PERMANENT INTERSTATE
COMMITTEE FOR DROUGHT
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CLUB DU SAHEL/CILSS

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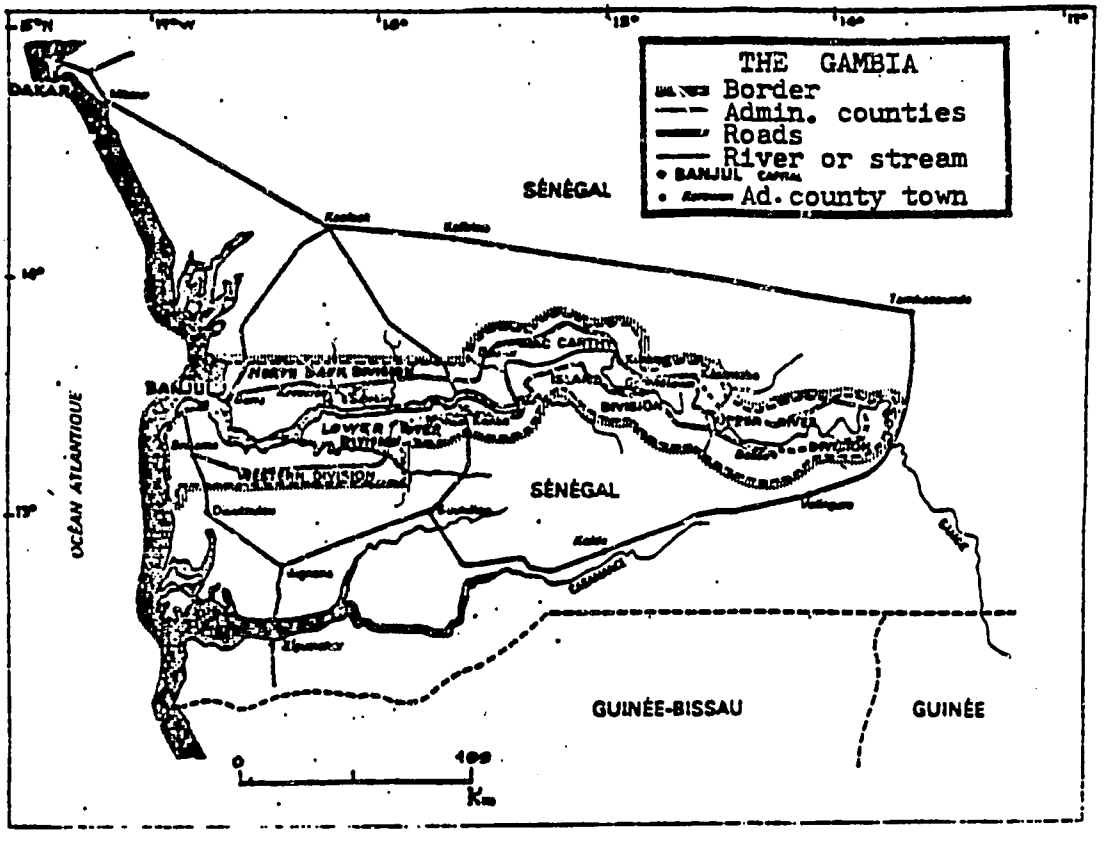
REPUBLIC OF GAMBIA



# DEVELOPMENT OF IRRIGATED AGRICULTURE IN GAMBIA:

## GENERAL OVERVIEW AND PROSPECTS,

## - PROPOSALS FOR A SECOND PROGRAMME 1980-1985 -




October 1979

CROP PRODUCTION TEAM

IRRIGATED FARMING

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# DEVELOPMENT OF IRRIGATED FARMING IN GAMBIA :

## GENERAL OVERVIEW AND PROSPECTS,
## - PROPOSALS FOR A SECOND PROGRAMME, 1980 - 1985 -

OCTOBER 1979

Report by :

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CLUB DU SAHEL/CILSS

GAMBIA

Irrigated Farming

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## FOREWORD

At the third Club du Sahel Conference held in Amsterdam in November 1978, the meeting stressed that the main objective of the development strategy for the Sahel is the increase in crop production. The 1979 working calendar gives priority to first generation rainfed and irrigated farming projects. The Conference emphasized the need to prepare a second generation programme for irrigated farming projects in 1979.

