuals published

A table giving the distribution of rainfall with comments is published for agriculture and the Presidency of the Republic. The Hydrological Service publishes a Hydrological Yearbook regularly. All data (including those from the networks managed by ORSTOM) are collected at the headquarters of the national Service. Information files on the stations throughout the country are nearly up to date.

B.6 Plans - studies and committees

Starting this year, arrangements have been made to publish a 10-day bulletin entitled "La météorologie et l'économie" (Meteorology and the Economy).

Several technical notes have been published relating in particular to potential evapotranspiration, the use of agrometeorological information for the development of crop production and a study on radiation in Upper Volta.

The second project document relating to the preparatory phase of the AGRHYMET Programme has been prepared. There are two co-ordinating bodies: The Higher Council for Meteorology and the Higher Council for Water, of which the Meteorological and Hydrological Services are members.

C. Conclusions

(a) Agrometeorology

The AGRHYMET Programme has largely achieved the short-term objectives contained in the first project document.

The meteorological network in Upper Volta has been established thanks to the additional contributions made by the project. Upper Volta now has one of the densest networks of the Sahelian countries; unfortunately the country is experiencing difficulties in recruiting qualified observers to operate and maintain all the stations.

The government has agreed to a great effort being made to provide the infrastructure. A large building for the Meteorological Service is nearing completion.

(b) Hydrology

The hydrological network is well developed, all the major rivers are being monitored and the calibration of new stations is being completed. The Service already has a number of valid data, ready for analysis and use for development projects. The government

will be able to take full charge of the network in 1981, when the training of Class II and III personnel, now in progress, has been completed.

For the time being, the central Hydrological Service at Ouagodougou does not have sufficient buildings.

The ORSTOM sub-contract has been carried out satisfactorily.

The government has always sent a sufficient number of students to Niamey.

2.4.1.7 Niger

A. Contributions

A.1 Personnel

(a) International personnel

The Niger national project started on 1 September 1975 when the agrometeorological expert took up his duties. He was assigned to Niger until 31 December 1977. After that date, expert services were provided by a new agrometeorological expert.

A sub-contract with ORSTOM was entered into for two years in order to assist the national Service to overhaul the network and supervise trainees. This sub-contract has not been renewed.

(b) National personnel

Originally, the national Department of Meteorology, which is direct by a meteorological engineer (Class I) had in addition 3 Class II engineers, 2 Class III and 46 Class IV. The main part of the meteo rological activities was entrusted to ASECNA; also, to enable the national Meteorological Service to carry out activities in the productive sector, all these staff were assigned to the project.

A senior technical officer and a hydrological technical officer were assigned to the project together with their supporting personn (a driver and a typist).

A.2 Fellowships

The following training programme was established for:

(i) agrometeorology

2 fellowships for 2 years (Class I)
5 fellowships for 2 years (Class II)
6 fellowships for 2 years (Class III)
1 fellowship for 6 months (instruments).

(ii) hydrology

1 fellowship for 2 years
1 fellowship for 1 year

in order to bring the two officers up to Class II and Class III levels, respectively.

This training was provided at the Centre in Niamey and abroad.

A.3 Consultants

No provision was made in the first project document for visits and missions by consultants.

A.4 Visits by personnel from the Centre and WMO HQ

Details and the frequency of these visists are given in Annex II.

A.5 Equipment

In order to strengthen the facilities of the two Services concerned in the project, equipment was received to a value of US $174,000, viz.: meteorological and hydrological instruments, vehicles and boats, a mini-computer, office equipment. It is to be noted howeve that the hydrological equipment and the two Land Rovers for hydrology have not yet been made available to the national Service. They are used for training at the Centre in Niamey, due to a lack of didactic material. The Programme Co-ordinator has indicated that the transfer will take place befor the rainy season. The initial allocation was US $160,000.

A.6 Land and buildings

In both cases, the two sections of the project have occupied provisional premises while awaiting the construction of new buildings at costs amounting to 60,000,000 FCFA for meteorology and to 15,250,000 FCFA for hydrology.

A.7 Funds received

The budget of the Meteorological Service which in 1975 was practically nothing reached 20,000,000 FCFA in 1978. The Hydrological Service draws its counterpart budget from the total budget of the Department of Agricultural Engineering. However the idea of the Service having its own budget in future is being studied. The UNDP contribution to the two sections of the project, for the same period amounts to US $417,616.

B. Results

B.1 Organization of Services

The agrometeorologists are under the Ministry of Transport; the two hydrologists are officially attached to the Department of Agricultural Engineering of the Ministry for Rural Economy.

The organization of the two Services seems to go half-way to meeting the objective. During the second part of the first phase of activities considerable attention should therefore be given to this item.

B.2 Personnel, trained and being trained

The following have been trained:

1 meteorological engineer (Class I)
2 agrometeorologists (Class III)
3 hydrologists (Class III) (not yet integrated into the Civil Service)

(the technical officer (Class IV) has not been trained to Class III level, but is nevertheless Head of the Interim Service pending the return of the Class I hydrologist).

The following are under training :

2 agrometeorologists (Class III)
1 hydrologist (Class I) (training to be completed by the end of 1978)
1 technician for radar maintenance

For the moment there is a lack of candidates available for training, in the country.

B.3 Meteorological and hydrological stations

The present synoptic network consists of 11 stations which are operating normally, some of which are being equipped. Another station is to be set up at Magang for radiometry.

The climatological network has 17 stations, 3 of which are not yet operational; 9 have already been strengthened by the project.

The rainfall network has 207 stations, very few of which are operating satisfactorily. The only agrometeorological station which has been set up is not yet in operation.

The Service proposes to become responsible for the agrometeorological station set up at Diffa by the Commission for the Lake Chad Basin. It also expects to set up, jointly with the AGRHYMET Centre, an agroclimatic reference station at Niamey.

The first expert left on 31 December 1977 and his successor, who took up his duties on 20 January 1978, has installed pyranometers at Agadès, Tahoua, Zinder and Tillabery.

Data from the principal stations reach Niamey by SSB. Certain stations can start to send the data by telephone to synoptic stations for transmission by radio to Niamey. Data will continue to be collected and transmitted by mail. Regular calculations for producing a bulletin will be continued.

The hydrological network consists of 27 stations which are under the control of the national Hydrological Service, in the western part of the country, while the remainder (dry valleys of Maradi, Tahoua, Agadès, Diffa) are under the control of ORSTOM. The Service has only one operational brigade instead of the three for which provision is made in the first project document. The network is ready for operation (ORSTOM sub-contract).

B.4 Land and buildings

The national Department of Meteorology can remain in the premises it now occupies. These latter have been adapted to the needs of the Service. As regards hydrology, no solution has as yet been found.

B.5 Information disseminated and manuals published

10-day agrometeorological bulletins have been requested by 15 agricultural users, 14 meteorologists and there were 56 requests from various sources.

Various requests for information have also been made to the Climatological Service. The Hydrological Service publishes regularly the Hydrological Yearbook for the Middle Niger and supplies basic data on request. Other Yearbooks are published by ORSTOM.

B.6 Plans - studies and committees

The second project document has been prepared.

The agrometeorological section proposes to strengthen the telecommunication network, to set up the agroclimatological reference station at Niamey together with the Centre, to continue and develop ecological monitoring, and lastly to devot itself to training observers for agrometeorological stations.

On the hydrological side, it is proposed to form two other brigades from the staff at present under training thus enabling the country to take on the management of the entire network. Efforts will also continue to be made to find funds for the construction of suitable premises.

No National Co-ordinating Committee has been formed.

C. Conclusions

(a) Agrometeorology

The AGRHYMET Programme has not obtained the results which had been hoped for. The network has not been overhauled due to a lack of qualified personnel to ensure the operation, checking and maintenance of the climatological stations.

The assignment of a new agrometeorological expert and the forthcoming increase in national staff will make it possible to make up for lost time.

The first agrometeorological stations will be chosen to be set up in areas where food crops are grown (millet, sorghum, and maize). Cards for phenological observations, the size of a post-card have already been printed and distributed to services and other bodies responsible for agronomical research having their own meteorological network.

(b) Hydrology

As in the case of agrometeorology, the absence of an infrastructure and qualified personnel considerably hinders the rational operation of the network. It will be necessary to await the assignment of personnel in order to start activities provided for in the Programme.

No arrangements have been made to continue training for technicians through the 1977/1979 period.

The ORSTOM sub-contract has been carried out satisfactorily.

2.4.2 Regional component

2.4.2.1 The Centre

The mission of the Regional Centre is as follows:

(a) to train technicians and engineers in agrometeorology and hydrology;

(b) to co-ordinate the activities of the national and regional components of the AGRHYMET Programme;

(c) to collaborate with all the other national, regional and international Services participating in the agricultural development of the Sahelian countries which are members of CILSS;

(d) to collect, analyse, process and collate, on a regional scale, the agrometeorological and hydrological data provided by the national networks;

(e) to disseminate appropriate advice on the meteorological and hydrological situation in the Sahel to national Services particularly oriented towards agriculture and livestock rearing;

(f) to undertake applied research with a view to developing new technological methods.

The immediate objectives of the project are as follows:

(a) to train meteorologists and agrometeorologists (Classes II and III). Class I meteorologists will also be trained in collaboration with the university of the host country. It is proposed to train 15 Class I meteorologists (3 from other French-speaking countries), 36 Class II (10 from other French-speaking countries), 46 Class III (10 from other French-speaking countries);

(b) to train hydrologists at pre-university level. This training is provided initially under a sub-contract with ORSTOM who will provide the technical personnel required for this task;

(c) to co-ordinate and supervise the setting up and development of the networks of the national Meteorological and Hydrological Services and to provide advice to these Services in the development of their activities in processing data for dissemination to users.

A. **Contributions**

A.1 **Personnel**

(a) **International personnel**

The Co-ordinator of the AGRHYMET Programme took up his duties in Niamey on 4 October 1975. Prior expert services were provided during 1975 amounting to 9.9 man-months. These expert services then increased to 37.1 man/months for 1976 and to 85 man/months for 1977. As from 1 January 1978 the figure is expected to be 88 man/months.

On 31 March 1978 the staff of the Centre was as follows:

1 Programme Co-ordinator
1 Deputy Co-ordinator and instructor in climatology
1 Principal Hydrologist
1 Hydrologist
1 Professor in general meteorology
1 Instructor in general meteorology
1 Instructor in agrometeorology
1 Expert in electronic instruments
1 Associate Expert in agrometeorology
1 Administrator

(b) **Locally recruited personnel**

On 31 March, this staff was as follows:

1 Senior secretary
1 Typist
3 Drivers (1 for tractors)
5 Gardeners/Watchmen

As a result of a general increase in salaries which has taken place in Niger, it is feared that non-professional staff may leave (secretaries, drivers, etc.) since this increase has not been applied by UNDP. It is difficult to find qualified personnel locally; thus, so far, it has not been possible to recruit a draughtsman. It took several years to find a typist.

The CILSS Ministers have called for a Class I meteorologist from a member country to take up duties as Director of the Centre in Niamey. This Director will be responsible for the local operation of the Centre and particularly the management and supervision of all contributions, either in the field of finance or of personnel, made by CILSS or its member countries. So far, this Director has not taken up his duties.

A.2 **Fellowships**

Provision is made for 6 man/months of fellowships in 1978.

A.3 **Consultants**

On 31 December 1977 the total figure was 8.3 man/months; in 1978, there is provision for 10 man/months.

4.4 **Sub-contract**

Training in hydrology has been undertaken by ORSTOM under a sub-contract with WMO for a period of 3 years. In order that the second hydrological technicians course should not be interrupted, France has offered to finance the sub-contract for a fourth year.

4.5 **Equipment**

Since being set up in June 1975 and until the present time, the Centre has received most of the equipment necessary for its activities to achieve the immediate objectives. This equipment is as follows:

- didactic material and books
- vehicles for transporting experts, consultants, Professors, students
- various pieces of furniture placed at the disposal of the ORSTOM sub-contract

However, certain delays in ordering hydrological equipment and also the loss of two large consignments which never reached their destination are to be deplored.

In order to avoid difficulties, the Co-ordinator has been authorized to have equipment, not exceeding 150 kg in weight, delivered by air. This limit should certainly be increased, particularly in countries not accessible by sea.

The solar radiation measuring equipment was received at the Centre in August 1977. Installation of the national components is taking place in the various countries.

4.6 **Land and buildings**

(a) **Contribution by Niger**

While awaiting the construction of the Regional Centre, the Government of Niger made a remarkable effort to speed up the implementation of the regional component of the AGRHYMET Programme. For this purpose, the Government has placed the following at the disposal of the project:

- on a provisional basis, and from the arrival of the first staff from abroad: a building in very good condition, with an area of 300 m² including outbuildings, this can be used as offices, classrooms for student training, store and garage;
- on a permanent basis: furniture and office equipment to value of 17 million FCFA. A piece of land with an area of 70 ha, situated close to the university campus and on the right bank of the Niger. For this operation the government had to move a village of 200 huts and spend a sum of 100 million FCFA on land improvement.

