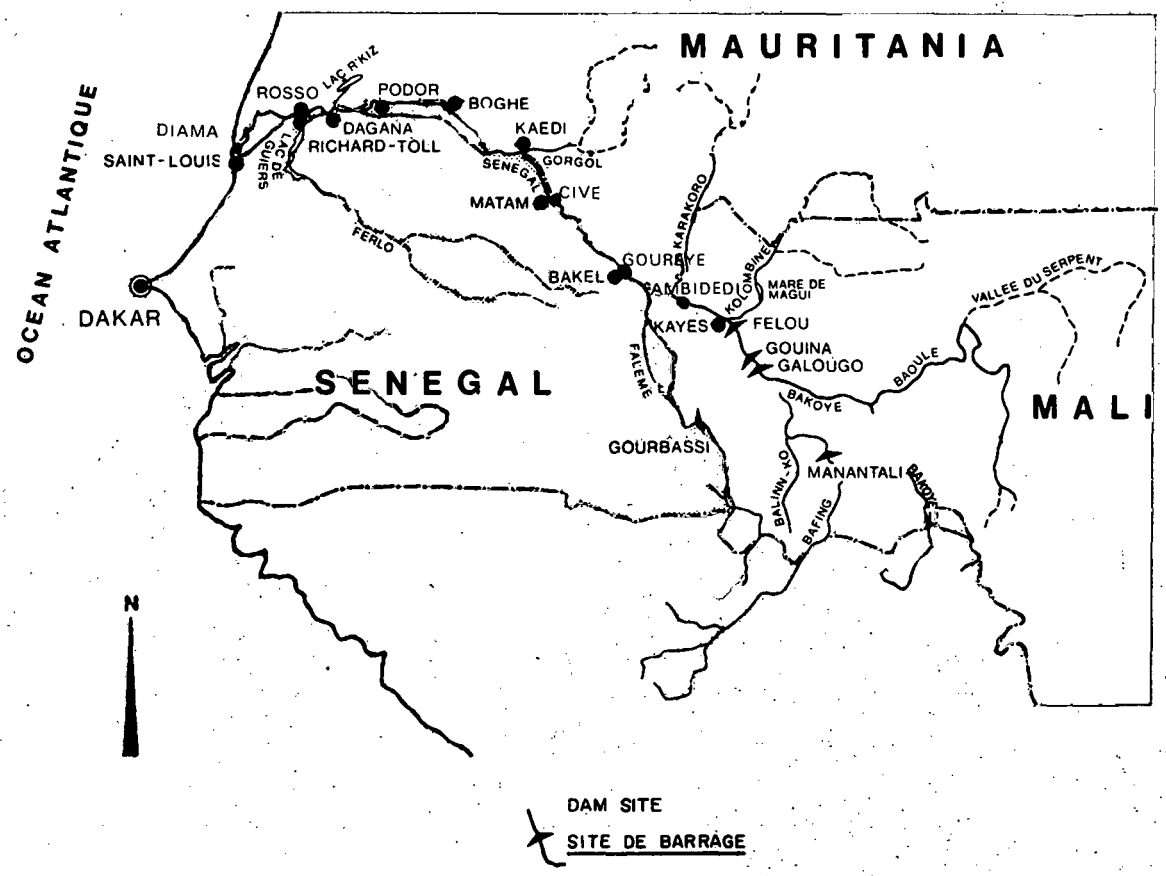
MALI — MAURITANIA — SENEGAL

RIVER SENEGAL



ORGANISATION POUR LA MISE EN VALEUR DU FLEUVE SENEGAL

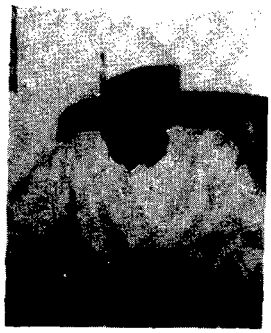
O.M.V.S.

1979

TABLE OF CONTENTS

PREFACE

At last !



A simple exclamation that occurs to us in prefacing this first issue of RIVER SENEGAL whose publication coincides with the laying of the foundation stone of the Diama dam.

At last ! It is at the same time a sigh of relief and a call of hope.

It is a relief to note that the countless difficulties that so often challenged the Delta dam project could not in the end halt the course of destiny. And we are stirred with hope because this foundation stone to be laid on 12th December by the three Heads of State of the Senegal river riparian countries is the starting point of a marvellous adventure that will transform this patch of West African soil, desolate today, into a land of prosperity for future generations.

The Diama dam is the first link in a chain of achievements that will bring fundamental changes to the basin and its populations.

And as early as next year, the construction of another dam, the Manantali dam, will commence. This will guarantee a regulated river flow making all things possible :

Once Diama and Manantali are filled, and this will be achieved in 1986, one will witness the development of a vast programme whose long term prospects extending over half a century are to substitute uncertain flood recession crops by irrigated farming on superficies that could amount to 375,000 ha, to create hundreds of factories along with balanced development of trade between agriculture and industry, between urban and rural areas, and the advent of a new life for our valourous farmers who will be protected against insecurity and ensured of substantial increase in revenues.

In the long term, this programme, which is that of the Senegal River Development Organization (OMVS) aims at articulating member States' development plans in the basin area, once the second generation dams, those of Galougo, Gouina, Felou and Gourbassi, have guaranteed a maximum flow regulation and increase the agricultural and hydroelectric potentials up to respectivelv 800.000 ha and 2 billions kWh.

Beyond the Senegal river basin, there are other Sahelian basins, those of the Gambia and Niger rivers and lake Tchad, to mention only a few, and beyond the Sahel, we may think of the sixty river and lake basins of the African continent whose immense potentials constitute most certain wealth for our people, engaged in the pursuit of development.

Concepts and methods developed by the OMVS, to the extent that they are transposable, could contribute to the definition of a strategy for the development of river basins at the level of our continent, a strategy that would attack the problem of under-development at its roots.

Finally, the Senegal river riparian States, by deciding joint ownership of all the infrastructures constituted by the Diama and Manantali dams and the port facilities, have expressed a will of cooperation unprecedented in Africa and in the world.

At a time when rehabilitation of the threatened Sahel is becoming one of the main concerns of the international community, this volition of Mali, Mauritania and Senegal to combine forces on an irreversible basis in order to rise to the height of the Project has exerted strong influence over the decision of many Aid to Development Funds, whose support guarantees the realization of the OMVS programme.

RIVER SENEGAL of which this first issue is devoted to a general presentation of the OMVS, will endeavour to periodically inform on the problems and performances of this vast enterprise with the constant concern for full awareness of its scope both within and without the Riparian States, the concern for generating a true mystique of development of the basin.

RIVER SENEGAL also aims at being a link, a liaison bulletin between African organisations entrusted with promoting the development of our natural resources.

MAMADOU AMADOU AW
HIGH COMMISSIONER

THE SENEGAL RIVER AND ITS TRIBUTARIES

THE Senegal river is formed by the junction near Bafoulabe, in Mali, at about 1.000 km from the Atlantic Ocean, of two streams, the Bafing (1) and the Bakoye (1) rivers. It crosses the western part of Mali, then for the rest of its course, it marks the border between the territories of Senegal and Mauritania.

The 760 km long Bafing river rises at an altitude of 800 meters in the Fouta Djalon mountains, in Guinea, then running North, crosses the plateaux of the Sudanian region before reaching Bafoulabé. With an annual mean flow of 430 m3/sec., it supplies more than half of the total Senegal river waters. Its water course is characterized by the presence of falls and rapids.

The Bakoye river is 640 km long; it rises in the vicinity of the Southern limit of the Manding plateau in Guinea, at an altitude of 500 metres. At its point of confluence with the Bafing, its mean annual flow is 170 m3/sec. This river also features a number of small falls and rapids along its course.

Downstream from Bafoulabe, the main tributaries of the Senegal river are the Karakoro and the Gorgol on the right bank.

On the left bank, the Faleme is its largest tributary. This 650 km long river rises in the Northern part of the Fouta Djalon mountains, at an altitude of 800 meters. It flows into the Senegal river 30 km upstream from Bakel, at which point it has a mean annual flow of 200 m3/sec.

THE SENEGAL RIVER BASSIN

The Senegal river basin covers a total area of approximately 300,000 km2, divided into three main regions : the upper basin, the valley and the delta, which are quite different in their topographic, geological, hydrographic and climatic conditions.

The Upper Basin, extending from the Fouta Djalon down to Bakel and supplying most of the run off into the river is a relatively wet region with an annual rainfall ranging from 700 mm to 2,000 mm. The rains which last from April to October in the mountainous area of the extreme South of the basin, causes the annual river flood that occurs between July and October.

The Valley; between Bakel and Dagana, is an alluvial plain surrounded by semi-desert regions. It forms a flood plain 10 to 20 km wide, but sometimes extending to 25 km. This agricultural region is made fertile each year by the river flood. The river has a very low gradient and forms many meanders; it has a system of effluents and, when outflowing from its minor bed, which is 200 to 400 m wide, it fills numerous small clayey basins called « oualos ». Some forty rocky and sandy sills extending across the river bed, hinder navigation during the period of low waters.

The Delta, downstream from Dagana, is the lowest reach of the river. Although there is only one river mouth, it can be considered as a delta with multiple branches. In this vast and totally flat area inundated by sea water during the dry season, the river is 400 to 500 m wide and relatively deep. Tidal influence is appreciable.

North of the 15th parallel, the boundaries of the Senegal river catchment area are not precisely defined. In fact, the arid climate and uniform topography gradually erase the hydrographic system.

The basin area is more or less divided as follows between the riparian States :

- — Republic of Mali : 155 000 km2
- — Islamic Republic of Mauritania : 75 000 km2
- — Republic of Senegal : 27 500 km2

THE SENEGAL RIVER REGIME

The stream flow regime of the Senegal river is essentially dependent on rainfall in the Upper Basin and is characterized by :

- — a high flow season from July through October,
- — a season of low flows gradually decreasing between November and May/June.

High flow season peaks are recorded late August or early September, followed by a rapid decrease in the flows during October.

At the end of the dry season, very reduced flows subsist in the larger stream channels or in the small tributaries with the most favourable conditions.