A mission of experts of the Club du Sahel (FAC, USAID) and of the CILSS travelled to Gambia on July 28th and stayed until August 2nd 1979. Their purpose was to examine the present status of irrigation and of irrigated farming projects in Gambia with national officials, to draft an appraisal of the first CILSS programme, analyse prospects and finally, compile the necessary materials and data for the design of a second programme covering the period 1980-85.

To be more specific, the mission attempted :

- To analyse the main problems encountered in the light of experience gained on existing perimeters and to reveal the constraints which are slowing down the development of irrigation, at farmers' level, at the level of management of perimeters and at national level ;

- to make concrete proposals to abolish these constraints or bridge the gaps hampering the implementation of a true irrigation policy.

- to identify studies and projects which are available or underway.

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- to gather all elements of information allowing a set of new projects to be identified, given the general planning work which has already been undertaken by the CILSS (in particular, the reports of the working group on "Irrigated Farming") and by national Departments (multi-annual plans). In addition to projects already available or under study, these new projects will form the second generation programme, provided that the national authorities agree ;

- to specify the needs for executives at all levels (managers, accountants, agronomic engineers, various technicians, advisors, etc) required by this programme and define the corresponding training measures ;

- to draft the chronological sequence of studies to be undertaken in order to bring each of the projects selected up to the stage of feasibility or execution specifications.

The report ends with a short account of the main physical, population and economic data for Gambia, emphasizing the place of irrigated rice in aggregate cereal production and in the national economy.

Proposals are made for a programme of studies and work to be implemented in the short term (1980-85) in collaboration with Gambian officials ; it would constitute the second irrigated farming programme of the CILSS/Club du Sahel in Gambia. This is the follow up and consolidation of the first CILSS programme which must be completed.

The report stresses the basic constraint on the development of irrigated farming, the intrusion of salt water which, in the dry season, can penetrate 256 km upstream from BANJUL. The proposed programme is thus conditioned and entirely centered on the implementation of projects for regulating the flow of the Gambia river.

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It should be observed that of the three crops studied by the Working Group on Irrigated Farming in 1976-77, rice wheat and sugar, rice is the only crop produced and its development alone is projected in the short term. It should be recalled nevertheless, that a regional research and test project on irrigated wheat has been proposed by the Group (1). Gambia will participate in this project, although the country's ecological conditions are unfavourable.

The present report attempts faithfully to reflect information and opinions of Gambian officials, as well as the contents of official documents given to or consulted by the mission ; some of the tables are reproduced in extenso.

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Note (1) - Wheat project : see the document "Development of irrigated farming in Senegal", CILSS/Club du Sahel, October 1979, annex F.

## SUMMARY AND CONCLUSIONS

1 - One of the main objectives of the Gambian government and of the "Rural Development Programme, 1980-85", is to satisfy the food requirements of the population, which is growing on average at the fast rate of 2.8% a year (5% for the urban population). By contrast, foodcrop production is stagnant and dangerously dependent on uncertain rainfalls.

2 - In 1979, "safe" rice production under irrigation on 2200 ha. of fully developed land represented only approximately 9% of the total cereal crop which is 72.500 tons. This situation brought Gambia to request aid of 33.714 tons of cereal in 1977-78; it had to import 31.900 tons of rice in 1977 ; its needs for foreign food products accounted for close to one third of the aggregate value of imports. Among the Sahelian peoples, the Gambian is the largest rice consumer at approximately 85 kgs per head and per year. Gambia devotes 61% of its farm land to groundnuts, a cash crop.