The land which is valued at approximately 50 million FCFA, is registered in the name of CILSS. The speed with which the land has been allocated has made it possible to construct two satellite buildings with 300 m² floor-space; each comprising 3 or 4 rooms. Although the floor-space is limited, the buildings are well fitted out to meet the basic needs for training in hydrology and agrometeorology, both from the point of view of practical and theoretical instruction.

(b) **External contributions**

The financial contributions by the following donors:

- United States	US$	820,000
- Netherlands	US$	1,783,000
- UNSO	US$	48,235

have made it possible to construct the buildings of the new Regional Centre, viz.:

- the two satellite buildings described above were taken over in October 1977
- the new Centre comprises two buildings at present under construction:
  - the first, intended to house students, with an area of 800 m^2, is divided into 5 residences, arranged radially and each having 10 rooms, 4 showers, 4 WCs and a kitchenette These residences converge on a common multi-Purpose room (meeting room, for study, etc);
  - the other, with an area of 2,200 m^2 is intended for instruction, data-processing and applied research. It is divided into four parts:
    - part for classrooms to accomodate 130 students (5 classrooms + 1 lecture-theatre)
    - part for various services (offices, printing-press, stores, data-processing, telecommunications, etc.)
    - part for documentation (library, etc.)
    - part for laboratory (offices and workroom)

Construction of this complex started on 1 June 1977. So far, the work-plan has been adhered to, and it is expected that the work will be completed by October 1978. At the moment, work on the living quarters are nearest completion.

The entire site is fenced off (including fields of crops and orchards) preventing animals (particularly goats) from entering.

It should be added that funds have just been found for the construction of three huts for professors, research workers and technicians staying temporarily at the Centre.

A.7 Funds for operation and equipment (see details in Annex IV)

(a) UNDP and donors

On 31 December 1977 the financial situation was as follows:

- personnel	618,887	dollars	spent
- sub-contract	285,000	"	"
- equipment	214,864	"	"
- miscellaneous	58,333	"	"
Total	1.177,084	dollars	spent

The commitment for 1978 is:

- personnel	US$ 424,350
- fellowships	US$ 4,950
- sub-contract	US$ 80,000
- equipment	US$ 10,000
- miscellaneous	US$ 30,000
Total	US$ 549,300

(b) CILSS and Advisory and Co-ordinating Committe

25% of the cost of operation and salaries for Sahelian personnel is provided by CILSS and 75% by the Advisory Committee. This division of costs was proposed at the second meeting of the Executive Committee of the AGRHYMET Programme (Niamey, 19, 20, 23 January 1978). It is quite understood that this proposal may be modified as and when the CILSS contributions are able to absorb the operation of the Centre.

The contribution is made up as follows:

1976 : 4 million FCFA
1977 : 10 million FCFA
1978 : 26,899,000 FCFA, of which 21,799,000 for personnel and 5,100,000 for equipment and operation

1979 : the budgetary provision is for 69,778,900 FCFA. This is increased by approximately 30% and comes under two headings:

counterpart personnel CILSS 32,522,900 FCFA

operation 37,256,000 FCFA

B. Results

B.1 Infrastructure of the Centre

The work of constructing the future Regional Training Centre at Niamey is progressing satisfactorily. The building intended for instruction has been designed so that the part for each element of the programme (instruction, laboratories for instruction and research, data-processing, telecommunications) can be extended if required. The accommodation for 50 students, also well designed, is nearing completion. A special fund to ensure good maintenance of these buildings is planned. The mission had occasion to visit several new buildings which are deteriorating due to lack of maintenance.

B.2 Training

(a) Agrometeorology

There are very close ties between the EAMAC (Ecole africaine de la météorologie et de l'aviation civile) (African school of meteorology and civil aviation) at Niamey and the Centre.

The first year's training of agrometeorological technicians (Class III) is undertaken in common.

The study programme for agrometeorologists (Classes II and III) is laid down by WMO; it is followed meticulously. Due to the difference between secondary and higher education in the African countries, the Centre has had considerable difficulty in assembling a group of students having the same general education before training. Efforts are now being made, not to give instruction at the average level, but to help each student to master the subject-matter. So far, the small number of students has made it possible to give this individual attention.

The stress is on practical work and experience at the training school but at present opportunities for thorough agronomical observations are limited because the farm which should serve for instruction has not yet been built. The building of this farm should be speeded up in as far as possible. Students only do one summer's work in the field in their own country.

The teaching staff at the school conform to the required terms of reference laid down by WMO and have a good knowledge of the Sahelian countries. However, it would seem that the university standard of the group as a whole is not up to that required by the faculties. This is not a criticism, but rather a point to be taken into consideration when extending Classes II and I training programmes.

There is a lack of personnel in the agronomical field and in agrometeorology. A head teacher gives about 300 hours of instruction per year to Class II and III students. About 1½ days per week are devoted to practical work. A second agronomist, an associate expert, gives 200 hours per year, one part being devoted to the protection of plant life. There seems to be too much theoretical work in proportion to practical work, to meet the real needs of Class III agrometeorologists under training at the school. It is possible that the WMO study programme needs adjusting, taking into account the capabilities of the students at present recruited for the school and the needs of the national Meteorological Services.

French is not the mother-tongue of a certain number of the staff teaching at the school. Consequently, the Centre should consider the possibility of employing a scientific editor to supervise the preparation of didactic material, to interpret certain concepts and seek examples which are suitably adapted to the African environment. This editor would also be responsible for the translation of texts, particularly from English into French.

The university resources available at Niamey do not at present allow Class I training. It is probable that this situation will continue for some time. The number of meteorologists in this class who can be absorbed by the national Services during the next decade will probably be reduced. Training of Class I meteorologists should take place in Europe, the United States and Australia.

Can we be certain that the Centre is capable of training Class I engineers having the same qualifications and competence as might be acquired in foreign institutions? A careful evaluation should also be made regarding the validity of the training of Class II agrometeorologists at the Regional Centre. The use of the time and of the competence of the teaching staff might be more effective if they concentrated on training a larger number of Class III technicians and on organizing special courses at the request of the Executive Committee.

(b) Hydrology

Training of senior technicians (Class III) takes place at the Centre.

The work programme of the ORSTOM sub-contractor has been established within the required time.

The mission has noticed that the periods of work last 1½ hrs. The teachers give 1¼ -hour lectures with ¼-hour breaks. The mission considers that it is difficult for students to concentrate for such a long period. The question of whether 45-minute lectures with 15-minute breaks might give better results, should be investigated.

The final ORSTOM report on the first course has not yet appeared. The tutor of the hydrological students over the past three years has been in charge of ORSTOM. A change of tutor for each course could be considered.

Regular meetings between the Co-ordinator and teachers facilitate the management of the courses. It is to be expected however that the end-of-year report will be more detailed in the analysis of courses given, the timetable followed and also that a more detailed evaluation will be included. This could greatly facilitate deciding what changes should be made to improve the standard of the courses.

The first training course (end of 1977) for senior technicians was effected as planned. 12 students attended the course, 11 of whom obtained their diplomas as Class III hydrologists. The second course is now being held as planned. Again there are 12 students; they will complete their studies at the end of 1979.

A third course is proposed for the period 1978-1980, one year in advance of the timetable proposed in 1974.

The total number of hydrological students is as had been arranged. It should be mentioned however that the distribution of students by countries is very irregular. Mali and Niger are not taking full advantage of the possibilities offered by the Centre.

The following table shows the number of hydrologists trained to senior technician level at the Centre in Niamey from each country:

	Course 1975 - 1977	Course 1977 - 1978
Cape Verde	-	2
Chad	3	2
Gambia	0	0
Mauritania	2	2
Niger	2	0
Senegal	2	2
Upper Volta	2	4
Elsewhere	1	0

Key:
- \- AGRHYMET Programme not drawn up for the country
- \+ Training in English-speaking countries
- * Lack of candidates
- ** One of whom did not obtain the diploma

It has always been possible to make the basic level of students uniform (more courses in mathematics, less practical courses for experienced technicians and the reverse for students holding "Baccalauréat

In general, a certain weakness is to be found in the students concerning general and applied physics subjects.

The courses of instruction for driving licences and swimming have produced poor results. The distribution of time for (a) revision of theory, (b) methodology, (c) tests, questioning and directed work, (d) field work, (e) temporary attachment; was initially: (a + b) : c, d, e : 1, 1, 1, 1.

During the instruction given for the second course, there was a tendency to increase directed work; this is a good thing. Thus the change in the name of the course (first course in applied hydrology, second course in operational hydrology) also becomes effective in the programme of work.

During the period November-April, the two expert hydrologists also spend part of their time in editing training courses, in making studies and in planning national networks and also to assist in services provided by the national Hydrological Services.

Provision should be made in future years to intensify the training of hydrologists, particularly at the Class IV level.

The distribution of technicians trained or under training is as follows:

(i) Technicians in agricultural meteorology (Class III)

- trained — 8 (two of whom have not taken up their posts)
- under training — 22 (two students defected during the first year)
- training planned to take place before 1980 — 36

(ii) Technicians in hydrology (Class III)

- trained	12	(one without diploma)
- under training	12	
- training planned to take place before 1980	29	

At the end of the preparatory phase of the AGRHYMET Programme, the trained staff should comprise:

- agrometeorologists	66
- hydrological technicians	52
Total	118

B.3 Co-ordination

(a) Regional component and national components

The Sahel is a vast region and the centres of the national Meteorological Services extend over several thousand kilometres from Banjul to N'Djamena. Co-ordination of the Programme from Niamey (or from any other place in the Sahel) is a difficult task. Travel between the various countries is difficult. At the same time, the national Meteorological Services are under different ministries in each country and operate under political, social and economic conditions which vary from country to country. In view of these difficulties, the degree of co-ordination which has so far been achieved is remarkable. Meetings between WMO experts and counterpart staff, meetings between the Directors of national Meteorological Services and meetings of the Executive Committee of the Programme greatly facilitate this co-ordination.

The Co-ordinator of the AGRHYMET Programme, in post at Niamey, hoped to visit each country at least twice per year; unfortunately he has not been able to keep up such frequent visits. In the case of Chad, this was because there is no regular air service between Niamey and N'Djamena and it takes more than 48 hours to make the journey by road, with all the attendant hazards. In order to mitigate this inconvenience, WMO has authorised, though somewhat late, the use of special flights. During these visits to the various countries, the Co-ordinator checks the activities of experts and makes many contacts with the users of the Programme in such a way as to ensure that there is very close collaboration and co-ordination. Very often the Co-ordinator is accompanied by one or two experts from the Centre. Following these missions, it is possible to plan regional activities in all fields.

While travelling and staying in each of the Sahelian countries, Professors and international experts assist students to carry out their practical training under good conditions. In addition they do not fail to make contact with their colleagues responsible for agricultural development.

In addition to the instruction which they give for training at Niamey, the two hydrologists share the activities of consultant for the national component. Thus, the chief hydrologist is responsible for Chad, Niger, Upper Volta and Mali (catchment area of the Niger) while the other hydrologist is responsible for Senegal, Mauritania, Gambia, Cape Verde Archipelago and Mali (catchment area of the Senegal).

The two hydrologists at the Centre often assist the Programme Co-ordinator in this field. They shared visits to the various countries as per their areas of responsibility.

These visits, undertaken before and during the rainy season, have taken up almost all their time (period May-October) and have enabled them to participate in the operation of the network, supervise the practical work of the students and check the work of the ORSTOM sub-contractors.

(b) With the Sahel development organizations

The programmes of the Centre give a list of 9 organizations in the Sahel and of 8 United Nations projects with which the Programme Co-ordinator makes contacts. Exchanges are being arranged with most of the development bodies, by official or informal agreements.

An official ASECNA/AGRHYMET agreement is under study.

There are close ties with all the international organizations. FAO and ICRISAT, for example, have complementary objectives with the Centre and this should facilitate the establishment of a programme of co-operation between them.

B.4 Processing the information

The Regional Centre will have an important function: the development of information management capabilities. The Centre should assist the national Meteorological Services in developing methods for the collection, processing and storage of data and should then co-ordinate all these activities to establish a data bank.

(a) Telecommunications

Setting up or strengthening links by SSB radio from main synoptic and agrometeorological stations to Headquarters will be a first step towards improving the process of collecting data on the national and regional scales. The national Headquarters will be connected to Niamey and will transmit a certain proportion of the data collected by the Centre.

In the end, the network will comprise a total of some 140 agrometeorological and synoptic stations (20 per country). Approximately 4 stations per country will be connected during the next few years. This project has been subject to some delays of an administrative nature even though funds had been made available for the purchase of equipment.

Computer system

A powerful computer will be installed at the Centre in Niamey. A computer system equipped with two 128 K CPU units will be installed with a wide range of peripherals. The premises in which the computer will be installed has been very well designed for the Sahelian climatic conditions. Access to the room in which it is installed will be limited. Most of the work will be undertaken through terminals installed in adjacent rooms. The computer at the Centre will be managed by a systems analyst/programmer (B.Sc. degree level or higher) who will be assisted by two other programmers at B.Sc. level and a breakdown mechanic trained in a factory. The first mini-computer (memory 16 K) for the AGRHYMET Programme will be installed at the Centre to enable national personnel to be trained. Two data entry technicians per country will be trained at the Centre. Later, a meteorologist or hydrologist from each country will be trained in the use of the computer.