At Bakel, which is often considered as marking the limit between Upper Bassin and Valley, and as the key-station of the Senegal river because of its location downstream from the lowest main tributary, the Faleme, the mean annual flow of the river is approximately 750 m3/sec., which corresponds to a run-

(1) In Malinke, Bafing means black river and Bakoye, white river.

off of some 23 billion m3. Mean monthly flows recorded may vary from a maximum 3 320 m3/sec. (Septembre to a minimum 9 m3/sec. (May).

Another major feature of the Senegal river regime is inter-annual variations. For the 1903-1978 period, mean annual flows recorded show differences exceding a 4 : 1 ratio between the rainiest and the driest seasons

Year 1913 mean annual flow : 270 m3/s - annual discharge 8.5 billions m3.

Year 1924 mean annual flow : 1245 m3/s - annual discharge 39.5 billions m3.

This irregular interannual flood variation represents one of the Valley main handicaps.

Indeed, it curtails the capabilities of a guaranteed agricultural production of this narrow area, bordered by two deserts. Land surfaces cultivable after flood recession may in fact vary from 15 000 ha to 100 000 ha depending on the amplitude, the duration and the date of the flood.

Exceptionally high waters cause extended damages in the Valley in 1890, 1906 and 1950. Extremely small floods are just as catastrophic since they do not allow for sufficient agricultural production in the Valley. The recent 1972-73 drought has been particularly disastrous for the populations and the economy of the OMVS member States.

At the time of low waters which last from November through May - June, when almost no rainfall occurs, the flows of the Senegal river and its tributaries progressively recede. The dry season excessively low flows result in the intrusion of sea water far upstream in the river bed. During the past years, the salt water intrusion passed beyond Dagana and stretched upstream as far as 200 km from Saint-Louis, almost reaching the Fanaye creek.

Inter-state cooperation

COOPERATION between the riparian States for the development of the Senegal river basin resources was initiated at an early date in the form of a sub-regional organization having the objectives of promoting and coordinating joint development actions within the Basin.

The « Mission d'Aménagement du Fleuve Sénégal » (1) *(MAS).*

1934 was the date of creation of the M.A.S. by the colonial administration. In 1959, it became a joint organization regrouping Senegal, Sudan and Mauritania.

Its mandate at that time was to assume the following responsibilities in liaison with the national services of the countries involved : follow-up of studies, supervision and control of development works within the Senegal river catchment basin, operation and control works executed for such developments. When the States recovered their sovereignty, the M.A.S. was reduced to Mauritania and Senegal due to the withdrawal of Sudan (now Mali).

A new organization was then established regrouping all four riparian States : Guinea, Mali, Mauritania and Senegal.

The Inter - State Committee (2)

During a meeting in Bamako in July 1963, the representatives of the Republics of Mauritania, Guinea, Mali and Senegal, laid the bases for cooperation by signing the « Convention relative à l'Aménagement du Bassin du Fleuve Sénégal » ((3).

By this Convention, the four riparian States declared the Senegal river, including its tributaries, an « international river » and established an Inter-State Committee. Under the aegis of this Committee and in collaboration with the United Nations Development Programme, the major studies were initiated, enabling the riparian States to define a programme of integrated development of the Senegal river basin resources.

The Convention on the status of the Senegal River, signed February 6, 1964, defines the basic principles of river resource exploitation.

Council of Ministers visiting the Diama dam site

The Heads of State of the riparian countries, encouraged by the results achieved by the Committee, decided extension of cooperation to other fields.

The « Organisation des Etats Riverains du Sénégal » (1) *(O.E.R.S.)*

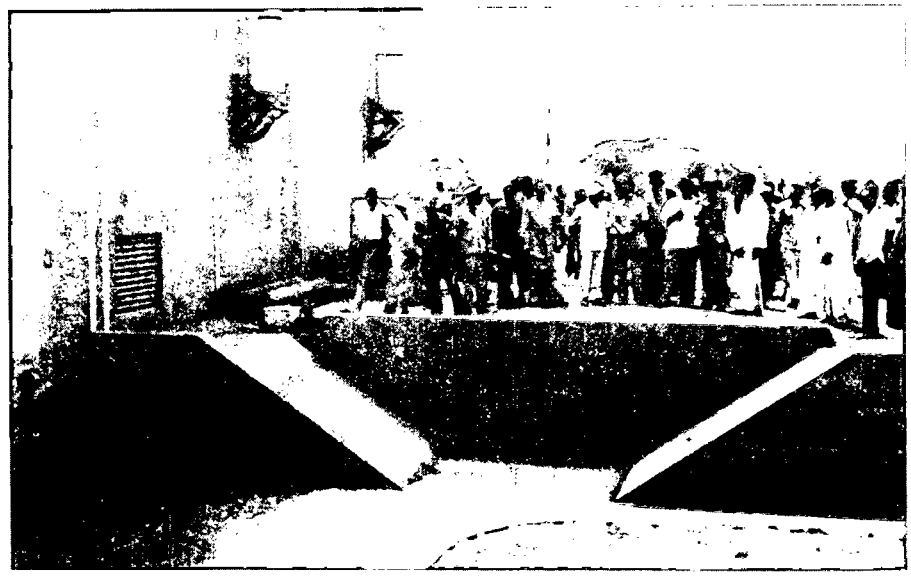
At a meeting in Labe on March 2, 1968, the Heads of State of Guinea, Mali, Mauritania and Senegal adopted the status of the « Organisation des Etats Riverains du Sénégal ».

In addition to the development of the Senegal river, the objectives of this new organization were the harmonization of the States' national development plans and the implementation of concerted policies for sectorial development.

Up to March 1972, operation of the O.E.R.S was paralyzed due to political difficulties that arose meanwhile in the relationships between the member States. Mali, Mauritania and Senegal decided then to denounce the February 6, 1964 Convention bearing internationalization of the Senegal river on the one hand and on the other hand to renounce definitively their O.E.R.S. membership.

Convinced of the pressing necessity of uniting their efforts for the development of the Senegal river, the three States established the O.M.V.S., charged essentially with developing the Senegal river basin resources.

OMVS, legal and institutional structure



Council of Ministers visiting a pumping station on the Senegal river

AT the institutional level, the way to development was beset with many obstacles and it took some time for this cooperation to evolve into the present organization.

Regrouped in the O.M.V.S., the Republic of Mali, the Islamic Republic of Mauritania and the Republic of Senegal have signed :

— a Convention relative to the status of the Senegal river,
— a Convention bearing creation of the O.M.V.S.,
— a Convention relative to the legal status of the common works.

These three Conventions are the basic documents governing activities in relation with the development of the Senegal river and of the basin resources.

The structure of the Organization is completed by purely consultative bodies created by decision of the Council of Ministers.

CONVENTION RELATIVE TO THE STATUS OF THE SENEGAL RIVER

The Convention relative to the status of the Senegal river was signed in Nouakchott on March 11, 1972 by the Heads of State of Mali, Mauritania and Senegal.

Under this Convention, the Senegal river, including its tributaries, is declared an international river on the territories of the Republic of Mali, of the Islamic Republic of Mauritania and of the Republic of Senegal.

Freedom of navigation on the river and equal rights as regards port and commercial navigation taxes are guaranteed to the citizens, the commercial vessels and the goods of the contracting States as well as to vessels chartered by one or several of these States. Taxes and fees should be representative of navigation services rendered and should not be discriminatory.

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(1) The Mission for the Development of the Senegal river.

(2) Inter-State Committee for the Development of the Senegal river basin.

(3) Convention relative to the Development of the Senegal Rivers Basin.

(4) Senegal Riparian States Organization.

Council of Ministers visiting the Manantali dam site

Freedom of navigation and equality of treatment also applies with respect to roads, railways and lateral channels created for the specific purpose of compenssating lack of navigability or defective reaches of the navigation channel in the river or its tributaries.

Moreover, common regulations will be established to ensure security and control of navvigation.

The contracting States also agreed to maintain their respective sectors of the river in good state of navigability, in compliance with common operational regulations.

With respect to exploitation of the river for agricultural or industrial purposes, the Convention establishes the principle of prior approval by the contracting States of all projects liable to significantly modify the characteristics of the river. The project documents should specify the impacts on :

— the river regime,
— the conditions of navigability and those of agricultural and industrial exploitation,
— the river water quality,
— the biological characteristics of the river fauna and flora,
— water requirement and water table level.

An amendment to the Convention signed on December 16, 1975, increased from 10 to 99 years the period required before any one of the contracting States could denounce the Convention. This decision reinforces the spirit of inter-State cooperation at the implementation level of joint Senegal river basin development policies.

CONVENTION BEARING CREATION OF THE OMVS

The Convention bearing creation of the O.M.V.S. was signed on March 11, 1972, in Nouakchott by the Heads of State of Mali, Mauritania and Senegal.

The Organization supreme authority is the Conference of Heads of State and Governments. Its permanent bodies were the Council of Ministers, acting at the conception and control level, and the Secretariat General at the execution level. Decisions of the Council of Ministers, as the decisions of the Conference of Heads of State and of Government, have force of law on member States.

A first amendment signed in April 1973 confers to the Organization the capacity of receiving grants, of subscribing loans and soliciting technical assistance.

On December 17, 1975, a global amendment to the Convention was signed, designating the High Commission as its executive body.

The creation of a Permanent Commission on water increased the number of the Organization permanent bodies to three.

An amendement was also signed on December 21, 1978, to confer full legal status to the Organization and to specify conditions of withdrawal of a member State. Any State that withdraws from the Organzation has to enter negotiations both with the other member States and interested third parties, for liquidation of its rights and obligations as subscribed under the Convention.

Withdrawal will become effective only after settlement agreements acceptable to the other member States and also to interested third parties have been signed. This clause gives the financing Sources participating in the O.M.V.S. programme the guarantee that in the event of its withdrawal, any former member State will fully respect its obligations towards the OMVS programme following the withdrawal.

The Organization functions within the framework of this set of precepts.

The Conference of Heads of State and of Government.