The Regional Centre will provide most of the computer programmes for national Meteorological Services. A store of spare parts will be continuously maintained at Niamey. The technician responsible for maintenance will provide assistance to national Services on request.

It is proposed that the staff in charge of national Services will arrange for their computers to be used for quality control and to organize and establish data files, as well as to carry out work and analyses of an everyday nature. The national Services will at first be responsible for developing the storage of all data recently collected. At the same time, efforts will be made to extract all useful information from the old files of the various organizations. Thus the archives will consist of both recent and old data.

Certain countries have already started to process old data, at the level of the Centre, however, this task is starting only slowly. The arrival of the computers and the use of time suggested for hydrologists during the second period of the first phase could facilitate this activity in the near future.

It will only be possible to prepare short-term forecasts at the end of the first phase.

A mini-computer with competent staff can constitute a "national resource" of considerable value and should be used to the utmost to support agrometeorological and hydrological analyses and research work; in addition, efforts should be made to increase the degree of competence in programming at the national level so that increased use can be made of computers. The time available after routine tasks have been completed should be used for processing other data, particularly data relating to agricultural development.

A mission for the retrieval of meteorological and agrometeorological data, accumulated in services other than the Meteorological Service has been undertaken in Senegal by a meteorologist from Uccle (Belgium). The data so collected have been transferred to microfilms. They will be transferred to magnetic tapes at Uccle and made available to the national Service and to the AGRHYMET Centre.

With regard to hydrological information, in particular that collected by ORSTOM during the last thirty years, it will be collected at the AGRHYMET Centre and put on magnetic tapes.

B.5 New technology through research

The long-term objective of the AGRHYMET Programme is to increase the agricultural production of the Sahel. All the components of the project should tend to this objective. As from the next phases 2 and 3, agrometeorological research should play an important role.

All the national programmes provide for the development of certain experimental installations. Some of the national meteorological centres are situated on sufficiently large pieces of land for field tests to be undertaken. Many new agrometeorological stations will be set up at existing experimental agricultural stations. The research to be undertaken at the national level will necessarily be of a simple, practical and applied nature.

The Regional Centre has a vast estate (70 ha.). This land will provide excellent opportunities for training students and for carrying out ecological and biometeorological research. Furthermore, the building of the Centre will have sufficient space for the development of basic (more fundamental) research laboratories, if required.

It is well understood that the teaching staff at the Training Centre in Niamey will devote some of its time to applied research.

While awaiting the right moment for further development of the research side, there is very close co-operation and co-ordination between the AGRHYMET Programme and all the research organizations in the Sahel. The Co-ordinator is, moreover, a member of the Sahel Institute Consultative Committee.

B.6 Dissemination of information to users

A printed manual for agrometeorological observers has been prepared by the Centre. It is well adapted for the purpose.

At the present time, the Services provide raw climatological data regularly which are used and interpreted by the users themselves. In the future, the Centre will provide more detailed information which will be available for the use of those responsible for development. It is essential to test the validity of data before making them available to rural users.

The Centre will assist in the definitions, specifications and standardization of various types of climatological and agrometeorological data obtained by the national components.

A sociological and anthropological study to determine the best ways of presenting information, so that it can be used by farmers, was carried out in Niger and Upper Volta. This kind of study should also be undertaken in the other CILSS countries in order to facilitate the dissemination of data later on.

Conclusions

(a) Personnel

There have been delays of up to one year in the arrival of most of the experts, instructors and teachers. However, thanks to the collaboration with EAMAC and thanks to the ORSTOM sub-contract, the training courses were able to start as planned.

The mission regrets that the post of Director is so far vacant.

(b) Land and buildings

The mission noted with very great satisfaction the large contribution made by Niger, which enabled the activities of the Centre to start and develop quickly.

The mission is also very appreciative of the very considerable contribution made by donor countries for the construction of the buildings and development of the land.

The ecological site has been judiciously chosen: the range of soils representative of the Sahel is present there; the proximity of the river, the presence of fields where food crops are grown and of orchards will certainly make it possible to carry out a whole series of agrometeorological and hydrological experiments which will contribute to the practical training of students of all categories. It will also be possible to carry out research on the basis of these experiments. Every precaution has been taken to ensure that this unique site is protected.

Construction of the buildings and annexes is well on the way to completion. Deliveries will probably take place on time. It will thus be possible to start instruction in these permanent premises in November next. The whole complex of buildings is well designed and the amenities of the premises are functional. Extensions will be possible at a low cost. There is also provision for the construction of three living quarters close to the premises for instruction and research, to accommodate professors and scientists passing through.

(c) Training

The mission notes with regret that the two fellowships for training two counterpart instructors have not yet been granted due to lack of candidates

The mission strongly recommends the adoption of the decision of the Executive Committee to recruit, at regular intervals, for training to senior Class III level, competent senior Class IV staff to be selected by internal competition.

In almost all cases, applications for posts in agrometeorology in the 1977/1979 year were submitted too late.

(i) in agrometeorology

Training of Class III technicians is taking place in accordance with the provisions of the project document. However, training of engineers is not following the proposed plan due to a lack of candidates of the required level.

The syllabus of studies, agreed by the Executive Committee and drawn up in accordance with the WMO directives is being adhered to but the number of teachers has to be increased in the subject of agrometeorology. The general level of instruction of students called upon to take the courses for works engineers or for senior technicians is not usually uniform. Some of them seem to have difficulty in assimilating the courses.

It seems that it will be difficult to train Class I engineers in the immediate future, in view of the limited number of candidates and of teachers of the required level.

Assuming that the setting up of an operational agrometeorological network is a matter of urgency, it would perhaps be desirable to strengthen to the maximum extent the training of Class II technicians, even if that should necessitate a reduction in the frequency of courses for Class II works engineers.

The mission notes with satisfaction the close collaboration between the AGRHYMET Programme and EAMAC in the field of training agrometeorological technicians.

(ii) in hydrology

Training of senior technicians is taking place in accordance with the provisions of the project document.

The syllabuses for courses in hydrology at senior technician level, although sound, have not yet been completely adapted to the needs of the countries.

The number of teachers is sufficient for the moment.

It seems that it will be difficult to train engineers in hydrology in the immediate future in view of the limited number of candidates and of teachers of the required level.

ORSTOM has carried out satisfactorily the tasks entrusted to it under the sub-contract.

The mission notes with satisfaction that arrangements have been made for continuous training of hydrologists at the AGRHYMET Centre while the valued activities of ORSTOM gradually decrease.

(d) Co-ordination

There is excellent co-ordination between the regional project and the national projects, in spite of the size of the Sahelian region and the difficulties of links, communications and transport, particularly with Chad.

The mission views favourably the half-yearly meetings of all the experts of national projects and of the Centre.

Co-ordination and supervision of the setting up and development of the agrometeorological network has been closely followed by the Co-ordinator, acting in his capacity of agrometeorological expert.

The expert personnel and the national personnel constitute a good multi-disciplinary and inter-disciplinary team whose entire activities are oriented towards implementation of the Programme.

The hydrologists assigned to the Centre, in addition to carrying out their planned programme of work, have already begun to implement many of the recommendations which the mission is called upon to formulate.

(e) Telecommunications

Delays of an administrative nature have occurred in the delivery of equipment, whereas the necessary funds for purchase have been made available in good time.

(f) Data-processing

The system of computers planned will probably not initially be used full time for the analysis of agrometeorological and hydrological data, and could be used by other national or regional services, in particular for research and studies relating to the objectives of the Programme.

The computers shortly to be installed at the Centre could be used for processing past data collected by the Programme from ASECNA and ORSTOM.

(g) Dissemination of data

Dissemination of data by the Centre has not yet started. However, it is to be hoped that with the installation of the telecommunications system and the arrival of the computers, and after the operational and maintenance technicians have been trained, this activity which is essential for the second phase of the project, will commence towards the end of the preparatory phase as planned in the project document.

Meanwhile, a considerable number of technical publications has already been issued by the Centre.

(h) Consultants

The missions provided for in the project document have not all been effected. It should nevertheless be noted that the principal donor countries have financed several missions and that, in this way, the expertise has been available.

(i) **Development of new technologies**

The position of the Centre with its 70 ha. of land could make it a remarkably good site for experimental work. Laboratories have already been planned for all the disciplines involved in agrometeorology and hydrology. At the same time, the proximity of the University should make it possible to arrange profitable exchanges on a permanent basis at the teacher and student level. Thus, the mission thinks that this activity which is expected to start towards the end of the preparatory phase, could enter the operational phase in due course.

2.5 Future outlook - Objectives

The importance of agriculture and livestock rearing in the Sahelian countries makes it necessary that the dissemination of climatological information be oriented towards the effects of weather and climate on plant and animal production, i.e. by definition towards agrometeorology. Furthermore, care must be taken to ensure that all the work involved in development does not accentuate the ecological imbalance which exists in the Sahelian region. Everything must be done to protect the environment and hence the need to ensure rational management of the natural and agricultural environment.

In the field of general agronomy and plant production, an analysis of the requests formulated by countries and a study of the attitudes of the major international scientific centres lead us to regard the following as having priority:

- water supply for plants and water control;
- dynamics of organic matter in the soil and agrosystems;
- conservation of genetic resources;
- plant protection.

The main objective of the AGRHYMET Programme is to make information, essential for this development, available to member countries of CILSS.

2.5.1 Dissemination of agrometeorological and hydrological information

It is quite certain that the information and warnings disseminated by the Regional Centre and the national Centres will result in a better harmonization between agricultural activities and the actual rainfall (sowing times, crop protection, conservation of harvests, etc.). At the same time forecasts of yield will be prepared regularly under the Global Information and Early Warning System for Food and Agriculture (GIEWS) organized by FAO in collaboration with WMO. Implementation of GIEWS, which was created by the World Food Conference (Resolution XVI), is the subject of collaboration between the FAO and WMO Secretariats. The forecasts of yield will be communicated to the authorities concerned.

Before disseminating agrometeorological and hydrological information applying to rural conditions, it is appropriate to find solutions to the problems relating to the collection, processing and transmission of the data.

2.5.1.1 Data-collection which is the fundamental basis for agrometeorological and hydrological information, requires:

- a sufficient density of the network of observers;
- representative and reliable data;
- speedy data-collection.

In order to achieve these objectives, it is necessary to have qualified personnel and suitable equipment. Most of the equipment is now available; unfortunately, for the time being, a lack of personnel makes it impossible to have a network of observations of the desired density. Rational operation of the networks will only be possible after agrometeorological observers and assistant hydrologists have been trained.

2.5.1.2 Data-processing

The national Meteorological Services (mostly assisted by ASECNA) are able to process certain meteorological data in real-time at the level of the centres where short-term forecasts are prepared, based on the data received; these are mainly used for aviation purposes.

Subsequent processing of information from synoptic, climatological and rainfall stations is at present undertaken by the climatological sections of the Services, which are responsible for checking and storing the basic documents prepared by the observers. For the moment these sections do not have the necessary facilities for data-processing; the data are sent to the ASECNA Headquarters at Dakar where there is a computer enabling the essential data to be processed.

The Hydrological Services now have monthly and annual publications containing hydrological data and these are available for users.

Under the ACRHYMET Programme there is provision for a mini-computer at each national Centre. The Regional Centre at Niamy will have a very powerful computer capable of processing and re-transmitting, at the regional level, the meteorological and hydrological data from the national Centres.

The entire system of computers will enable a data bank to be set up on magnetic tapes, easy to retrieve and process according to the needs of users (agriculture, livestock rearing, forestry, etc.). It is essential to train qualified staff to ensure rational operation.

2.5.1.3 Interpretation and dissemination of data

Constant liaison is necessary between the agrometeorologists and hydrologists assigned to the ACRHYMET Programme and the principal persons responsible for agricultural development in the Sahelian countries, in order to ensure sound interpretation of the data.

Application of data, interpreted for rural users, should be effected through organizations, projects and societies for development and popularization. It is essential to check the reliability of the data before they are disclosed and supplied to farmers. The latter would be reluctant to accept any failure in the results hoped for.

From the foregoing, it will be apparent that the dissemination of information depends essentially on having qualified personnel for either the national components or the regional component. In each country, the meteorological and hydrological activities applied to agriculture will only have a real impact on development if they are integrated into well-organized

national Services. It is also necessary that these activities should be coordinated with adequate guidance for farmers by the agricultural services and with an appropriate orientation of agronomical research.

Until the end of this preparatory phase and probably during the first years of the pre-operational phase, the main task of the AGRHYMET Programme will be to train national technicians capable of:

- collecting data;
- checking data;
- processing data;
- analyzing and interpreting data.

A few rules should be laid down in order to accomplish this effectively:

- training should be continuous and should not end on leaving the Centre and when diplomas have been awarded;
- for practical reasons, training as a whole should be provided by institutions;
- training should aim at maintaining a good balance between the various categories of personnel working under the Programme;
- particular importance should be placed on the training of field staff at any level and in any specialized subject;
- at the highest levels of organization, group seminars consisting of many trainees of various levels and limited to general discussions on many subject, should be arranged;
- training for technicians should be given in classes which are limited in size and should be limited to well-defined subjects and accompanied by practical demonstrations in the field.

Under the WMO/FAO agreements, provision is made for a general agronomical expert having a good knowledge of the Sahel and of tropical dry crops to be assigned shortly. He will mainly be responsible for training technicians at the Centre in Niamey. Later on he will be able to take part in co-ordinating programmes concerning agronomical research in the Sahelian countries.

It is also very desirable that agronomical and ecological instruction should be developed to a much greater extent, thus facilitating the integration of the AGRHYMENT Programme into those bodies, organizations, societies and national services responsible for development. It would therefore be necessary to arrange specialized courses in agronomy (pedology, plant improvement, plant protection, etc.) and lectures on the environment which would be given by consultants.

3. RECOMMENDATIONS

During its visits to the member countries of CILSS and following discussions with responsible staff of the AGRHYMET Programme and the various users of this Programme, the mission considers that the AGRHYMET Programme has effectively started and that the preparatory phase should be completed within the planned time scale, in view of the contributions contained in the UNDP/WMO/Governments project documents for the period 1978 to 1981. However, certain difficulties have been encountered by the countries in particular in ensuring:

- recruitment for training technicians, agrometeorological observers and assistant hydrologists;
- integration of new national personnel of all categories into the Civil Service;
- regular and effective allocation of funds for operation, necessary to carry on the agrometeorological and hydrological work.

These considerations lead the mission to formulate the following general recommendations, which apply to all member countries of CILSS:

(a) to increase, as soon as possible, the staffs of technicians, agrometeorological observers and assistant hydrologists;

(b) to increase the number of candidates capable of following the technician training in all the fields (agrometeorological meteorological and data-processing) at the Regional Centre in Niamey;

(c) to use to the maximum extent the national institutions or other bodies already in existence such as schools for agriculture, livestock rearing, water supplies and forestry, in order to train the observers and assistant hydrologists. These infrastructures should, if ncessary, be strengthened to provide agrometeorological and hydrological instruction. Through this solution it sould be possible:

- to train, quickly, Class IV personnel at the general level of BEPC, versatile and readily capable of taking part in the management of agrometeorological and hydrological stations. Their integration into the Civil Service would probably be easier since there is now a senior staff of works leaders or assistant technicians;
- to make the main users more aware of the AGRHYMET Programme, i.e. the national services for agriculture, livestock rearing, water supplies and forestry, agricultural engineering, etc.
- to use the experts of the AGRHYMET Regional Centre in Niamey, whose staff would be increased for this purpose. This group of teachers would be available to give courses and for practical work in the national schools, in other institutions or in the field;
- ensure, as soon as possible, the satisfactory operation of the agrometeorological and hydrological networks.

The mission also recommends that:

(a) all personnel be quickly integrated into the Civil Service as soon as they are trained, in order that they may play an effective part in achieving the objectives of the Programme;

(b) funds necessary for operation be allocated regularly and and effectively, particularly those for allowances payable to field staff;

(c) collaboration with ASECNA services be further strengthened.

Lastly, the mission strongly supports the setting up of machinery for co-ordination between the national Meteorological Service, the services for climatology, agrometeorology, hydrology and the users services, as provided for in the project documents, in order to enable the AGRHYMET Programme to achieve its objectives fully. To conclude, the mission has examined the documents prepared with a view to the preparatory phase being pursued and notes with satisfaction that aspects which were matters for concern have been given special attention in these documents. The mission is very pleased about this and recommends that the activities of the project be pursued in accordance with the said documents. However, the mission makes the following special recommendations and suggestions with a view to the anticipated results being achieved.

3.1 National components

3.1.1 Chad

3.1.1.1 Suggestions and recommendations

(a) Suggestions

Buildings:

Two solutions are suggested for the Centre of the national Meteorological Service:

- permanent allocation of the building loaned provisionally by ASECNA. Restoration and fitting out could be carried out quickly, using the sum of US $ 50,000 allowed for construction work. This solution would provide rapid communication between the national Meteorological Service and the ASECNA Telecommunications Centre situated within the precincts of N'Djamena airport;
- ASECNA quickly taking up the land offered to it in order to construct a new building. This solution would obviously be more costly and would delay the permanent installation of the services of the national Meteorological Service.

(b) Recommendations

The mission recommends that implementation of the project be continued in accordance with the project document. Furthermore, the mission makes the following special recommendations:

(i) Meteorology and agrometeorology

The setting up of climatological and agrometeorological stations should be undertaken with regard to the needs of agricultural development. The choice of sites will be made in consultation with the user services (agriculture, livestock rearing, forestry, etc.)

The arrival of the associate expert agrometeorologist should be deferred until the mini-computer has been installed.

Recruitment of qualified national personnel is absolutely necessary, as a matter of extreme urgency, for the continuous operation and control of the stations. This condition should be fulfilled before proceeding to further installations.

The network should not be too extensive, so that there can be better liaison, rapid and frequent checks and better maintenance of the installations.

The setting up of instruments requiring careful maintenance (such as solarimeters, recorders and integrators) at stations which are difficult to reach is not recommended for the immediate future.

(ii) Hydrology

The customary assistance of the ORSTOM hydrological services until 1 January 1979 for setting up and training in the field of two new brigades under the national Hydrological Service.

The immediate assignment (before the 1978 rainy season) of an associate expert who will take part in local training of driver-mechanics and assistant hydrologists during at least one rainy season.

The construction of offices, stores and small workshops for the brigades of the sub-sectors at Moundou, Sarh and Abéché, as soon as possible (plans available).

Five hydrological brigades should be operational towards the end of 1981: orders for, and delivery of material to equip them will take place as and when technicians, assistant hydrologists and driver-mechanics are assigned.

Training in applied hydrology of a hydraulics engineer or agricultural engineer, in order to provide the Service with with a section for operational hydrology and also an office for development by about 1981.

3.1.2 Mali

3.1.2.1 Suggestions and recommendations

(a) Suggestions

The mission suggests that the national Meteorological Service and the Hydrological Service be amalgamated in order to facilitate implementation of the AGRHYMET Programme.

(b) Recommendations

(i) Agrometeorology

With regard to agrometeorology, the mission recommends that the project be carried on in accordance with the project document. The mission further recommends:

- that the possibility of not renewing a contract for an expert in agrometeorology but, instead, providing for the services of consultants, be studied;
- very close collaboration between the services of the national Meteorological Services and those of the Hydrological Service;
- speedier delivery of material ordered and if possible its transport on a routine basis by air in view of the geographical situation in Mali;

- additional training in agrometeorology for Class III and IV personnel, which could be undertaken at Sotuba where there is an operational agrometeorological station;
- in the case of engineers from Mali, their specialization should be widened by training at American, Canadian or Australian universities, where there is an agrometeorological syllabus;
- more frequent inspection of the network; this could be undertaken by one or two mobile teams;
- establishment of an experimental programme relating to agricultural techniques in relation to climate (wind breaks, cover crops, etc.); this programme to be established after consultation with the National Committee for Agronomical Research would be carried out at operational agrometeorological stations;
- establishing a mobile workshop for the maintenance of material allocated to the AGRHYMET Services, in view of transport difficulties and the great distances to certain stations in Mali;
- the construction as soon as possible of:
  a) the building with an area of 600 m^2, plans for which have already been drawn up and proposed in 1977;
  b) 4 stores for the setting up of 4 agro-climatological stations.

(ii) Hydrology

As regards hydrology the mission recommends:

- the preparation and adoption of a detailed work plan;
- that, for the moment, only spare parts necessary for overhauling the material and vehicles acquired under the AGRHYMET Programme and other previous projects be ordered;
- that a consultant, whose tasks will be defined during implementation of the project, be placed at the disposal of Mali.

(iii) Telecommunications

The mission recommends:

- making an inventory of all telecommunication facilities now available;
- repairing radio transmitting/receiving stations;
- establishing an operational communications network between the Centre of the national Meteorological Service, ASECNA and the climatological and agrometeorological stations;

- overhauling the transmitter/receivers (transceivers) making the best use of the facilities existing in the national Meteorological Service, ASECNA and the Hydrological Service.

3.1.3 Senegal

3.1.3.1 Suggestions and recommendations

(a) Suggestions

The mission suggests that personnel already trained in agrometeorology be employed in an effective fashion in their own discipline.

(b) Recommendations

The mission recommends that the project be continued in accordance with the project document. The mission further recommends:

(i) Agrometeorology

- training as soon as possible of: two Class I agrometeorologists who will be essential for the continuance of the Programme during the coming years and for supervision of works engineers and technicians, trained or at present being trained at the Centre in Niamey; versatile observers, i.e. having had training in meteorology and agronomy, in order to increase the number of agrometeorological stations;
- facilitating and speeding up the integration of trained personnel into the Civil Service;
- increasing the allocation of funds for operation, in particular to facilitate the inspection of stations and improve maintenance of the network. This network should be kept in perfect condition to meet the required needs;
- speeding up the processes of collection, analysis and dissemination of data.

(ii) Hydrology

The mission recommends:

- assignment of a hydrologist for the final period of the first phase of the Programme; he will preferably have experience in the hydrology of estuaries affected by tides;
- supplying, as soon as possible, the spare parts necessary for replacement and the overhaul of all the equipment delivered under the project;
- ordering and delivering new equipment as and when the technical staffs increase;
- waiting until the second phase of the Programme to train engineers in applied hydrology, in view of the number of bodies and societies working in this discipline in Senegal;
- making freely available funds already allocated for the operation of the Services;

speeding up the assignment and training of (Class IV) assistant hydrologists in the field.

3.1.4 The Gambia

3.1.4.1 Recommendations

The mission recommends that implementation of the project be continued in accordance with the project document. The mission further recommends:

(i) Agrometeorology

- seeking and recruiting national engineers and technicians in order to give them an essentially agrometeorological training which is well suited to the country;
- establishing a short- and medium-term agrometeorological experimental programme and laying down the phenological and meteorological observations to be made at the principal stations in the country. Such a programme would also serve to determine the number and category of meteorologists to be recruited to meet the needs.

(ii) Hydrology

- recruiting and training engineers in agricultural hydraulics or agricultural engineering with specialization in applied hydrology, depending on present and foreseeable needs;
- recruiting and assigning an associate expert during the the coming years in order to meet, for the moment, the needs for hydrological studies to be undertaken within the Ministry of Agriculture and Natural Resources.

3.1.5 Mauritania

3.1.5.1 Suggestions and recommendations

(a) Suggestions

The mission suggests, that before the end of this year, a Service be set up incorporating both meteorology and hydrology under the same ministry. in order to ensure better co-operation between the activities of agricultural development and those of agrometeorology and hydrology.

(b) Recommendations

The mission recommends that implementation of the project be continued in accordance with the second project documents. The mission further recommends:

(i) Agrometeorology

- training agrometeorological observers through the instruction given at the National School of Agriculture, Livestock Rearing and Forestry at Kaedi;
- increasing the number of Class II and III personnel to be trained at the Centre in Niamey;
- not setting up new climatological or agrometeorological stations before having the qualified personnel to ensure operation and maintenance;

establishing closer collaboration between the ASECNA Meteorological Service and those of agricultural development, while awaiting the setting up of the National Meteorological Service;

endeavouring to find the necessary funds for the construction of a building to house all the agrometeorological and hydrological services and improving the present living accommodation.

(ii) Hydrology

- sending one of the associate experts planned for the Centre, to Kaedi during the rainy season with a view to carrying out hydrological studies on the right bank of the river Senegal and in the region of the Gorgols.

mission also recommends that a workshop be fitted out for the pair of all material and vehicles placed at the disposal of the project. Repair and maintenance of this equipment, which has to stand up to heavy wear and tear, is a matter of urgency.

3.1.6 Upper Volta

3.1.6.1 Recommendations

The mission recommends that the project be continued in accordance with the project document. The mission further recommends:

(i) Agrometeorology

- undertaking training of multi-purpose observers in order to operate the agrometeorological network to the best advantage;
- progressively converting the climatological stations to agrometeorological stations;
- entrusting the management of stations to technicians whose main tasks will be to ensure the regularity of the data and the maintenance of the equipment; these technicians will be assisted by observers;
- increasing the number of specific data which can be used directly by the national Services and the organizations, projects or bodies responsible for the development of the country;
- studying whether the rainfall network has not exceeded its optimum density.

(ii) Hydrology

- from mid-1979, assigning to the project a WMO expert in applied hydrology rather than an operational hydrologist, in order to assist HER in the use and interpretation of all the data already available;
- also finding the necessary funds for the construction of the buildings for the Hydrological Service.

3.1.7 Niger

3.1.7.1 Recommendations

The mission recommends that implementation of the project be continued in accordance with the project document. The mission further recommends:

(i) Agrometeorology

- setting up, as soon as possible, 3 or 4 agrometeorological stations, depending on the degree of urgency laid down in the down in the plan for the development of the country, and ensuring that they are operating in a satisfactory manner; these stations would be managed by 2 or 3 multi-purpose observers who would have to be trained;
- endeavouring to find national candidates in order to follow the training programme laid down in the project document.