As the supreme authority, this Conference defines the Organization cooperation policies and makes decisions as to overall economic development. Presidency of the Conference is for successive two-year terms by each of the Heads of State and of Government.

The Council of Ministers.

This body of the Organization is responsible for conception and control. It elaborates overall policy for the development of the Senegal river and its resources and for cooperation between the riparian States. Within such framework, it defines priority actions and fixes each member States contribution to the Organization's budget for operation, studies and works.

Council decisions are taken by unanimous agreement of the member States.

Presidency of the Council is for successive two-year terms by each of the member States.

The High Commission

The High Commission, executive body of the Organization, applies the Council of Ministers' decisions. It reports on the execution of these decisions and on all initiatives taken under the directives received and within the limits of its mandatory powers.

The High Commission is directed by a High Commissioner appointed by the Conference of Heads of State and of Government for a renewable four-year mandate. In the intervals between Council of Ministers' meetings, the High Commissioner represents the Organization.

He also represents the member States in their relations with international aid and bilateral cooperation agencies on matters relating to Senegal river development. In this capacity and within the limits of his mandatory powers, he is authorized to enter negociations and transactions in the name of all the member States. He may also be commissioned by one or more member States to seek financing for works in relation to the river development.

Advisors appointed by the Council of Ministers collaborate with the High Commissioner under his direct authority.

The High Commissioner is assisted and seconded by a Secretary General also appointed by the Conference of Heads of State and of Government, and acting as his deputy during interims.

The High Commissioner may, on his own responsibility, delegate powers to the Secretary General.

The Secretary General is the head of Administration. He is assited by Directors appointed by the Council of Ministers.

Heads of Departments and Divisions complete the Organization structure.

These services as a whole contribute to the proper functioning of the High Commission at both administrative and technical levels, and in particular with respect to the execution of studies and works for the coordinated development and rational exploitation of the Senegal river resources.

The Permanent Commission on Water.

Composed of representatives of the Organization member States, this Commission is responsible for defining the principles and conditions governing allocation of the Senegal river waters between the member States and between use sectors, namely industry, agriculture and transport. It gives consultative advice to the Council of Ministers.

CONVENTION RELATIVE TO THE LEGAL STATUS OF COMMON WORKS

In 1974, the Heads of State and of Government have decided that works of common interest constructed on the Senegal river will be jointly owned by the O.M.V.S. member States.

The purpose of the December 21, 1978, Convention is to define precisely the legal status of these works and the mode of application of the concept of joint ownership.

— *Status of common works :* the Convention defines the legal status of common works, notably the conditions of elegibility of a work to such a status, the conditions of execution of the works, the priviledged status granted by the States to common works, etc...

— *Rights and obligations of co-owner States :* These rights and obligations are based on the fundamental principles of equality and equity.

— *Management of the works :* The Convention defines the respective roles of agencies to be established for the management of common works, of the High Commission as coordinator and of the O.M.V.S. that exercices rights of oversight. It also determines the legal status of these agencies as well as the privileges and immunities granted to them by the co-owner States.

Therefore, this Convention constitutes significant progress in the fields of cooperation beween the O.M.V.S. member States as well as that of international public law.

Two Consultative bodies have been created by the Council of Ministers.

1) *The « Comité Inter-Etats de la Recherche et du Développement Agricole »* (1) *(C.I.E. R.D.A.)*

Established by a resolution of July 1976, the CIERDA is a consultative body having the objective of harmonizing national agricultural research and development programmes of the member States in view of the integrated development of the Senegal river basin.

The presidency and secretariat of this Committee are assumed by the High Commission. It is composed of two representatives from each State and one from the High Commission.

2) *The « Comité Consultatif »* (2)

Considering the need for permanent relations with those countries and organizations that approve the O.M.V.S. objectives and give financial and technical support for the realization of its programme, the Council of Ministers has, by a resolution of July 4, 1976, established the O.M.V.S. Consultative Committee composed of representatives from Governments and Organizations participating in the realization of the O.M.V.S. programme, and of representatives of the organization.

The presidency and secretariat of this Committee are assumed by the O.M.V.S. High Commission. The Committee's purpose is :

a) To assist the O.M.V.S. High Commission in the investigation of the ways and means to carry out the programme, notably the mobilization of financial and human resources.

b) To promote systematic exchange of information between its members on rules and procedures for fund mobilization and allocation, on project progress, and on prospects of developing cooperation between the O.M.V.S. and the cooperating countries and organizations.

c) To improve conditions and procedures of resource mobilization.

The Committee gives advice and formulates recommandations on those matters submitted to it.

Since its creation, the Committee has held several meetings and the results of these sessions have contributed to implementing the construction of the O.M.V.S. common works.

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(1) The Inter-State Committee for Agricultural Research and Development.
(2) Consultative Committee.

SENEGAL RIVER DEVELOPMENT STUDIES

FIRST attempts at developing the Senegal river Basin date back to more than a century ago and were conducted on an empirical basis. Of note are those of Baron Roger and the nursery specialist Richard but in particular the experiments by Colonel Shult on sugar cane, cotton and indigo at the beginning of the 19th century. However, it was only in the wake of the second world war that the first notions of overall development of the Senegal river appeared. Credit for these undoubtedly goes to Belime, a pioneer in the development of the Niger river and its internal Delta, also author of a report on the mobilization of the Senegal river resources.

The first concrete proposals concerning development of the Senegal river arose from the studies carried out between 1925 and 1930 by the « Union Hydro-Electrique Africaine » (UHEA) (1) and the M.A.S. Yet, it was only in 1963, following a United Nations Mission to study the Senegal river basin, that an integrated approach was adopted for studies on development of the river resources.

Indeed, following this Mission's report, together with financial assistance from the United Nations Development Programme (U.N.D.P.) and technical support from the United Nations Office for Technical Cooperation (O.T.C.) and the United Nations Food and Agriculture Organization (F.A.O.), the Senegal riparian States undertook to execute a series of studies covering all aspects of basin development with a view to integrated development of its resources.

Mineral prospection in the Senegal river Upper Basin

O.M.V.S. experts' working session

With regard to flow regulation and energy production, an inventory was drawn up of dam sites in the Upper Basin and various development assumptions were made.

For each assumption, advantages were compared against cost, primarily with respect to the site's energy production potentials. The full range of possibilities was examined from minimum flow regulation of 100 m3/s up to ultimate flow regulation of 550 m3/s for maximum energy production, or of 700 m3/s for irrigation of maximum superficies. In the latter case, the energy production would be considerably reduced.

As regards agricultural development, the studies permitted on the one hand the preparation of a census of the Basin's cultivable lands, the analysis of land development systems, and of all problems relating to the transition from traditional extensive farming to modern intensive farming, the study of the possible association of agriculture and husbandry, etc... and on the other hand to initiate research into improving crop yields by the introduction of crop varieties and farming techniques which have proved successful in other parts of the world, taking into account the Basin's particular climatic and pedologic conditions. These studies indicated that the possibilities of increasing agricultural production by improving traditional farming were extremely limited and that irrigation remained the only acceptable solution to the Senegal river basin agricultural production problems.

Exhaustive studies also conducted on river navigability conclude that it is possible and necessary to develop river transport in order to unlock a large part of the basin, notably Mali, a non coastal country. To achieve this, it is necessary to regulate riverflow, improve sills and construct ports and places of call.

On the basis of all these studies, the O.E.R.S. took in 1970 the decision for a first stage development of the Senegal river with a flow regulation of 300 m3/s. An optimisation study was conducted towards the end of 1973 demonstrating the programme's feasibility.

However, the disaster caused by the 1972-73 drought had led the O.M.V.S. member States to reformulate their objectives, specifiying that apart from contributing to the région's economic development, the programme should above all safeguard the basin population and environment against climatic risks.

Enrouraged by several financing Sources who expressed their intention to participate in the programme, the O.M.V.S. conducted engineering studies for the major regional infrastructure works.

The Diama dam engineering study financed by France was started in June 1976 and completed in July 1978.

The Manantali dam and navigation channel engineering studies are financed by the Federal Republic of Germany. The Manantali study was started in September 1976 and completed at the beginning of 1979.

The navigation channel study is in progress and should be completed by the end of 1979.

The development of ports and places of call will also be subject to studies to be financed by Canada.

The 1978 Global Evaluation study demonstrated the complementarity of the Diama and the Manantali dams whose simultaneous construction has been decided by the O.M.V.S.

At the same time, support studies are being carried out to provide a better approach to certain problems closely related to river development. The major studies are :

— the study on allocation of the investment and operating costs of the regional infrastructure works between use sectors and between the O.M.V.S. member States. The principle has been adopted of an allocation based on the benefits accruing to each state from river development.

— the study on the impacts of river development on the environment. This study is in process of completion. It particularly evidences the consequences of the creation of a reservoir upstream from Manantali, the construction of an anti-salt barrier downstream, at Diama, and river flow regulation. This affects many fields such as public health, aquafauna, forestry, etc. The study recommends solutions to alleviate the negative effects of river development.

— the survey for the establishment of a first order geodetic network to serve as a basic control for the topographic survey needed for any hydro-agricultural project. Furthermore, orthophotographic maps at a scale of 1/10.000 covering a total surface area of 255,000 hectares distributed between the three countries, as well as a panchromatic and infrared aerial coverage at a scale of 1/50 000 of the part of the Senegal river basin located in the three member States will be available for development studies and planning.

Biological nitrate fertilizer production experiment in Rindiao

Research on rice varieties

These several studies are financed by USAID grants.

— the socio-economic study of the basin was designed to collect and analyse basic demographic, sociological and economic data to be used for the formulation of development policies, global and sectorial planning, and for selection and design of projects in the various sectors. It is financed under the D.T.C.D. (2) regular budget with contributions from U.N. D.P., F.A.C., INSEE (3), ORSTOM (4), USAID and the Italian Government. When completed, it will provide the basis for a system of permanent evaluation of the results obtained.

With regard to industry, a study financed by the F.R.G. and executed by UNIDO will identify those industries that could be established in the Senegal river basin, notably those related to agricultural and animal husbandry development.

These studies have enabled the O.M.V.S. to formulate a coherent programme. The first phase of this programme could be achieved in the 1980s.