(ii) Hydrology

- speeding up integration of the new technicians into the Civil Service;
- endeavouring to find national candidates to continue the training programme laid down in the project documents;
- engaging an expert in operational hydrology having wide experience of the management of a Hydrological Service extending over at least two consecutive years, in order to assist in the setting up of an efficient national Service. The arrival of the expert would preferably coincide with the return of the Chief of the Service to the country;
- staggering the delivery of material to coincide with the return of the senior technician students, and only after the Niger counterpart has placed a satisfactory store at the disposal of the hydrologist

3.2 Regional component

3.2.1 The Centre

3.2.1.1 Recommendations

In view of the results obtained in so short a time and of the efforts which have been made by the Governments of Niger and the donor countries, the mission recommends that the regional project of the AGRHYMET Programme be continued as described in the project document. Nevertheless, an analysis of these results leads the mission to make the following special recommendations:

(a) Personnel

The mission recommends:

- assignment, as soon as possible, of the Director of the Centre and recruiting of counterpart personnel to be assigned to the Centre;
- assignment of additional experts as described in the following paragraphs.

(b) Land and buildings

The mission recommends:

- creating immediately a special fund, to be credited each year with the equivalent of 2% of the value of the buildings. This amount, intended entirely for the maintenance of these buildings would be managed by a competent body ("trust fund" for example);
- developing, as soon as possible, the land and infrastructures to be used for demonstration purposes and for the practical work of the students;
- engaging for this development the services of a pedologist, a consultant having wide experience in hydro-agricultural development techniques in a semi-arid zone and an associate expert to supervise the works.

(c) Training

The mission recommends that the Centre should:

- take part in the training of multi-purpose observers and assistant hydrologists by sending teachers assigned to the Centre on mission to any of the member countries of CILSS requesting this;
- study the possibility of arranging short courses in agronomy for the meteorologists and hydrologists of the countries;
- arrange, as soon as possible, training for two counterpart instructors, as provided for in the project document;
- give practical instruction in data-processing and programming to engineers and technicians in order that they may be able to use the computers;
- ensure that students' applications are submitted as soon as possible so that courses can start on the appointed dates;
- study the possibility of adapting the period of study within the year to the requirements of instruction;
- endeavour to find funds for the services of consultant teachers;
- endeavour to find funds for fellowships in order that training may be carried on continuously;
- provide the services of a scientific editor to translate and edit scientific and didactic material, paying special attention to adapting certain concepts and certain examples to African conditions.

(i) In agrometeorology

- press, to the maximum extent, for the training of technicians until the end of the first phase;
- postpone the training of Class I engineers at the Centre in Niamey to the second phase of the Programme; meanwhile, possibilities for their training abroad should continue to be sought;
- assign the agronomist, for which provision is made, and recruit a highly-qualified agrometeorologist, both of whom will be employed full-time for instruction and applied research.

(ii) In hydrology

- continuously adapt the syllabuses for training in hydrology to the needs of the countries;
- continue the training of senior hydrological technicians, using the services of ORSTOM and of the experts already assigned, or to be assigned, to the Centre and in the countries;
- continue the training of engineers abroad;
- retain the full-time hydrologist of the Centre with a view to training Class III and IV hydrologists. He will be assisted by an associate expert who will deal with directed work and practical work. The same associate expert could also undertake missions to the Sahelian countries to carry out other work, depending on how urgent the work is;
- towards the end of 1979, assign an additional hydrologist to teach at the Centre;
- expand the courses in general and applied physics, with more appropriate didactic material if possible;
- increase the amount of directed work, at the same time decreasing the number of theoretical revision courses in the field acoustics, etc., and also, if necessary, decreasing the amount of practical work, while students are staying at the Centre;
- take more advantage of training in the field, by providing the support of hydrological experts or associate experts or by any other effective means;
- study the possibility of giving a coefficient of 2 for the two practical training courses and a coefficient of 1 for the final examination;
- promote studies on the hydrology of deserts and the Sahel in order to be in a better position to provide for the needs of the countries.

(d) Co-ordination

The mission recommends:

- continuing with EAMAC and seeking wider collaboration with ASECNA; also pursuing and intensifying collaboration with all the national services and international or regional organizations responsible for rural development in the Sahelian region;
- ensuring close co-operation between the AGRHYMET Programme and the programme for the protection of plants in the member countries of CILSS, in particular with the research and development component of the integrated fight;
- providing for the continuing assignment of the principal hydrologist, he will start or continue the following activities:

(i) assistance in co-ordination as regards hydrology and applied hydrology with development societies and planning offices, etc. in the CILSS countries (OMVS, CIEH, RNC, CBLT, etc.)

(ii) continuously monitoring the uniformity and optimum density of the hydrological networks of the countries;

(iii) monitoring the use made of data available for development projects or applied hydrological research;

(iv) development of hydrological laboratories for training and applied research at the Centre;

(v) taking part in the supervision of practical training;

(vi) assistance, as far as possible, to the directed and practical work of hydrological students;

(vii) intensifying co-ordination and collaboration between the AGRHYMET Programme and the inter-national and national organizations and bodies responsible for research and the exploitation of ground-water in the countries.

(e) Telecommunications

The mission recommends:

- strengthening as soon as possible the existing telecommunication network and ensuring that it is operating in a satisfactory manner.

(f) Data-processing

The mission recommends:

- using the computers of both the national and regional components in the best interests of the development of the countries. Each country should have a team capable of processing various types of data;

(g) Dissemination of data

The mission recommends:

- to standardize the presentation of data intended for various users in all the Sahelian countries. This task could be entrusted to the Regional Centre.

(h) Development of new technologies

The mission recommends:

- that the Centre, in consultation with the Sahel Institute and other interested bodies, should define the medium- and long-term programme of applied research in agrometeorology;

- that the Centre should participate in the co-ordination of applied research in agrometeorology in CILSS member countries;
- that the needs of this programme be considered when recruiting the future staff of the Centre;
- that co-ordinated planning in this field of entrusted to one or more persons for this task.

(i) <u>Deliveries of equipment</u>

- making provision for the budgets, not only for standard material (maintenance and repairs) but also for the replacement of durable material which has reached the end of its economic or technical life;
- leaving the Co-ordinator even more latitude so that he may order and have certain material sent by air if urgently required, particularly countries not accessible by sea (Chad, Mali, Niger, Upper Volta).

Appendix A : Itinerary and use of time

Appendix B : List of persons met

APPENDIX A

EVALUATION MISSION OF THE AGRHYMET PROJECT

from 17 III to 14 IV 1978

Itinerary

Dates	Stay	Departure to	Flight	Times
Wednesday 15 March	Geneva			
Thursday 16 March	Geneva	Niamey	AF 669/RK 29	17.50 - 03.00
Friday 17 March	Niamey			
Saturday 18 March	Niamey			
Sunday 19 March	Niamey	N'Djamena	special flight	14.00 - 19.00
Monday 20 March	N'Djamena			
Tuesday 21 March	N'Djamena	Niamey	special flight	14.00 - 19.00
Wednesday 22 March	Niamey	Bamako	RK 301	18.00 - 20.00
Thursday 23 March	Bamako			
Friday 24 March	Bamako	Dakar	MY 41	14.00 - 16.00
Saturday 25 March	Dakar			
Sunday 26 March	Dakar			
Monday 27 March	Dakar	Banjul	special flight	06 00 - 07.00
	Banjul	Dakar	special flight	20.00 - 21.00
Tuesday 28 March	Dakar			
Wednesday 29 March	Dakar	Nouakchott	DS 351	08.00 - 09.00
Thursday 30 March	Nouakchott			
Friday 31 March	Nouakchott	Dakar	RK 317	08.15 - 09.00
Saturday 1 April	Dakar	Abidjan	UY 709	09.30 - 11.30
	Abidjan	Ouagadougou	RK 38	20.30 - 22.30
Sunday 2 April	Ouagadougou			
Monday 3 April	Ouagadougou	Niamey	special flight	17.30 - 20.45
Tuesday 4 April to				
Friday 14 April à	Niamey	Visits		

National Meteorological Services and the Regional AGRHYMET Centre - Meeting for synthesis and drafting of the report.

Owing to the breakdown of the airplane for flight RK 317, the mission had to change the original itinerary and schedule.

APPENDIX B

LIST OF PERSONS MET

CHAD : MM. W. HARPER - Resident Representative of the UNDP in Chad

ALLAHOU TAHER - Secretary of State for the Development of Agriculture and the Countryside and for the Fight against Natural Disasters

KASSER BADAOUI - Director-General of the Ministry of Development of Agriculture and the Countryside and for the Fight against Natural Disasters

LERE WAPI - Director of Agriculture

YAGA - Interim Representative of ASECNA

DJAMIL MANY - Chief of the Meteorological Servic of ASECNA

A. CHOURET - Hydrologist at ORSTOM (under contract with AGRHYMET) N'DJAMENA

MLATAC - Hydrologist at ORSTOM - N'DJAMENA

BARDET - Deputy Chief of the ASECNA Metecrological Service

B. DERUELLES - Deputy Resident Representative

J. BRAWN - UNDP Officer in charge of the Programme

T. DARNHOFER - Agroclimatology Expert in charge of the National project

Y. NELNGAR - Senior Hydrology Technician

M. NAYALTA - Senior Hydrology Technician

GAMBIA :

MM. F. M'BOGE - Permanent Secretary, Ministry of Agriculture and Natural Resources

MALICK A.K. JOHN - Co-ordinator, Gambia River Basin studies

E.A. NJIE - Director, Department of Hydrometeorological Services

M.M. SAHOR - Meteorological Officer, Department of Hydrometeorological Services

J.F. COLLBRAN - Programme Officer, UNDP

P. HUTCHINSON - WMO Expert Agroclimatologist

D. PRABHAKAR - WMO Expert Hydrologist

MALI

MM. BLANCH-SOLER	- UNDP Representative in Mali
G. AMADOU GOLOGO	- Director of the national Meteorological Service Chief of the ASECNA Meteorological Service
A.N. DEMBELE	- Director of Hydraulic Engineering and Energy
D. DOUKOURE	- Agrometeorologist, counterpart of the project's expert
M. KONATE	- Agrometeorologist - D. N. M.
K. KONARE	- Agrometeorologist - D. N. M.
BA OUMAR	- Deputy Chief of the ASECNA Meteorological Service
ABDOULAYE BA	- Chief of the Hydrology Section, counterpart of the project's expert - Directorate of Hydraulic Engineering and Energy
OMAR OULD ALY	- Hydrologist - Directorate of Hydraulic Engineering and Energy
J.P. LAMAGNAT	- Hydrologist - ORSTOM - BAMAKO
JAKOBSON	- UNDP Officer in charge of the Programme
M. LUBNIN	- Agroclimatology Expert, officer in charge of the national project
ABDOULAY SIDIBE	- Chief of the central brigade
AMADOU DIADIE WELLE	- Chief of the flood forecasting brigade
SOULEYMANE SAMEKE	- Chief of the Bani brigade

MAURITANIA :

MM. A. MOULAYE	- Director of Hydraulic Engineering and Energy - NOUAKCHOTT
BOKOUM	- Director of Agriculture - NOUAKCHOTT
S. KAMARA	- Chief of the ASECNA Meteorological Service - NOUAKCHOTT
AGHIB	- Civil Aviation - NOUAKCHOTT
BASSIROU DIAJANA	- Hydrogeologist - Directorate of Hydraulic Engineering and Energy - NOUAKCHOTT
M. D'ASTUGUES	- UNDP Representative - NOUAKCHOTT
M. KETATA	- WMO Agrometeorology Expert in charge of the national project
J. HOORELBECK	- ORSTOM Hydrologist (under contract with AGRHYMET)

NIGER

MM.	M. CHALLONS	- Resident Representative of the UNDP in Niger
	DJEMBA YUMBULA	- Assistant to the Resident Representative of the UNDP
	H. DIALLO	- ASECNA Representative in Niger - Director of the national Meteorological Service - President of the AGRHYMET Programme Executive Committee
	E. PIEL	- Chief of the ASECNA Meteorological Service
	OUSMANE ABBOU	- Hydrologist in the Agricultural Engineering Service in Niamey
	LIHIDA BONDIERE	- Hydrologist in the Agricultural Engineering Service in Niamey
	M. LUCIDO	- WMO Agrometeorology Expert in charge of the national project
	ALI SEYNI	- Director of the Agricultural Engineering Service
	M. HOEPFFNER	- ORSTOM Representative in Niamey

CENTRE

MM.	D. RIJKS	- Programme Co-ordinator
	J.C. ZILLHARDT	- Deputy Co-ordinator and Climatology Instructor
	J.L. DEVINCK	- Professor in Meteorology
	W. OWEN	- Chief Hydrologist
	M. N'DIAYE	- Meteorology Instructor
	E. MELLAART	- Agrometeorology Instructor
	G. DEROO	- Instruments Instructor
	C. BABAU	- Hydrologist
	P. GOINS	- Expert in Electronics
	J.J. GERBIER	- Administrative Officer
	P. VOSSEN	- Associate Expert in Agrometeorology
	M. HOEPFFNER	- Teacher from ORSTOM
	R. GATHELIER	- Teacher from ORSTOM