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(1) Hydro electric Union of Africa.
(2) UN. Department of Technical Cooperation for Development.
(3) National Statistics and Economic Studies Institute.
(4) Office for Overseas Scientific and Technical Research.

THE SENEGAL RIVER DEVELOPMENT PROGRAMME

DESPITE tremendous potentials in natural resources and availability of skilled labour, the economic growth of the O.M.V.S. member States has not yet been sufficient to secure the populations' standard of living in terms both of stability and of prosperity.

The drought cycle of recent years has further deteriorated an already difficult situation regardless of governments' attempts to check the constraints hindering development of resources.

The Senegal river development should provide a definitive solution to the many problems that, until now, have prevented any real upsurge of the member States' economies.

PRESENT STATE OF DEVELOPMENT IN THE SENEGAL RIVER BASIN

The States have undertaken many development projects in order to improve living conditions of their population and to derive full benefits from the Senegal river basin resources.

A) *Agricultural development*

This concerns the improvement of traditional farming, the introduction of controlled submersion and of intensive irrigation.

a — Yields of rainfed and flood recession crops have not reached satisfactory levels due to their close dependency on rainfall or on river floods. Even in normal years, rainfed crops, which are grown on relatively poor soils, have very low yields. The same applies to flood recession crops. None of the efforts made towards improving agricultural production techniques were successful because of consecutive years of low rainfall and unsufficient floods during the past decade.

b — Controlled submersion is also contingent on the Senegal river floods, which are too short and too highly irregular to permit satisfactory results. Perimeters already developed in the Senegal river valley for controlled submersion farming are either abandoned or progressively converted to perimeters with total water control, so as to compensate for uncertainties of rainfall and floods.

c — The results of irrigation development in the Senegal river valley since 1947 have been extremely encouraging whenever this technique has been correctly applied. However, the extension of this method has been considerably limited due to low flow in the dry season and the intrusion of salt water in the delta and lower valley. Whereas irrigated farming, which requires substantial investments, will only be profitable with intensive exploitation.

B) *Livestock Development*

Marked progress in animal husbandry in the Bassin resulted from improvements in the selection and management of livestock resources and solutions to problems of animal health and water supply with a considerable increase in the size of the herds from 240 000 head of cattle in 1955 to well over 700 000 in 1971-72.

Under current conditions, herds being more and more vulnerable to drought, extensive animal husbandry can hardly develop.

C *Industrial and mining development*

As regards mining, the most advanced feasibility study is that of Falémé iron ore deposits in Senegal. This study has revealed two major constraints in relation with high costs for transport and energy. Whereas the problem of transport costs remain unsolved, a solution to the energy problem could largely be found in the development of the Senegal river.

Due to the very same constraints, the search of financing for the feasibility studies in relation with Malian iron and bauxite deposits encountered difficulties.

With regard to industrial development, the only company now operating in the basin is the « Compagnie Sucrière Séné-

galaise » (1) (C.S.S.) in Richard Toll which exploits some 8 000 ha, of sugar cane partly irrigated by the Senegal river and partly by the Lac de Guiers, the latter being recharged by the Senegal river floods.

Establishment of new industries is mostly dependent on the development of irrigated agriculture and intensive animal husbandry, both contingent upon river flow regulation.

D) *Development of river transport*

In spite of insufficient transport infrastructure in the river region, there has been no development in navigation transport in recent years. On the contrary, a regression has been recorded and since 1962 trafic has been less than 25,000 tons per year. Numerous factors were involved notably the short period of navigability between the river mouth and Kayes, the lack of any direct ocean-river liaison, the non-availability of adequate vessels etc... Malian traffic excepted, increase in transport volumes also largely depends on agricultural development in the Basin be it for import of inputs for intensive agriculture or for export of production surpluses.

From the analysis of development attempts, it appears that two major physical constraints considerably limited efforts towards improvement in the various sectors: uncertain rainfall and irregular river flows in terms of seasonal and inter-annual variations. The consequence was insufficient infrastructure development and massive emigration of the working population that is so essential for any large scale development. Yet the region is rich in resources though they cannot be developed unless such constraints are alleviated.

(1) **Senegalese Sugar Company.**

THE SENEGAL RIVER BASIN RESOURCES

A) *Intensive irrigated agriculture potentials :*

Following an exhaustive pedologic survey, cultivable lands in the Senegal river valley and delta have been estimated at more than 800 000 ha, not taking into account the area between Bakel and Kayes which is presently under survey for the determination of its suitability for irrigation.

At present, the total irrigated area of 22 000 ha is very small compared to productive potentials. If cultivation of this area poses no problem during the flood season or even during the cold dry season when the river flow is approximately of 40 m3/sec in March which allows for irrigation of a maximum of about 33 000 hectares, at the time of low flows however, the irrigable area depends on water discharges in the river and on water reserves built up during the flood, and can vary from a minimum of 400 to a maximum of 4,000 ha. To this area one should add some 8,000 ha irrigable by Lac de Guiers waters during the low flow period.

It will be possible to irrigate a total area of 375,000 ha once regulated river flow of 300 m3/s is achieved and salt intrusion is blocked by the Delta anti-salt dam.

B) *Animal production potentials*

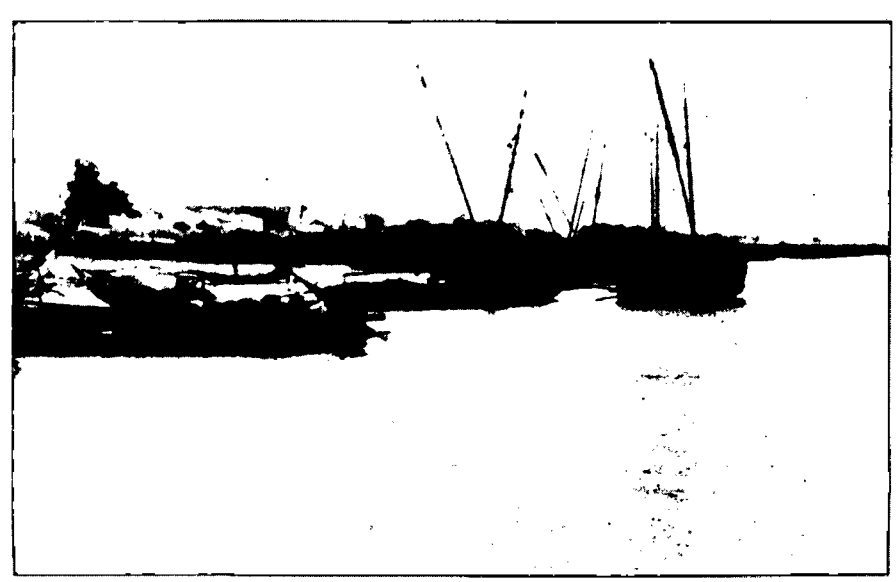
Assessment of animal production potentials should take into account those regions where animal production may be affected by irrigation development in the basin. Prior to the high mortality recorded during recent droughts, notably in 1972-73, livestock amounted to :

Country	*Bovine*	*Ovine-Caprine*
Mali	860 000	1 350 000
Mauritania	1 000 000	2 400 000
Senegal	850 000	1 100 000

Thus approximately one fourth of the three O.M.V.S. member States' bovine stock and one fifth of the ovine-caprine stock are found in the Senegal river basin.

A large part of these herds will be affected by hydro-agricultural developments in the valley either directly in the case of herds stationed near the river, or indirectly in the case of herds transferred from the sahelian zone to ranches inside the irrigated perimeters.

Forage crops on irrigated perimeters in the basin should yield between 3 and 4 billion forage units which is more or less equivalent to forage available during the dry season in the sahelian areas close to the Basin.



Port of Kayes

C) *Power production potentials*

Dam sites on the Senegal river and its tributarie where power production would be possible at lower cost are located in the upper basin either in Mali or in Guinea.

Total production potential amounts to 4,733 million KWh of which 3,384 could be produced in Mali at the following sites :

Manantali	800	million	KWh
Galougo	1,520	«	«
Gourbassi	104	«	«
Small Gouina	560	«	«
Felou	400	«	«

This represents approximately two thirds of the total hydroelectrical potential as estimated from surveys and studies on the three O.M.V.S. countries.

D) *Navigation potentials*

Senegal river traffic development is contingent on improvement of the navigation channel on the one hand and availability of appropriate transport means on the other, two factors which combined should result in very economical transport costs. Following river flow regulation and improvement of the navigation channel, notably clearing of the sills and construction of ports and places of call, it will be possible to use vessels of increasing capacity in order to reach increasingly reduced kilometer-tonne unit costs. Thus river transport is a basic component of river development.

E) *Mining industry potentials*

Ore deposits in the Senegal fiver Basin represent a large percentage of the O.M.V.S. member States identified mineral resources.

The following iron ore deposits have been prospected : in Senegal, the Kenieba and other reserves in the Falémé region, of an estimated 600 million tonnes, with a content of 60-68 % of iron oxides, have been identified. In Mali, between Kayes and Koulikoro, three is an iron deposit of over 2 billions tonnes out of which 500 million tonnes of easily exploitable good quality mineral ore concentrated in the Senegal river basin, have already been subject to extensive prospections.

In that same region in Mali, easily exploitable bauxite deposits of high alumina content (over 40 %) have been evaluated at more than 800 million tonnes of mineral ores.

In Mauritania, exploratory surveys revealed the presence at Cive, near Kaedi, of phosphate deposits of over 4 million tonnes with a tricalcic phosphate content of 50 to 70 %.

To a large extent, the mining of these ores is dependent on the availability of low cost power and transport, a condition that can only be met through the development of the Senegal river Basin.

F) *Forestry potentials*

In the Upper Basin, the Sudano-Guinean zone and the Sudanese zone offer the highest forestry potentials, with « woodland parks » — a bush or forest-type savannah — that could produce several million cubic meters of wood per year. However, optimal production can be achieved only through sound management practices, in particular bush-fire control and judicious reforestation measures. In the Valley and the Delta, forest resources consist mainly of firewood and of Gonakie fruits and bark for tanning. Gonakie forest superficies will be significantly reduced following river flow regulation and hydro-agricultural developments; an area of 30 000 ha or 50 % of the total superficies could be lost. In spite of this loss, rational exploitation of the remaining area should yield annually some 300 000 m3 of firewood. In that same region, an estimated 20 000 ha area could be replanted with Gonakie trees and pro-

Irrigated rice field

b) Limited diversification of exports : exports from the OMVS countries remain limited to only few products and trading partners ; thus, their economies are highly vulnerable to world price fluctuations and to changes in their partners' economic situation.