SENEGAL

MM. OUSMAN FALL	- Technical Adviser to the Ministry of Equipment, Dakar
MANSOUR SECK	- Director of the national Meteorological Service, Dakar
A. FALL	- Director of the Hydrological Service
A. NEHMAN	- Deputy Resident Representative of the UNDP
AMADOU N'DIAYE	- National Meteorological Service
DOUDOU TALL	- " " "
M'BAYE DIOUF	- " " "
MANSOUR SAR	- Adviser to the Minister of Rural Development
J.M. LORGE	- Assistant Resident Representative of the UNI
R. VASIC	- WMO Meteorology Expert in charge of the national project
J. LERIQUE	- ORSTOM Hydrologist (under contract with AGRHYMET)

UPPER VOLTA :

MM. ALY CISSE	- CILSS Exec. Sec. - OUAGADOUGOU
YAYA IDRISSA	- Director of the Projects and Programmes Division - OUAGADOUGOU
J.P. OUEDRAOGO	- Director of the national Meteorological Service - OUAGADOUGOU
B. IDO	- Director of Hydraulic Engineering and Agricultural Equipment - OUAGADOUGOU
D. NIKIEMA	- Chief of the Hydrological Service at the Directorate of Hydraulic Engineering and Agricultural Equipment - Counterpart for the project - OUAGADOUGOU
J. HOGEL	- Resident Representative of the UNDP in Upper Volta
HAARMAN	- Officer in charge of the programme, UNDP
KERE-VIM	- Senior Hydrology Technician at HEAE
NIKIEMA DIEUDONNE	- Director of HEAE

ANNEX II

Appendix A. List of Visits by the staff of the Centre to the various Countries

Appendix B. List of Visits by WMO Headquarters' and FAO staff to the various Countries

VISITS TO THE PROGRAMME BY WMO AND FAO

Place	Carried out by			Purpose
Ouagadougou, Niamey	B. Lagarde AFR Division/WMO	March	1975	Discussions with UNSO, CILSS and UNDP
Ouagadougou	E. Davy WMO Consultant	March	1975	Preparation of documents
Niamey	D. Nijhoff AFR Division/WMO E. Davy WMO consultant	May	1975	Meeting of donors for the Sahel
Niamey	B. Lagarde AFR Division/WMO	February	1976	Director's Meeting
Niamey	B. Lagarde AFR Division/WMO M. Frère FAO	Mars	1976	Meeting of Experts
Dakar, Banjul, Niamey	B. Lagarde AFR Division/WMO	October - November	1976	Discussions on implementation and Meeting of Experts
N'Djamena	D. Nijhoff AFR Division/WMO	December	1976	Meeting of CILSS Ministers
Niamey	R. Schneider Deputy S.G., WMO G. Weiss WWW Director/WMO D. Nijhoff AFR Division/WMO G. Popov FAO	February	1977	Informal Planning Meeting and Executive Committee of the Programme

APPENDIX B

Place	Carried out by	Date	Purpose
Dakar, Bamako, Ouagadougou	B. Lagarde AFR Division/WMO	March 1977	Discussions on implementation
	R. Foote TCO Director/WMO		
Niamey	B. Lagarde AFR Division/WMO	March 1977	Meeting of the Co-ordinating and Advisory Committee of the Programme
	M. Frère FAO		
Praia	B. Lagarde AFR Division/WMO	May 1977	Extention of the Programme at Cape Verde
	B. Lagarde AFR Division/WMO		
Niamey	M. Frère FAO	November 1977	Meeting of Experts
Niamey	R. Foote TCO Director/WMO	January 1978	Meeting of the Executive Committee of the Programme

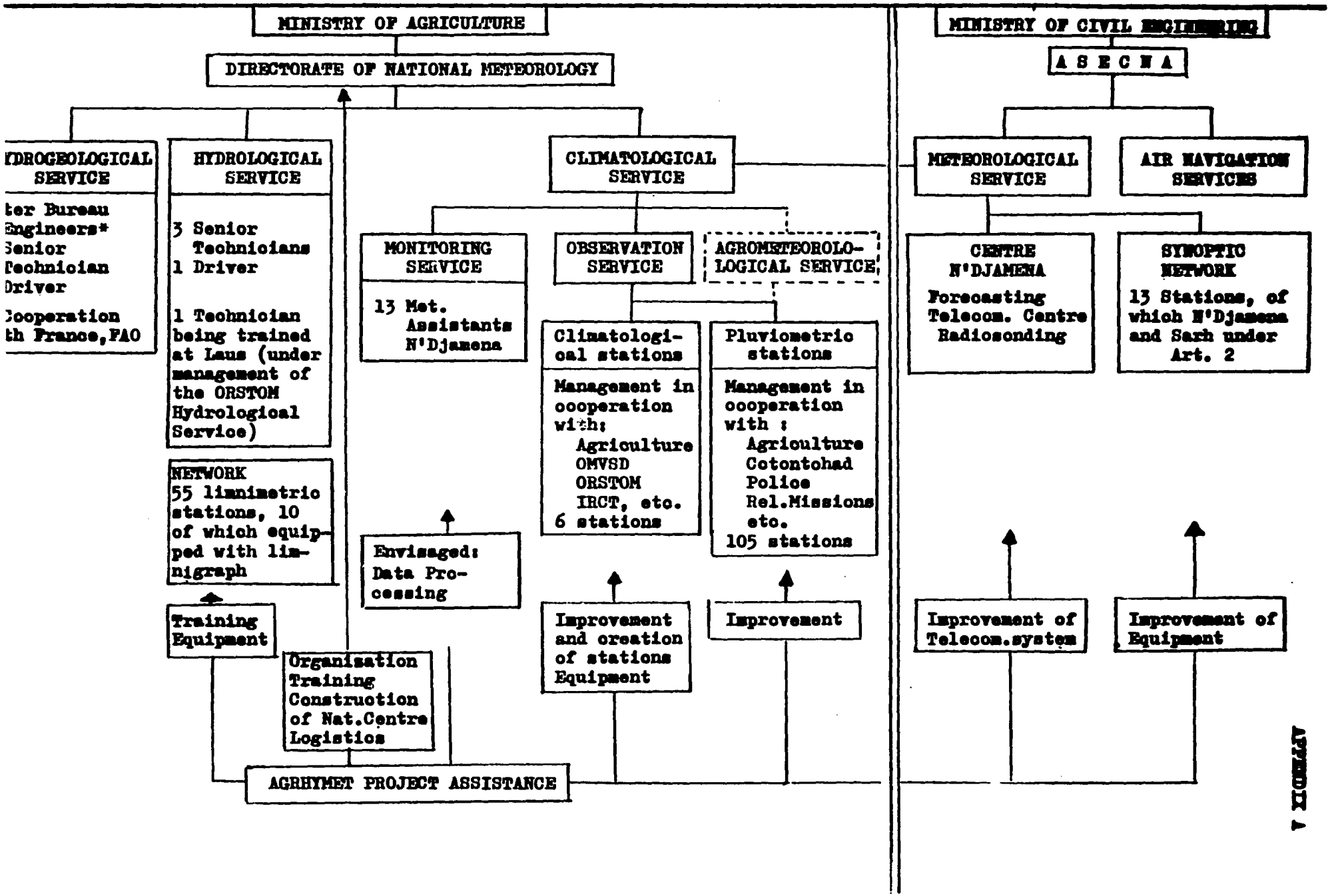
ANNEX III

Appendix A. Organizational Diagrams of the national Services

Appendix B. Networks

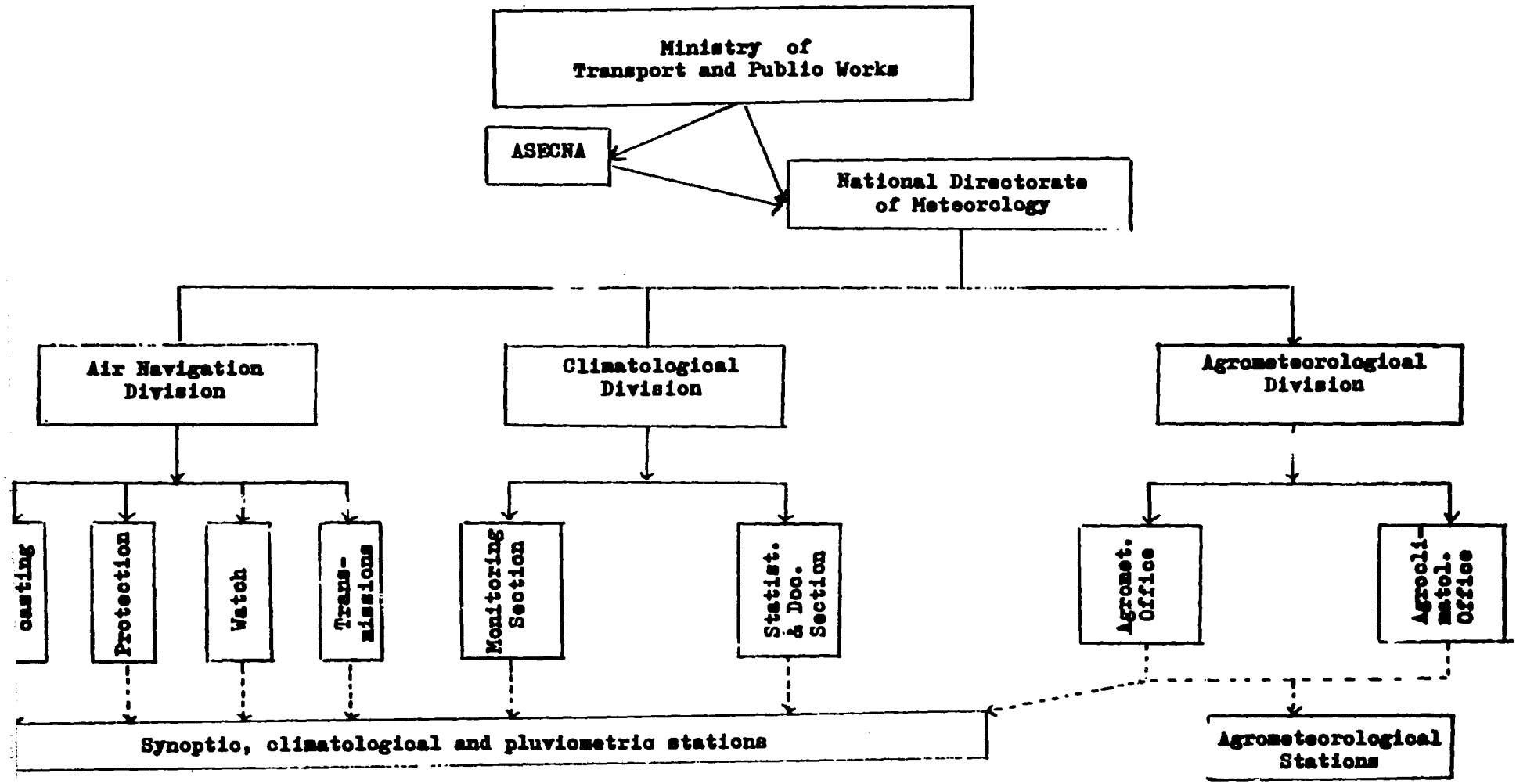
Appendix C. Buildings

REPUBLIC OF CHAD - METEOROLOGICAL AND HYDROLOGICAL SERVICES (As at beginning of 1978)



APPENDIX A

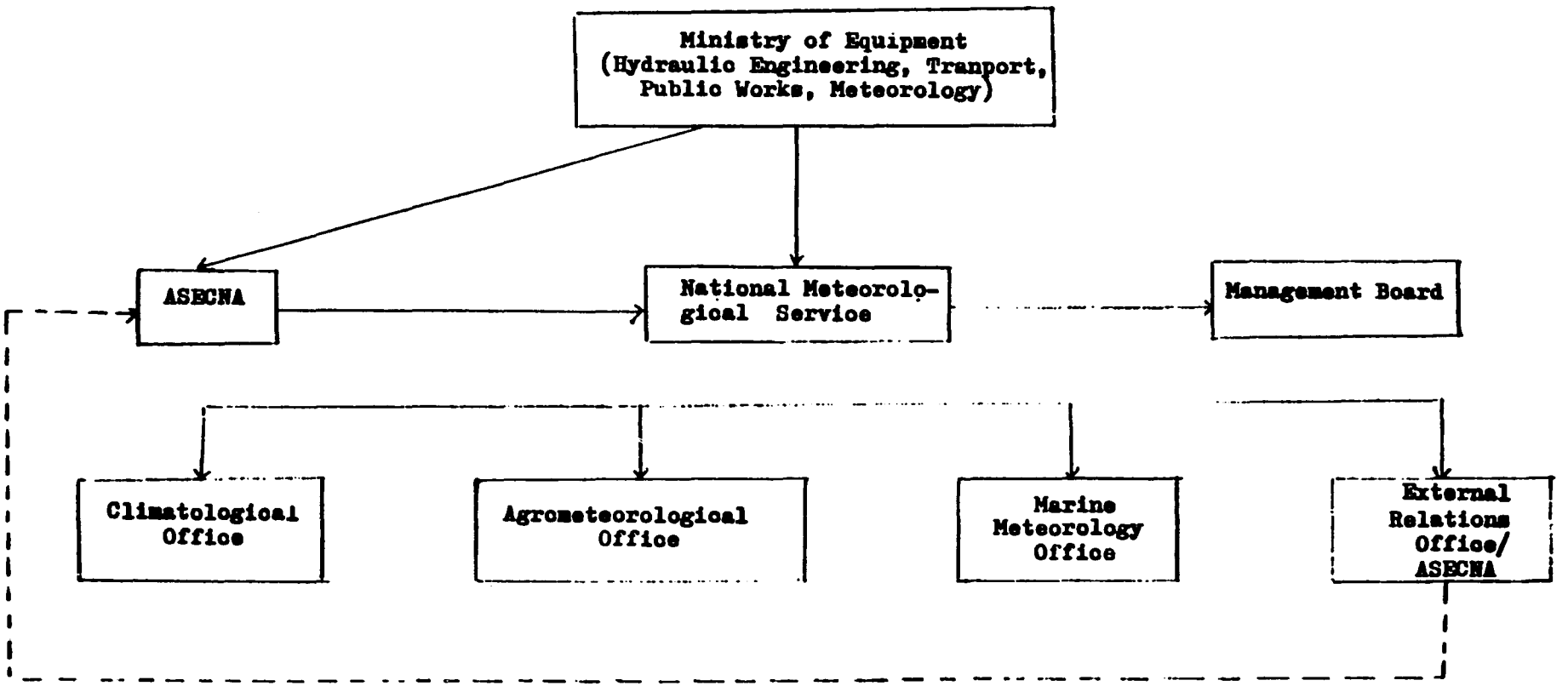
REPUBLIC OF MALI - ORGANIZATION OF SERVICES



Note: The climatological and agrometeorological Divisions are now grouped together under one Division and use practically the same staff.

Republic of Senegal

ORGANIZATION DIAGRAM OF THE NATIONAL METEOROLOGICAL SERVICE



OBSERVATION NETWORK

Stations	Number of stations already installed and ultimate development of the network				
	Stations already installed	Stations to be installed (Phase 2)	Stations to be improved (Phase 2)	Stations to be installed (Phase 3)	Optimal Level of operation
Synoptic	75	13	43	25	113
Agrometeorological	29	34	18	15	78
Hydrological					
a) equipped with recorders	183	74	26	55	338
b) direct observation	111	0	20	13	104
Climatological	84	51	28	40	175
Pluviometric:					
a) forming part of the Meteorological Services	472	331	173	196	1028
b) others	29	-	29	-	-
Radiation	11	23	7	7	41

APPENDIX B

TELECOMMUNICATIONS - NATIONAL NETWORKS

Stations to be included in national meteorological telecommunications networks

Country	Number of stations which will transmit their data by means of telecommunication			
	Stations already installed	Stations to be installed/improved Phase 2	Stations to be installed Phase 3	Optimal level of operation
Gambia	1	7	0	8
Upper-Volta	7 + 2	7	3	19
Mali	15	19	13	47
Mauritania	13	9*	0	22
Niger	11	14*	5	30
Senegal	13	6*	1	20
Chad	7	10	3	20

* Hydrological requirements are indicated below.

Stations to be included in national hydrological telecommunications networks

Country	Number of stations which will transmit their data by means of telecommunications			
	Stations already installed	Stations to be installed/improved Phase 2	Stations to be installed Phase 3	Optimal level of operation
Gambia	0	7	0	7
Upper-Volta		6	6	12
Mali	14	8	20	42
Mauritania	0	7	8	15
Niger	0	3	3	6
Senegal	0	3	2	5
Chad	0	3	2	5

APPENDIX C

BUILDINGS AND PREMISES AVAILABLE FOR THE HEADQUARTERS OF NATIONAL SERVICES

(Summary)

Service	Present situation	Proposed plan with optimal area in m^2 *	Estimated expenditure in US $
Gambia			
Joint Services	Temporary building	Yes (1,000)	240,000
Upper-Volta			
Meteorological Service	Temporary premises	Yes	Financed on the national budget
Hydrological Service	Temporary premises	No	Financed on the national budget
Mali			
Meteorological Service	Inadequate premises	Yes (655)	260,000
Hydrological Service	Temporary building		
Mauritania			
Meteorological Service	Inadequate premises		
Hydrological Service	Temporary building		
Joint Services		Not yet	
Niger			
Meteorological Service	Temporary premises	No	
Hydrological Service	Temporary premises	No	
Senegal			
Meteorological Service	Permanent Building		
Hydrological Service	Temporary premises	No	
Chad			
Meteorological Service	Inadequate premises		
Hydrological Service	"		
Joint Services		Yes (980)	360,000
Hydrological Brigade	None	Yes (340)	120,000

* between brackets, area in the first stage

ANNEX IV

Appendix A. Experts, Grants and Distribution of Equipment (by countries)

Appendix B. Budget for the projects

IMPLEMENTATION OF THE AGRHYMET PROGRAMME

(31.1.78)

EXPERTS	Name	Country of origin	Commencement of duties	Departure	Financing
Centre					
1. Programme Co-ordinator	Rijks, D.	Netherlands	3.10.75	on duty	UNDP
2. Deputy Co-ordinator and climatology instructor	Zillhardt, J.	France	1.06.75	on duty	UNDP
3. Professor in meteorology	Devinck, J.-L.	France	1.02.77	on duty	UNDP
4. Chief Hydrologist	Owen, W.	U.K.	11.09.76	on duty	UNDP
5. Meteorology instructor	Ndiaye, M.	Senegal	27.08.76	on duty	UNDP
6. Agrometeorology instructor	Mellaart, E.	Netherlands	30.09.76	on duty	UNDP
7. Instruments instructor	Deroo, G.	Belgium	1.07.77	on duty	Belgium
8. Hydrologist	Babau, C.	France	18.10.76	on duty	UNDP
9. Expert in electronics	Goins, P.	U.S.A.	2.08.77	on duty	U.S.A.
10. Administrative officer	Gerbier, J.-J.	France	1.02.76	on duty	Netherlands
11. Associate expert in agrometeorology	Vossen, P.	Belgium	21.04.77	on duty	Belgium
Gambia					
1. Agroclimatologist	Hutchinson, P.	U.K.	8.04.76	on duty	UNDP
2. Hydrologist	Prabhakar, D.	U.K.	11.01.76	on duty	UNDP/ Netherlands
Upper-Volta					
1. Agroclimatologist	Baldy, Ch.	France	9.10.75	21.12.77	UNDP
Mali					
1. Agroclimatologist	Lubnin, M.	U.S.S.R.	28.10.75	on duty	UNDP
Mauritania					
1. Agroclimatologist	Ketata, M.	Tunisia	1.08.76	on duty	UNDP

APPENDIX A

	Name	Country of origin	Commencement of duties	Departure	Financing
Niger					
1. Agroclimatologist	Espinar, M.	Spain	1.09.75	31.12.77	UNDP
2. Agroclimatologist	Lucido, M.	Italy	1.01.78	on duty	UNDP
Senegal					
1. Meteorologist	Vasic, R.	Yugoslavia	1.04.75	on duty	UNDP
Chad					
1. Agroclimatologist	Darnhofer, T.	Austria	1.04.76	on duty	UNDP

CILSS COUNTERPARTS

Ms C. Badiou	(France)	-	Head Secretary
Ms Kadidiatou Mazou	(Niger)	-	Typist
MM. Garba Saddi	(Niger)	-	Driver
Moussa Sori	(Niger)	-	Driver
Issa Baoua	(Niger)	-	Tractor driver
Maidoukia Ch.	(Niger)	-	Warden/Gardener
Tourba China	(Niger)	-	Warden/Gardener
Yacouba Tch.	(Niger)	-	Warden/Gardener
Issaka Yamb.	(Niger)	-	Warden/Gardener
Maman Danj.	(Niger)	-	Warden/Gardener

	Name	Country of origin	Mission dates	Financing
CONSULTANTS				
Data processing	Paling, E.	Netherlands	15.08.76 - 15.11.76	UNDP
Tropical meteorology	Ruchon, M.	France	14.11.76 - 24.12.76	UNDP
Tropical meteorology	Dhonneur, G.	France	15.02.77 - 14.03.77	UNDP
Preparation of documents and presentation of the Programme	Bernard, E.	Belgium	23.01.77 - 29.01.77 20.02.77 - 5.03.77 3.05.77 - 10.05.77 24.05.77 - 3.06.77	Belgium
Broadcasting of data	Van Hamme, J.L.	Belgium	2.05.77 - 24.05.77	Belgium
Broadcasting of data	Poncet, Y. Ms	France	20.04.77 - 24.05.77	Belgium
Collection of existing data	Drèze, A.	Belgium	17.10.77 - 18.11.77	Belgium
Data processing	Doore, S.	U.S.A.	07.77 - 08.77	U.S.A.
Meteorological telecommunications	Whipple, D.	U.S.A.	10.77 - 11.77	U.S.A.
Meteorological telecommunications	McCord,	U.S.A.	06.77 - 07.77	U.S.A.

FELLOWSHIPS GRANTED

Field of training	Name	Number of months in 75	76	77	78	79	80	Remarks
Gambia								
Agrometeorology Class II	Faal		12	12	7			
	Ceesay		12	12	7			
Hydrology Class I	Jasseh	-	-	9	12	12	12	
	Touray	-	-	7	12	12	12	
Instruments	Demba	-	-	5	-	-	-	
	Silva	-	-	-	6	-	-	
Marine meteorology	Sahor	-	-	2	-	-	-	
	Total 163	-	24	47	44	24	24	
Upper Volta								
Meteorology Class I	Ouedraogo	-	3	12	7	-	-	
Agrometeorology Class II	Hama	2	12	12	7	-	-	
	Gnoumou	-	3	12	7	-	-	
	Diallo	-	3	12	7	-	-	
	Kontongomde	-	3	12	7	-	-	
	Ouattara	2	12	12	7	-	-	
Agrometeorology Class III	Yoni	5	12	9	-	-	-	Including course on radiation instruments
	Zoungrana	-	3	12	7	-	-	
	Ouedraogo	-	-	3	12	7	-	
	Some	-	-	3	12	7	-	
	Senou	-	-	3	12	7	-	
Hydrometeorology Class II	Kam	-	-	3	12	12	12	
Hydrology Class I	Ouedraogo	-	6	-	-	-	-	Results insatisfactory
Hydrology Class III	Kere	1	12	11	-	-	-	
	Kabore	1	12	11	-	-	-	
	Ouattara	-	-	1	12	11	-	
	Mihin	-	-	1	12	11	-	
	Bicaba	-	-	1	12	11	-	
	Traore	-	-	1	12	11	-	
Radiation instruments	Kabore	-	-	1	-	-	-	
	Total 456	9	81	132	145	77	12	

Field of training	Name	Number of months in 75	76	77	78	79	80	Remarks
be Verde Islands								
ıronautical meteorology Class III	Freitas	-	-	3	3	-	-	
irology Class III	Da Costa	-	-	1	12	11	-	
	Bettencourt	-	-	1	12	11	-	
	Total 54	-	-	5	27	22	-	
li								
rometeorology Class I	Konate	-	3	9	-	-	-	
	Konare	-	3	9	-	-	-	
rometeorology Class III	Coulibaly	2	12	9	-	-	-	Including course on radiation instruments
	Mbaye	2	12	9	-	-	-	Including course on radiation instruments
	Dicko	-	3	2	-	-	-	Discontinued because of illness
	Konate	-	3	12	7	-	-	
	Maïga	-	-	3	12	7	-	
	Coulibaly	-	-	3	12	7	-	
	Diarra	-	-	3	12	7	-	
diation instruments	Toure	-	-	3	-	-	-	
	Total 166	4	36	62	43	21	-	
uritanie								
rometeorology Class III	Boubacar	-	3	12	7	-	-	
	Dia	-	3	8	-	-	-	Results too poor
	Abdallahi	-	-	3	12	7	-	
	El Aghoup	-	-	2	12	7	-	
trology Class III	Diop	1	12	11	-	-	-	
	Raby	1	12	11	-	-	-	
	Saar	-	-	1	12	11	-	
	El Kharfy	-	-	1	12	11	-	
	Total 172	2	30	49	55	36	-	

Field of training	Name	Number of months in 75	76	77	78	79	80	Remarks
ger								
rometeorology Class III	Adamou	2	12	9	-	-	-	including course on radiation instruments
	Miliki	3	12	9	-	-	-	Including course on radiation instruments
	Ganda	-	3	12	7	-	-	
	Chetima	-	3	12	7	-	-	
drology Class I	Beidou	-	-	-	9	-	-	
drology Class III	Abdou	1	12	11	-	-	-	
	Kanta	1	12	11	-	-	-	
dar maintenance	Sangare	-	-	3	3	-	-	
	Total 154	7	54	67	26	-	-	
négal								
teorology Class II	Ndiaye	*9	7	-	-	-	-	* financed previously under another project
	Diouff	*9	7	-	-	-	-	
	Tall	*9	6	-	-	-	-	
	Ly	*9	5	-	-	-	-	
rometeorology Class II	Sall	-	12	12	-	-	-	
rometeorology Class III	Kamara	*4	-	-	-	-	-	
	Diagne	2	12	9	-	-	-	Including course on radiation instruments
	Sow	2	12	9	-	-	-	Including course on radiation instruments
	Séné	-	2	12	8	-	-	
	Lo	-	-	3	12	7	-	
	Kamara	-	-	2	12	7	-	
eorology Class III	Diatta	*3	-	-	-	-	-	
rology Class III	Seck	1	12	11	-	-	-	
	Thiam	1	12	11	-	-	-	
	Sangare	-	-	1	12	11	-	
	Ndiaye	-	-	1	12	11	-	
ine meteorology	Seck	-	2	-	-	-	-	
	Total 301	49	89	71	56	36	-	

Field of training	Name	Number of months in 75	76	77	78	79	80	Remarks
Chad								
Agrometeorology Class II	Betoloum	-	3	12	7	-	-	
Hydrology Class I	Haltebaye	-	-	-	9	-	-	
	Acheikh	-	-	-	9	-	-	
Hydrology Class III	Haltegaye	1	12	11	-	-	-	
	Naringar	1	12	11	-	-	-	
	Younane	1	12	11	-	-	-	
	Ngaradoumadji	-	-	1	12	11	-	
	Guirbaye	-	-	1	12	11	-	
Agrometeorology Class III	Alifa	-	3	12	7	-	-	
	Raiwe	-	3	12	7	-	-	
	Ngakoutou	-	2	12	7	-	-	
	Gabsougo	-	-	3	12	7	-	
	Soronang	-	-	2	12	7	-	
	Total 268	3	47	88	94	36	-	
Overall total	*84/1734	74	361	521	490	252	36	* 84 students trained or being trained for 86 grants, 2 students having received 2 consecutive grants.