For instance, 80 % of the total 1971 exports of Mali consisted of cotton, livestock, groundnut and by-products, dried and smoked fish. Inter-regional exchanges between African countries increased only from 12 % in 1960 to 19 % in 1970.

In Mauritania, the MIFERMA, the only company that mines iron ore, produced 62 % of the 1972 exports.

In Senegal also, one single product, the groundnut, represents 60 % of the agricultural sector added value and more than 70 % of exports in the 1960 to 1970 period. The drop since 1967 in groundnut prices caused by a reduction in price support by France and the European Economic Community, resulted in an abrupt decline in production.

Unfavourable terms of exchange and dependency on a limited range of products are the true reason for insufficient domestic capital formation. Under these conditions economic growth is highly dependent on external capital in-flow which can be as much as 43 % for Senegal (1969-73 Plan). 75 % for Mauritania (1970-73 Plan) and 78 % for Mali.

c) Landlocked regions : development of the Eastern regions of the coastal countries and development of Mali is hampered by insufficient transport infrastructures, be it for local services, inter-regional exchanges and external exchanges. The situation is aggravated by transport costs which increase as distance from the coast increases.

d) High power costs have prevented development of a large demand. Further, the limited market for power has caused hydro-electrical resources not to be exploited.

Due to the energy crisis, to price increases and above all to possible oil shortages, accelerated development of the region hydro-electric resources becomes all the more urgent and justified.

D) *To accelerate economic development of the Member Countries through intensive regional cooperation.*

Development of common interests and establishment of interdependency links by developing the Senegal river should help promote inter-state cooperation through the development of regional exchanges, the acquisition of regional specialisations and the institutional reinforcement of cooperation within the O.M.V.S.

SHORT AND MEDIUM TERM PROGRAMME

To achieve the objectives thus determined, the O.M.V.S. member States have decided to implement a short and mid-term programme consisting in the establishment of regional infrastructure for flow regulation, anti-salt protection, transport and power production, which is needed to make available the basic resources of the first stage of integrated development. It also consists in setting up national structures for the accelerated development of the resources thus available on each state's national territory.

A) *Regional infrastructure programme*

This programme has been designed for the purpose of simultaneous development of the three major water use sectors once river flow is regulated : irrigation, navigation and hydroelectric power production.

To achieve this triple purpose, the Council of Ministers reaffirmed in July 1972, by resolution N° 1/72/CM.S.D., that the first stage of the Senegal river basin integrated development be based on a river flow regulation at a minimum 300 m3/s.

The overall infrastructure needed for the three use sectors should include :

— *a regulating dam :* the Manantali site has been selected for construction of this key work, since it meets all first stage integrated development requirements : sufficient water storage to ensure a 300 m3/s river flow regulation and to produce relatively high quantity of energy, 800 million KWh firm energy per year.

Factory construction in the Senegal river Delta

Cattle breeding in the Senegal river Valley

— an *anti-salt dam :* the Diama site has been selected for its construction notably because of its geographical location, which permits the development of a maximum area in the river delta.

— the construction of *ports and places of call* between the river mouth in Senegal and the town of Kayes in Mali : the Saint-Louis ocean river port will permit direct ocean-river link ; the Kayes river port will connect river and rail transport for destination inside Mali ; the places of call along the river will facilitate unlocking of the basin region.

— *river sill improvement* to give passage to vessels of sufficient capacity so that the river becomes an economic and efficient means of communication.

Construction and operation of these regional infrastructure works should result in :

— river flow regulated at 300 m3/s released from the Manantali reservoir which alone would permit irrigation of 255 000 ha of land in the valley, whereas the Diama impoundment at a water level of 1.5 I.G.N. will supply water to an area of about 42 000 ha. The combined action of the two dams wi'l increase irrigable superficies to 375 000 ha or an increase in the order of 25 % as compared to the capacity of each dam taken separately. Recharge of Lac de Guiers (in Senegal), Lac R'kiz and the Aftout es Sahel depression (in Mauritania) will be guaranteed.

— sill improvement and construction of port facilities combined with flow regulation will permit year round river navigation for vessels with a minimum draught of 1.5 m.

— the Manantali reservoir will permit production of 800 million KWh/year guaranteed at 90 %, this quantity is sufficient for the initial phase of industrial and mining development in the basin.As an indication, this energy should be sufficient for processing 10 millions tons of iron ore (MIFERSO project) or for producing some 50 000 tons of aluminium.

— the subsequent development of two downstream hydroelectric sites would double the Manantali dam capacity.

— flood abatement will ensure protection against flood for towns and farms downstream of Bafoulabé.

— during a transition period, pending sufficient irrigation development, the Matantali reservoir will permit the release of a 2 500 m3/s artificial flood during 30 days in August and September for flood recession crops, thereby ensuring modest yet sufficiently stable revenues for the population dependent on this traditional farming.

These regional infrastructure works represent only the first part of the Senegal river basin integrated development efforts, the second consisting of sectorial activities designed to exploit the resources made available by the regional infrastructure.

B) *Sectorial development*

Several actions have to be carried out simultaneously with a view to the integrated development of the various sectors of the three countries' economies.

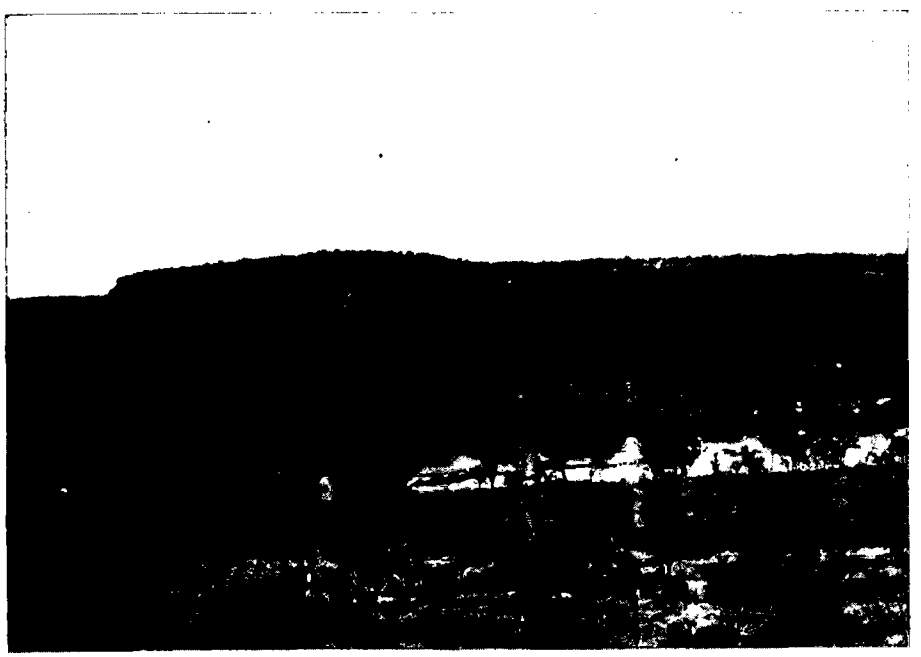
a) In the agricultural sector, two actions should be undertaken in parallel : on one hand the setting up of all technical, institutional and financial means required for or permitting attainment of the target average devellopment rate of 5 000 ha/ year, and on other hand, the

formulation of methodologies for the transfer of agricultural techniques in order to achieve high yields and crop diversification. Each State has established at the national level a structure responsible for the satisfactory performance of this task, they are : the « Operation Vallée du Sénégal, Terekole, Magui » (O.V.S.T.M.) in Mali, the « Société Nationale de Développement Rural » (1) (SONADER) in Mauritania and the « Société d'Aménagement et d'Exploitation du Delta » (2) (S.A.E.D.) in Senegal. Whereas agronomic research, which has the objective of improving agricultural technology and of adapting high yielding varieties, is the responsibility of national structures which receive regional technical support from the O.M.V.S.

b) In the animal production sector, the objective is for technical progress in the field of agriculture to also benefit animal husbandry in the basin and neighbouring areas by promoting close association between these two branches of activity, notably through implementation in the Valley of intensive livestock breeding, utilizing crop products and by-products and the supply during the dry season of animal feed supplement to cattle ranching in the sahelian zone.

c) In the forestry sector, actions are to be carried out in different areas. In the valley, the issue is mainly to compensate the loss of Gonakie forest land following hydro-agricultural development or the cessation of flooding. To this end, one should envisage planting of Gonakie trees, inside or outside the perimeters, in the low lands not fit for cultivation, afforestation of « dieri » lands adjacent to the Valley and establishment of wind-breaks on the perimeters. On the dry sahelian lands extending from both sides of the Valley, it is necessary to implement a fire-fighting system, to check overgrazing in order to protect and later to regenerate the vegetative cover. In the Upper Basin, emphasis will be on erosion control and soil conservation, forest protection and regeneration, and the establishment of artificial forests.

d) In the mining sector, actions will mainly consist in accelerating ongoing feasibility studies and initiating additional studies on ore deposits in view of further feasibility studies. Power produced at Manantali as well as its low cost should be one of the factors that will determine future development of mining in the river region.



Dam site prospection in the Senegal river Upper Basin

e) In the industrial sector, impulse to development will be the implementation of agro-industries : rice mills, sugar refineries, tomato concentrate canneries, etc..., which will be dependent on industrial crop development. As regards other industries, with the exclusion of the Diamou (Kayes) cement factory, the issue will be chiefly to initiate feasibility studies, taking into account availability of cheap energy, year-round river navigability, and development of intensive agriculture and of animal husbandry in the region. Development rates will be consistent with those of the other sectors.

f) In the transport sector, before flow regulation, river trafic should be so organized as to reach a transport capacity sufficient for the conveyance of the sizable production surpluses generated by the shift to double cropping on all lands developed and previously cultivated under a single cropping system.

g) In the public health sector, the fundamental task will be the setting up of the means to control any extension of endemic diseases.

C) *Programme profitability*

Although it should be stressed that the realization of the regional infrastructure programme is a pre-investment operation since it is a pre-requisite to any other development project in the basin, nevertheless overall programme profitability has been subject to exhaustive studies. Profitability varies according to a number of factors, the most important being thermal energy cost and river trafic assumption, in particular those on the existence or non-existence of mineral trafic. Under the least favourable assumption, rate of return is estimated at 7.93 % whereas the most favourable assumption yield a rate of return of 12.78 %. Actual return will most certaintly be at a rate between these two extremes, and therefore may be considered as highly acceptable, in particular if one considers that this programme will extend over a 40 or 50-year period.

However it is essentially the O.M.V.S. long term objectives that have induced financing sources to participate in the realization of the programme.

(1) National Rural Development Corporation
(2) Delta Development and Exploitation Corporation

FINANCING OF THE PROGRAMME

THE O.M.V.S. has obtained considerable support from friend countries and from financial institutions for the financing of its programme, both for studies and construction of works.

STUDIES

Financing of the studies is secured mainly by grants from friend countries, international financial institutions and also by the Organisation's annual operating budget, fully funded by the member-States.

Preliminary feasibility studies were conducted between 1964 and 1974, at a total cost of about 12 millions US dollars. This cost has been mainly covered by funds from the United Nations Development Programme and some bilateral aid agencies.

The engineering studies for regional infrastructure works are financed by grants from the following sources :

— Diama study France
— Manantali study West Germany
— Navigation study West Germany
— Study of ports and places of calls Canada

With respect to general support studies, they are financed by grants from bilateral aid and and from United Nations and UNDP. They concern agronomic research project (U.N.D.P., U.S. A.I.D.), socio-economic study (United Nations, Italy, France's Aid and Cooperation Fund), environmental study (U.S.A.I.D.), geodetic surveys and mapping of the Valley and the Delta (U.S. A.I.D.), various technical studies and institutional support (U.N. D.P., U.S.A.I.D., Great Britain).

Globa financing for the studies exceeds 40 million US dollars.

Meeting of O.M.V.S. projects' co-financiers - Consultative Committee

WORKS

The realization of the major infrastructure works, namely the dams, port facilities and navigation channel development requires considerable financing under the exceptionally favourable terms of aid to development : very long repayment time with a grace period and low interest rates.

The financing sources reacted very encouragingly to the O.M. V.S. request for their participation in the realization of the programme.

Following the second meeting of the O.M.V.S. Consultative Committee, held in Dakar in mid-October 1978, and several missions of O.M.V.S. officials, sometimes at the highest level, sums committed by the financing sources up to the beginning of the third quarter of 1979 amount to 493.5 million US dollars. This financing is intended for priority allocation to the construction of the dams, and has been obtained from :

Financing sources	*Million US dollars*
Abu Dhabi	50
Saudi Arabia	100
Islamic Development Bank	20
Canada	8.5
France	56
Iran	4
Italy	24
Kuwait	68 (1)
Federal Republic of Germany	92
African Development Bank (African Development Fund & Nigerian Trust Fund)	52
European Development Fund	19 (2)
Total	493.5

To this are to be added increases of firm contributions and contributions from financing sources who have pledged support to the OMVS but have not yet given any indication as to the sum they will contribute. To be mentioned are : the United States of America, Qatar, the Arab Bank for Economic Development in Africa (BADEA) and the European Economic Community (5th E.D.F.).

The total sum of firm commitments and of pledges by sources which have not specified the amount of their contribution, enabled the O.M.V.S. to undertake procedures required for the construction of the initial works.

Due to the extremely high costs of the dams, estimated at some 800 million US dollars when taking into account price increase during the construction phase, the O.M.V.S. had to adopt a construction programme by instalments, although remaining in full compliance with overall objectives set forth.

Available financing permits construction of the following first instalment of the works to commence immediately :

— construction of the Diama dam composed of a spillway, a lock, closing and stop dikes, and an access road. The following components are postponed : restoration of the left bank dike, construction of the right bank dike, construction of the Saint-Louis - Nouakchott road link which will cross the river on the dam and entail surfacing the access track linking Saint Louis to Diama.

— construction of the Manantali dam consisting of the dam, of deforestation works, of resettlement of population uprooted by the reservoir, of construction of the access road and of improvement of the Dakar - Mahina railway. Construction and equipment of the hydro-electric power plant as well as establishment of high tension transmission lines and stations will be undertaken according to energy requirements and financing availability.

(1) Kuwait's total contribution amounts to 75 million US dollars of which 7 million are allocated to navigation projects.

(2) Or 15 million account units under the 4th EDF.

With the forthcoming implementation of the Diama and Manantali dam construction, the O.M.V.S. has carried through the wager of starting a process of integrated development of the Senegal river basin resources, as initially designed, to achieve the major long term objectives set forth by the three States.

This result was obtained by combining three basic factors :

1) *Strict planning of the O.M.V.S. and member States' actions.* It took ten years for the studies started in 1963 under the auspices of the Inter-State Committee to arrive at the definitive programme for the first phase of Senegal river development. Included in this programme, in addition to regional infrastructure projects, are all actions to be undertaken at a national level with a view to developing the resources made available through river flow regulation.

2) *Close cooperation between the O.M.V.S. member States.* It is by means of such cooperation that the O.M.V.S. has been able to overcome all obstacles to integrated development of the Senegal river basin. In this respect, one should mention as evidence of the will of the States to surpass themselves for the well being of their people, the basic conventions on which this cooperation rests.

3) *International solidarity.* During the drought cycles which have devastated the Sahelian countries, solidarity has expressed itself in the form of substantial food aid, enabling the populations to survive the crisis until harvest time. In order to help the O.M.V.S. find a final solution to problems created by the various physical and economic constraints, countries and financial institutions that had already offered substantial assistance to the O.M.V.S. countries, decided to lend their support for the realization of this ambitious programme that should result in a drastic transformation of the Senegal river basin, thus exploiting nature to man's best advantage.

DIAMA DAM

ANALYTIC DATA SHEET

I – DAM SITE

The site selected for construction of the Diama dam is located in the delta next to the village of Diama, 23 km upstream from Saint-Louis, near the river mouth, spanning the territories of Mauritania and Senegal.

II – PROJECT OBJECTIVES

During the months of low river flow, seawater intrudes up the river bed and reaches sometimes as far as Dagana, 200 km upstream from the river mouth, depriving the riparian population and agricultural perimeters of the soft water supply needed for human consumption and for perimeter operation. Thus the dam has the following threefold objective :

— to prevent seawater intrusion and to protect either existing or projected headworks for water supply and irrigation ;

— to provide a water impoundment permitting double cropping on about 42 000 hectares with a water storage level of + 1.5 I.G.N. and 100 000 hectares at elevation + 2.5 IGN.

— to improve recharge of lake de Guiers (Senegal), lake R'Kiz and the Aftout es Sahel depression ,Mauritania).

The dam anti-salt function will further permit full use for irrigation downstream of Demet of the 100 m3/sec. flow regulated from Manantali and required for the particular purpose of navigation by the Demet sill, the most downstream of the difficult sil's. With the combined operation of the two Diama and Manantali dams, irrigable superficies in the Valley and Delta will be appreciably increased from a 297 000 ha area (Manantali : 255 000 ha ; Diama : 42 000 ha) to a 375 000 ha area, that is an additional 25 %.

III – TECHNICAL CHARACTERITICS

The design of the main work is that of an adjustable dam that moves during the flood period to ensure normal discharge of the river waters and that closes at the time of low flows to prevent intrusion of salt water and to impound soft water.

The dam is composed of the following elements :

— *a flood spillway :* this concrete structure consists of seven bays 20 meters wide, equipped with radial gates operating vertically, permitting the projected water storage at elevation + 1.50 I.G.N. durring the first phase and 2.50 I.G.N. during the second phase and giving passage to the 100-year flood.

— *lock :* the 175 m x 13 m navigation lock will be directly adjacent to the dam and will give passage to vessels and barge convoys.

— *dikes :* additional structures to the dam will be a closing dike, a stop dike and embankments on the right bank (to be constructed) and on the left bank (already existing). Embankments on both sides of the river permit the creation of the water reserve and protection of the major bed against flooding.

At an operating level of + 1.50 I.G..N, the Diama reservoir will impound 250 hm3 and will cover a total area of some 236 km2. The zone of influence of the dam extends up to Demet, at approximately 400 km upstream from Saint-Louis.

— *Roads :* an access road will connect Saint-Louis to Diama during the construction period and is to be ultimately used for dam operation purposes. A road link between Saint-Louis and Nouakchott is also projected ; it will cross the river over the dam and will be partly constructed on the right bank dike.

IV – PROJECT PROGRESS

Construction studies, financed by France (FAC), were awarded in June 1976 to a group of French Consulting Engineers, composed of SOGREAH, COYNE et BELLIER, BCEOM.

Prequalification of construction contractors was carried out between April and July 1978. Invitation to bid was published at the end of November 1978. A visit by the contractors to the site was organized at the end of the first fortnight of January 1979. Submission of proposals and opening of the bids were carried out on April 2, 1972, and bid evaluation was completed at the end of June. The foundation stone could be laid in November 1979. Construction work is scheduled to start in December 1979.

The dam could be filled in 1985 or 1986.