D. EQUIPMENT DELIVERED FOR THE PROGRAMME	$
Centre	
Meteorological instruments (screens, recorders, etc.)	
Hydrological instruments (limnigraphs, cup-wheels, etc.)	
Teaching and demonstration equipment (physics, electricity, etc.)	
Inflatable boats (2)	
Landrover (1)	
Peugeots 504 (2)	
Minibuses (3)	
Office equipment, furniture, calculating machines	
Technical books	
Agricultural equipment (tractor, plough, etc.)	
Irrigation equipment (pump, pipes, etc.)	
Interpretation equipment	
Radiation instruments (for redistribution within the countries)	
	520.000
Gambia	
Meteorological instruments	50.000
Hydrological instruments	51.000
Landrovers (4)	
Peugeot 504 (1)	33.000
Inflatable boats (3)	8.000
Boat (10 m) (1)	41.000
Office equipment, calculators, etc.	11.000
	194.000

Upper Volta		
Meteorological instruments		78.000
Hydrological instruments		17.000
Peugeot 504 (1)	)	
Peugeot vans (2)	)	41.000
Toyota P.U. (3)	)	
Range Rover (1)	)	
Inflatable boats (2)		5.000
Office equipment, calculators, etc.		15.000
		156.000
Mali		
Meteorological instruments		106.000
Hydrological instruments		16.000
Inflatable boats (2)		8.000
Peugeot 504 (1)	)	
Landrovers (4)	)	38.000
Renault R4 (1)	)	
Office equipment, calculators, etc.		7.000
		175.000
Mauritania		
Meteorological instruments		62.000
Hydrological instruments		22.000
Peugeots 504 (2)	)	38.000
Landrovers (4)	)	
Inflatable boats (2)		5.000
Office equipment , calculators, etc.		6.000
		133.000

Niger		
Meteorological instruments		89.000
Hydrological instruments		22.000
Peugeot 504 (1)	)	32.000
Landrovers (4)	)	
Inflatable boats (2)		5.000
Office equipment, calculators		6.000
Mini-computer		20.000
		174.000
Senegal		
Meteorological instruments		41.000
Hydrological instruments		45.000
Landrovers (3)		26.000
Inflatable boats (2)		5.000
Office equipment, calculators, etc		14.000
		131.000
Chad		
Meteorological instruments		73.000
Hydrological instruments		20.000
Peugeot 504 (1)	)	34.000
Landrovers (4)	)	
Inflatable boats (2)		5.000
Office equipment, calculators, etc.		7.000
		139.000
	Overall total	1.622.000

ANNEX V

Appendix A. Diagram of the Centre's Activities

Appendix B. Seminars and Meetings (regional)

Appendix C. Reports and Publications

DIAGRAM OF THE CENTRE'S ACTIVITIES

	1977	1978	1979	1980	After 1980
A. Construction of buildings					
a) Teaching complex					
b) Accommodation					
c) Agrometeorological outbuil.					
Hydrological outbuildings					
d) Transit section					
e) Site development					
f) Maintenance					
B. Training					
a) Agrometeorology-Class III					
Class II					
Class I					
b) Hydrology - technicians					
c) Specialised training					
d) Number of instructors:					
- professional level	6	7	7	7	?
- technical level	2	2	2	2	?
e) Delivery of teaching equipment					
C. Co-ordination activities					
D. Data Processing					
a) Installation of equipment					
b) Training of staff					
c) Creation of maintenance infrastructure					
d) Operational phase					
e) Co-operation with external organisations					
f) Creation of data banks					
g) Processing of previous data					
h) Analysis of previous data					
E. Telecommunications					
a) Installation of the AGRHYMET/Centre/national Centre					
b) Installation of links with RMC's					
c) Installation of equipment to receive satellite data					
F. Development of new technologies					
G. General activities					

APPENDIX B

SEMINARS - MEETINGS (Regional)

1. MEETINGS OF THE CO-ORDINATING AND ADVISORY COMMITTEE

January	76 in Geneva (Report)
May	76 in Geneva (Report)
March	77 in Niamey (Report)
November	77 in Geneva (Report)

2. MEETINGS OF THE EXECUTIVE COMMITTEE

February	76 in Niamey (preparatory meeting) (Report)
February	77 in Niamey (Report)
January	78 in Niamey (Report)

3. MEETINGS ON MANAGEMENT TRAINING

February	76 in Niamey (preparatory meeting) (Report)
January	78 in Niamey (Report)

4. MEETINGS OF EXPERTS (semi-annual)

March	76 in Niamey (Report)
November	76
March	77
November	77

5. SEMINARS

9-11 February :	Meeting on the dissemination of agrometeorological and hydrological information, Niamey 1977 (Report)
21-23 February :	Informal planning meeting on the AGRHYMET Programme, Niamey 1977 (Report)

APPENDIX C

Project RAF/74/080 WMO July - December 1977

REPORTS

- Brief survey of the situation of the Project (Fr.) - October 1975.
- Report on the State of Project RAF/74/080 (Fr.) - December 1975.
- Situation Report (Eng.) - December 1975.
- Training Programme Agrometeorology Class 3 Course (Fr.) - February 1976.
- Training Programme Operational Hydrology Class 3 Course (Fr.) - February 1976.
- Report of the Meeting of National Directors of Meteorology, Hydrology and the Civil Service of the Sahel Countries (Fr.) (Feb. 76)- March 1976.
- Review of developments in the implementation of the Programme - March 1976.
- The conservation and utilisation of water. Rijks, London - March 1976.
- Existing and planned function of the Centre for Agrometeorology and Operational Hydrology in the Sahel - April 1976.
- Training Programme Agrometeorology Class 2 Course (Fr.) - May 1976.
- Report on Implementation of the Programme (Fr. & Eng.) - May 1976.
- Statistics Course - M. Zillhardt - for Agro. Class III, 53 pp. - May 1976.
- Telecommunications survey for the agromet-hydromet project in the Sahel (not published). Mc Cord - August 1976.
- Natural resources and environmental conditions. Rijks, Amsterdam - October 1976.
- Report of the Meeting of AGRHYMET Experts - November 1976.
- Meteorological Forecasting for Hydrologists (WMO No. 492 : Lectures on Forecasting of Tropical Weather, including Tropical Cyclones, with particular reference to Africa : Proceedings of WMO Seminar. W.G. Owen - November 1976. Dakar).
- Meteorological Forecasting for Agriculture. (WMO No. 492 : Lectures on Forecasting of Tropical Weather, including Tropical Cyclones, with particular reference to Africa : Proceedings of WMO Seminar. D. Rijks - Dakar - November 1976).
- Regional Centre for Training and Practical Application in Agrometeorology and Operational Hydrology for the Sahel Countries (2 editions), 13 pp. J.L. Devynck - 1977.
- Report on the Practical training of the Class Agro. III 2 at the experimental ranch station at Kerkissoye (Niamey), 4.7-9.7 1977, 5 pp. Students from Class Agro. III 2 of 1977 and P. Vossen. July 1977.
- Drawings of the phenological phases of wheat, maize and soya beans, 3 pp. Stencilled reproductions taken from three photocopies obtained by FAO, P. Vossen - August 1977.

- Brief outline of Marine Hydrology, 9 pp. C. Babau - August 1977.
- Development and management of a hydrological basein, 7 pp. C. Babau - October 1977
- Provisional inventory of Graminaceae found on AGRHYMET terrain in the period June-September 1977, 2 pp. P. Vossen - October 1977.
- The flower, spikelet and inflorescence of Graminaceae, 5 pp. P. Vossen - October 1977.
- Acquisition and Monitoring of Representative Surface Water Data. Evaluation and Prediction in Hydrology - Section I : Evaluation. (WMO Seminar on Applications of Meteorology and Hydrology to Drought Problems in the Sahelian Zone and other parts of Africa). W.G. Owen - Niamey, November 1977.
- Acquisition and Monitoring Soil, Phenological and Agricultural Data. (WMO Seminar on Applications of Meteorology and Hydrology to Drought Problems in the Sahelian Zone and other parts of Africa). W.G. Owen - Niamey, November 1977.
- Report of the Meeting of Experts of the AGRHYMET Programme - 26-29 October 1977 - November 1977.
- Training Programme Course for Agrometeorologists Class III (new edition). J. Zillhardt - 30 pp. December 1977.
- Provisional inventory of diseases, parasitic plants, and harmful insects and birds found on millet, sorghum and niébé crops on the AGRHYMET terrain, Niamey, May-October - 30 pp. P. Vossen - December 1977.
- Survey of data processing requirements and equipment available and needed for the agrometeorological and hydrological Services in the Sahel countries. S. Doore, NOAA, (limited distribution). G. Paling - November 1976.
- Report of a seminar on the Broadcasting of Agrometeorological and Hydrological Information, Niamey - February 1977.
- Report on the informal planning meeting of the hydromet Programme, Niamey - February 1977.
- Course on Tropical Meteorology. G. Dhonneur, 160 pp. - March 1977.
- Prediction of water use in semi-arid tropics. D. Rijks, Riverside - April 1977.
- AGRHYMET Programme : Teaching and training. N'Baye N'Diaye, 13 pp. - 11-15 April 1977.
- Climate-soil-plants relationship. E.A.R. Mellaart. (Ibadan seminar), 8 pp. - 1977.
- Calculation of evapotranspiration according to Penman. E.A.R. Mellaart, 19 pp. 1977.
- A few notes on interpolation. E.A.R. Mellaart, 13 pp. - 1977.
- The Water Balance (with figure) E.A.R. Mellaart, 15 pp. - 1977.
- Phenological charts. E.A.R. Mellaart, 6 pp. - 1977.

- Plant cultivation and agrometeorology. E.A.H. Mellaart - 1977.
- Entholoqical drawings : Reproduction of some of the drawings by Gillard A. and Pelerents C. Dierijke Plantenparasiten, Rijksuniversiteit Gent, Belgium. P. Vossen, 7 pp. - May 1977.
- Physical water-erosion processes. C. Babau, 15 pp. - May 1977
- Directions for the use of the "Universal" Chaix compass. C. Babau, 13 pp.- 1977.
- The AGRHYMET Programme in the CILSS states and its contribution towards Sahel development strategy, Ottawa. D. Rijks. May 1977.
- Instructions for agrometeorological observers (provisional edition 120 pp. - May 1977.
- Study mission on the broadcasting of agrometeorological and hydrological information for practical use by farmers and stock breeders. 65 pp. J.L. Van Hamme and Y. Poncet. May 1977.
- Use of Spray Pesticides in Northern Nigeria. Partial translation of Johnston D.R. and Hontington K.A., Weather and Crop spraying in Northern Nigeria, Weather, Vol. 32, No. 7, July 1977, pp. 249-257. P. Vossen - 11 pp. - June 1977.
- Summary of the course of applied physics and hydraulic engineering - 14 pp. M. Hoepffner.
- Rudimentary Statistics - 15 pp. March 1976 - M. Hoepffner.
- Flow measurement based on velocity measurement - 30 pp. - 1976 - M. Hoepffner.
- Course on pluviometry - 17 pp. - M. Hoepffner - 1977.
- Study on solid transport . 5 pp. - April 1976 - M. Hoepffner.
- Water quality - 7 pp. - April 1976 - M. Hoepffner.
- Use of hydrological data in development projects for hydraulic engineering- 27 pp. - June 1977 - M. Hoepffner.
- Course on Hydrometry : scales and limnographs - 37 pp. + drawings - M. Hoepffner.