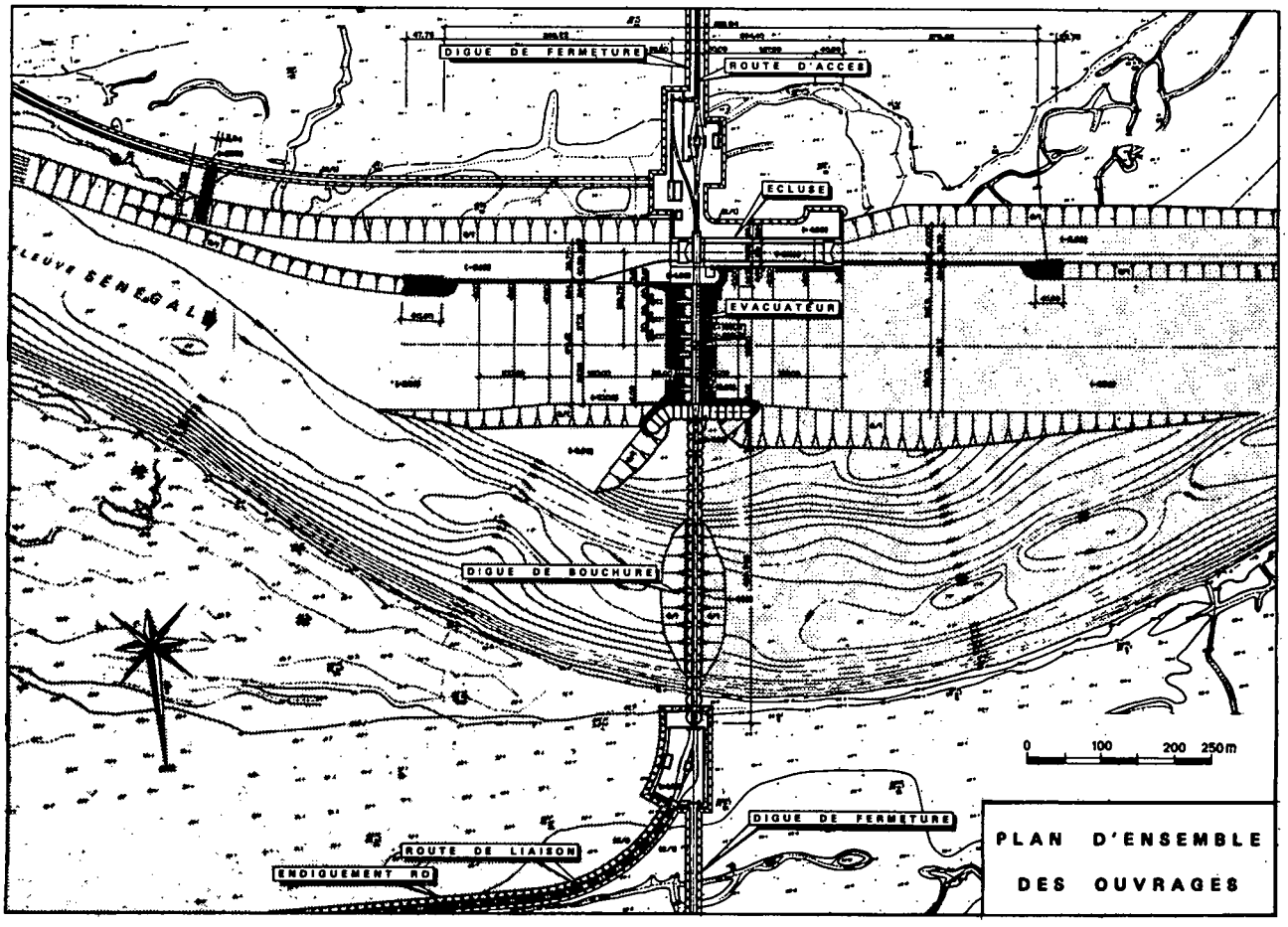
V – FINANCING OF THE WORK

First instalment works are divided into six lots of a total cost of 132,569,000 US dollars at 1979 economic conditions.

V – FINANCING OF THE WORK

LOTS	First instalment of works	Costs (1979 price base) 1 000 US $
1	Civil engineering of dam, lock and stop-dike	94.394
2	Closing dikes	1.129
3	Access track and buildings	8.230
4	Supplementary headworks	3.401
5	Electrical and hydraulic equipment	13.394
6	Studies, supervision and administration	12.021
	TOTAL	132.569

General plan of Diama dam works



MANANTALI DAM
ANALYTIC DATA SHEET

I – DAM SITE

The Manantali dam site is on the Bafing river, one of the major tributaries of the Senegal river and is located 90 km South-East from Bafoulabe, in the Republic of Mali.

II – PROJECT OBJECTIVES

Exhaustive studies conducted by the OMVS have shown that in order to achieve the fundamental objectives of integrated development of the Senegal river basin resources, a regulated 300 m3/sec. river flow should be secured from the start.

The Manatali dam, as it has been designed, is the work that best meets this prerequisite. Its construction will satisfy the following multiple purposes :

- — irrigation of 255 000 ha of land in the valley ;
- — year round navigability of the Senegal river between Saint-Louis and Kayes, by securing a 100 m3/sec. flow that could be recovered in the river mouth area for the irrigation of an additional 120 000 ha ;
- — a firm 800 GWh/year electric power generation ;
- — the development at a later date of two downstream hydro-electric production sites that would double the capacity of the Manantaly plant ;
- — abatment of the crest in order to reduce sufficiently the 1 000 year and 100 year flood to respectively the present 100 year and 10 year flood crests, and thus ensure protection of the population centres and of the crops cultivated in the valley, and to reduce the cost of the embankments ;
- — the supply during a transition period of a 200 m3/sec. regulated flow and the release for one month in August - September of a 2.500 m3/sec. artificial flood to maintain optimal conditions for traditional flood recession farming, pending expansion of irrigated agriculture throughout the Senegal river valley.

III – TECHNICAL CHARACTERITICS

Dam : it is a dam of the combined type (flow regulation and hydro-electric power production) composed of a concrete structure in its middle part that houses all surfaces hydraulic structures, and of two lateral rock-filled dikes.

— length of the concrete structure	492.8 meters
— length of the rockfilled dikes	992.0 »
— maximum height above foundations	65 »
— normal water storage level	208.0 meters IGN
— water level corresponding to the 1.000 year flood	310.5 » »
— crest elevation	212.5 » »
— storage volume	11 billion m3

— flood spillway : eight (8) 9 meter wide bays equipped with radial gates

— penstocks : seven (7) 3.8 m x 4.8 bays equipped with radial gates.

— headworks : five 14 m x 15.4 m extended by five conduits of a 4.8 m diameter.

Power plant : The power plant will be constructed at the foot of the concrete dam buttresses.

a) *Turbines*

— design capacity	40 MW
— maximum discharge	113 m3/s
— normal head	40 to 53 m
— rotation velocity	150 r.p.m. ; 50 HZ
— diameter of runner	3.80 m

b) *Generators*

— unit capacity	46 MVA
— rotation velocity	150 r.p.m. 50 HZ 20 pairs — 6 poles
— normal voltage	13 800 volts
— annual power production	
● firm :	800 GWh
● marginal :	150 to 200 GWh.

c) *Transformers*

— capacity	46 M/A
— length	6,5 meters
— width	4,5 »
— height	6,0 »

As regards power stations and lines, the development at a later date of a high tension network will depend upon the utilization of power produced. The station is to be equipped with four transformer output connections with the possibility of adding a fifth connection. Potential users of the power produced are the Faleme iron mines, the Balea bauxite mines, the towns of Bamako, Kayes, etc...

Access road

This 90 km long access road will link the Dakar-Mahinanding railway and the dam site. Starting from the village of Mahinanding it ends at the site on the right bank dowstream of the dam.

IV – PROJECT PROGRESS

Engineering studies and invitation to bid documents for the construction of the dam have been financed by the Federal Republic of Germany and executed by a group of Consulting Engineers composed of the following firms :

— RHEIN-RUHR, German, sponsor ;

— TRACTIONNEL - STUCKY, Belgian ;

— SOCIETE SENEGALAISE D'ETUDES ET DE DEVELOPPEMENT (SONED), Senegalese.

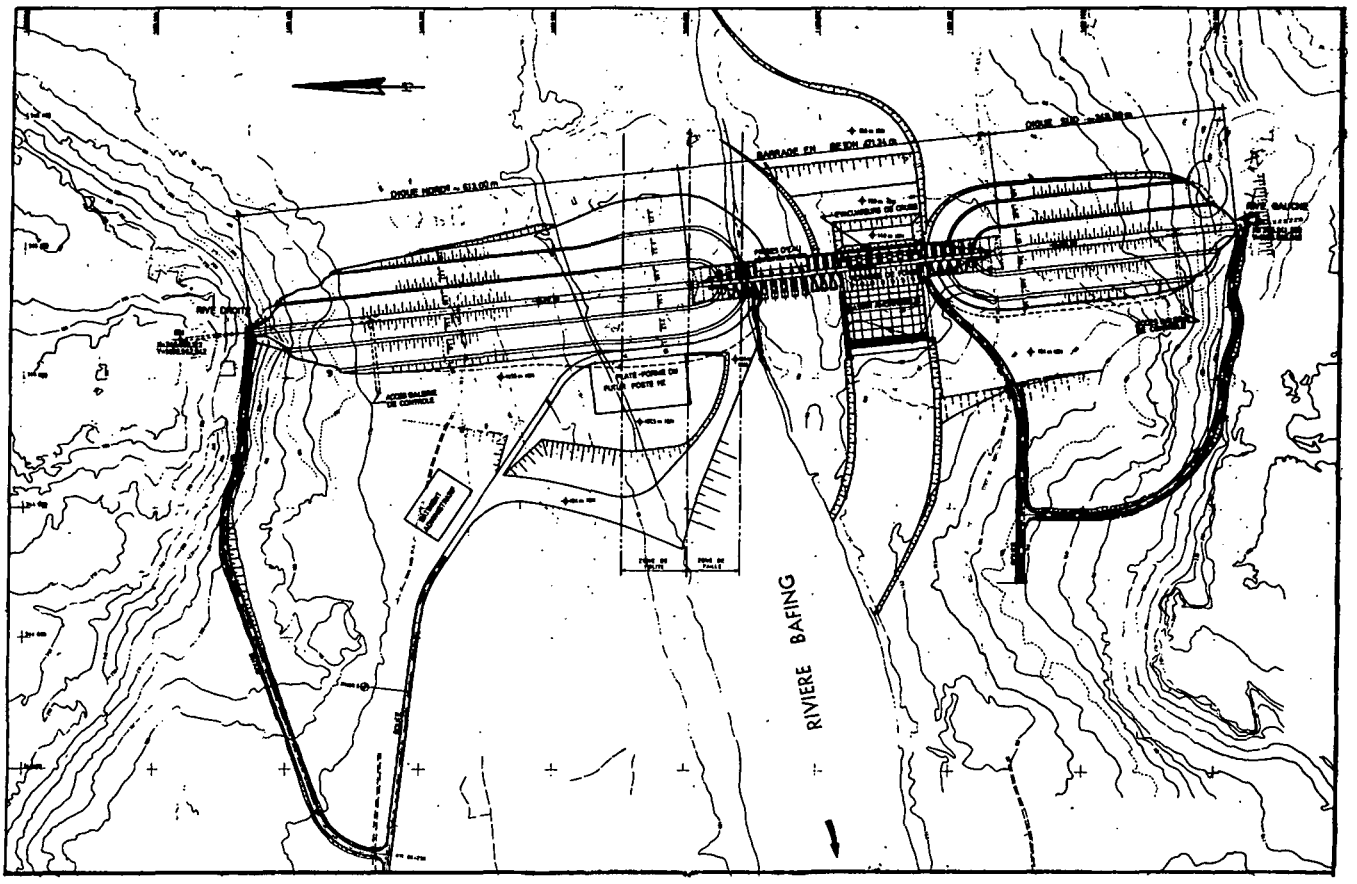
Prequalification of contractors is completed. Invitations to bid could be issued in December 1979. Tenders would be submitted six months later. Dam construction works to be executed in stages will commence during the first quarter of 1981. The reservoir should be filled at the latest in 1986.

V – FINANCING OF THE WORK

The first stage works are divided into seven lots at a global cost of 463,411 million US dollars at 1979 economic condition.

Lots	First instalment of works	Costs 1 000 US $ (1979 price base)
1	Civil engineering of dam at 208 m elevation	371 308
3	Hydraulic equipment	27 416
8	Access road	15 707
9	Population resettlement	8 248
10	Deforestation	4 821
11	Studies, works supervision and control	23 818
12	Railway	12 092
	TOTAL	463 411

Manantali dam scale model



General plan of Manantali dam works

SENEGAL RIVER DEVELOPMENT FOR NAVIGATION

ANALYTIC DATA SHEET

I – LOCATION

The Senegal river navigable chanel extends from the mouth at Saint-Louis to Kayes in Mali, a distance of 948 km.

II – PROJECT OBJECTIVES AND TECHNICAL CHARACTERITICS

Development of the Senegal river region through the introduction of modern farming, the establishment of agro-industries and mining possibilities opens up broad prospects for utilisation of the river as a means of communication and thus renders imperative its development for navigation purposes.

Regulated river flow of 300 m3/s at Bakel due to the Manantali dam will improve the water depth available on the restrictive sills. However, in order to obtain year-round navigation for vessels and convoys with economically acceptable draughts, excavation and correction work will have to be carried out. This work will consist in either rock removing or dredging of sills according to the case, and stabilising the navigation channel by free flow corrections.

The unavoidable corollary of navigation channel improvement is its maintenance and even further improvement and also the establishment of a suitable beacon system. To this end a Waterway Directorate will be set up and equipped, responsible for :

- — setting up and maintaining a beacon system and cleaning the river bed ;
- — maintenance and excavation dredging ;
- — topographic, bathymetric and hydrographic studies ;
- — waterway user information service ;
- — navigation inspection and waterway police ;
- — equipment supply and maintenance.

Navigation infrastructure construction naturally results in the need for rational and efficient organisation of its exploitation. An Inter-State Navigation Company on the Senegal river is thus planned, equipped with a fleet adapted to the river nautical features and including :

- — ocean-river link vessels to ensure cabotage between the ports of Dakar, Nouakchott, Nouadhibou and the Senegal river ;
- — river tramps or power barges for transport between Saint-Louis, the various places of call and Kayes ;
- — passenger vessels.

III – PROJECT PROGRESS

The engineering study contract financed by the Federal Republic of Germany was awarded in April 1977 by the OMVS to the Consulting Engineer Consortium comprising two German firms LACKNER and PARTNER and DORSH - CONSUL and the Swiss Company ELECTROWATT.

Studies commenced in May 1977 for an initial 27 month-period. The first phase study series concerns :

- — the general study on Senegal river basin traffic,
- — the definition of navigation channel development works,
- — the study on a beacon system and its equipment,
- — the project economic evaluation.

The phase I General Report was submitted in February 1979. The completed study with the invitation to bid dossier should be available at the latest at the beginning of 1980.

Studies completed have indicated that :

- — foreseeable transport development on the Senegal river could reach the following volumes, according to the different time perspectives.

Type of traffic	RIVER TRAFFIC IN 1.000 t./an			
	1985	*1990*	*2000*	*2025*
Miscellaneous goods	450	620	1 600	5 300
Hydrocarbons	135	210	460	1 800
Phosphate	—	800	—	—
Alumina		1 200	1 200	1 200
Iron ores				
- pellets	—	5 000	5 000	5 000
- or ores	—	10 000	10 000	10 000

— Improvement of the navigation channel to a 1.90 m reference water depth and 55 m width will provide passage with possibility of two-way traffic for push barge convoys that can be as long as 165 m and as wide as 11.40 m with a draught of 1.50 m during 8 months and 2.00 m during 4 months of the year. Loading capacity of these convoys will be of the order of 2,600 T.

— According to cargoes, transport cost price will vary from 7.20 CFA F./kmT to 4,60 CFA F./kmT for miscellaneous goods and hydro-carbons. This cost could be as low as 2.65 CFA F/kmT for the transport of heavy cargo.

— at a reference water depth of 1.90 m during the transition phase, overall investment for improvement of the navigation channel, for installation and equipment of the Waterway Directorate, for establishment, equipment and vessel purchase of the Interstate Navigation Company will be of the order of 37 billion CFA F for traffic consisting solely of miscellaneous goods and hydrocarbons. Transport of phosphate would require an additional 3.5 billion CFA F.

— Project economic evaluation for the period 1982-2025 indicates an internal rate of return ranging from 13 % for the transport of miscellaneous goods and hydrocarbons to 17 % if the transport of phosphate is included.

Direct benefits of a minimum 4 billion CFA F at the start of river transport and as high as 70 billion CFA F in 2025 are expected due to transport costs savings.

Cargo-boat on the Senegal river

Indirect benefits accruing from the project to the three member countries' national economies concern :

- an estimated added value of 6 billion CFA F in 1985 and 77 billion in 2025.
- improvement in the balance of payments through the reduction of annual payments in hard currencies as a result of the project. Such savings will be significant after the 1986-90 period and could be as high as 12.5 billion CFA F during the period 2000 to 2025.
- the direct and indirect creation of some 7400 new employments around 1985, a figure which could increase to 31 000 in 2025.
- promotion of economic development in the three OMVS countries and unlocking of Mali and of the Eastern regions of Senegal and Mauritania.

V – FINANCING OF THE WORK

This financing is to be sought from outside sources. Some financing sources have already expressed their interest in the project ; however, pledges announced are far from covering overall financing requirements.

PORTS AND PLACES OF CALL

ANALYTIC DATA SHEET

I – GENERAL

Construction of the Diama and Manantali dam will permit unprecedented development of the Senegal river basin and neighbouring regions.

Such development will generate considerable traffic, estimated by the Senegal river improvement study at 540 000 T/year by 1985 for miscellaneous goods and hydro-carbons and that could reach 2 million tonnes by the end of the century.

An additional traffic of 800 000 T/year of phosphate and eventually of 1 200 000 T/year of alumina and 5 000 000 T/year of iron pellets may be expected.

II – PROJECT PURPOSE

For the trans-shipment of these goods, the construction or the improvement and equipment of the following is envisaged :

— an ocean-river port at Saint-Louis in the Senegal river estuary,
— a river port at Kayes in Mali,
— some 10 places of call between Saint-Louis and Kayes.

III – PROJECT PROGRESS

Engineering studies for these projects which are to be financed by subventions from the government of Canada, will be awarded to a Consortium of Consulting Engineers.

The objectives of these studies are :

— to develop a master plan for the ports of Saint-Louis and Kayes and for the places of call, taking into account trafic requirement, projections of the study on Senegal river development for navigation.

— to conduct for all port and place of call facilities a study on organisation, management and operation, on infrastructure capacity, equipment and manpower (senior and other staff) requirements.

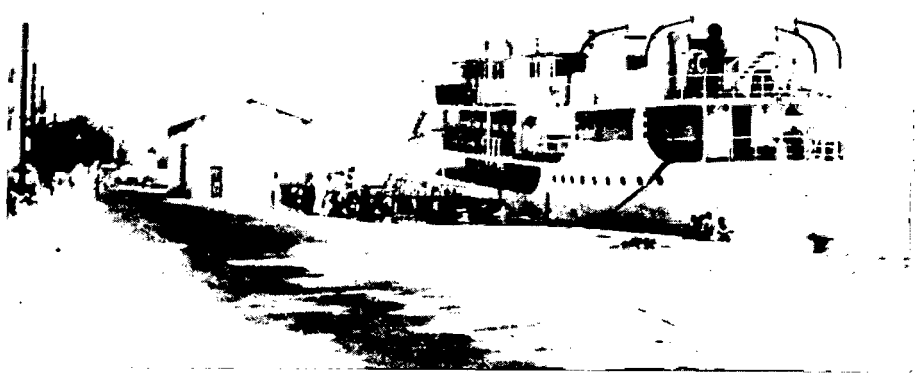
— to evaluate the construction cost of facilities proposed in the master plans as well as operating and maintenance costs.

— to identify first stage installations among those proposed in the master plans.

These engineering studies that could be initiated in the spring of 1980 for an approximate 30 month period will prepare invitation to bid dossiers for all the structures and works selected for immediate execution.

IV – FINANCING

Project cost will be known with sufficient approximation at the end of the engineering studies. Its financing will be sought from outside bilateral and multilateral sources, some of which have already expressed their interest.



Port of Saint-Louis

Irrigated maize field.

OFFSET - G.I.A. - DAKAR