3 - The assessment of the needs of a population which should exceed 1 million by the end of the century (i.e., 95 inhabitants per $km^2$), necessitates the establishment in the short term of strict programming of foodcrops, whose quantity can only be secured by using intensive irrigation (demand for paddy rice will be 205.000 tons in the year 2000, necessitating approximately 23.000 ha of new land, farmed on a two-crop rotation).

4 - Gambia possesses approximately 81.000 hectares of land identified as irrigable, and it may seem quite paradoxical, that a country which extends on either side of a large river has not used the water available for irrigation more. The basic reason is that the development of large perimeters is encumbered by considerable entries of sea water, which can reach Kuntaur, 256 km upstream of Banjul, at the end of the dry season. Given these circumstances, a recent study put forward the hypothesis that the amount of water necessary for a 5000 hectares perimeter would drive this "salt tongues" close

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to Georgetown, 280 km from Banjul, preventing among other things the off-season operation of the Jackhally and Patchar perimeters, an approximately 2600 hectare project scheduled in the first CILSS programme.

5 - Large-scale development of irrigation necessitates the presence of regulating dams on the Gambia river. These dams are under study at the Organisation for the Development of the Gambia river basin, (OMVG). The Yelitenda anti-salt bridge-dam located 135 kilometers from the coast on the Gambia river was brought under feasibility study in April 1979 and would by itself support irrigation of approximately 24.000 hectares of rice plantations grown under two-crop rotation. The cost for this dam, whose building would last four years, is estimated at $ 65 million.

6 - Two other regulating dams are envisaged in Senegal in the framework of the concerted development of the Basin under the aegis of the OMVG, the dam-reservoirs of KEKRETI and SAMBANGALOU.

The Kekreti dam would allow 29.000 hectares to be irrigated in Senegal and 24.000 hectares in Gambia ; furthermore, it would supply electrical power evaluated at 160 million KWH per year. The preliminary study assessed the cost of this dam at $ 103 million.

The Sambangalou dam, whose study is at the same preliminary stage, would allow 29.000 hectares to be irrigated and 690 million KWH of electricity to be produced per year. It would cost $ 143 million.

7 - The total surface area of small irrigated perimeters existing at present is 2780 hectares ; the World Bank, the People's Republic of China and the Taiwan mission participated in their development.

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Crop rotation has almost failed, and the cultivation intensity ratio is little above 1.1. The main problems met are : maintenance of hydraulic networks and pumping stations, draining, the agricultural calendar, the sensibility of rice to cold weather and producer prices for paddy rice.

The Gambian authorities have decided to rehabilitate and durably consolidate these small operations in the very near future. There will be no major extension of irrigated perimeters before a decision has been taken about the regulating dams on the Gambia river.

8 - The chief long-term objective of the proposed second generation programme is to build the Yelitenda anti-salt dam (in 1985), as well as three pilot hydro-agricultural developments with a total surface area of 2900 hectares. Feasibility studies for the two Kekreti and Sambangalou dams are being continued, as well as the execution study of one of them after optimisation of the regulating dams.

The programme takes account of the fact that execution and management of these large projects implies the drafting and implementation of a practical training programme, as well as short missions to provide institutional support to the OMVG. The programme also includes completion of the projects in the first generation programme, especially the execution of the Jakhally and Patchar perimeters. The provisional estimate of cost is 65 million dalasis.

The aggregate cost of this second generation programme is estimated at 405 million dalasis, i.e., approximately $ 186 million.

The cost of the Yelitenda anti-salt dam accounts for 55% of this high figure. At the same time, the road-bridge function of this dam, the basic surveys of the Basin, the Kekreti and Sambangalou surveys, and the institutional support to be provided to the OMVG are of interest beyond the national Gambian framework.

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## - CHAPTER I -

# I - ASPECTS OF GAMBIA

## 1.1 - POSITION AND GEOGRAPHICAL CHARACTERISTICS

The Republic of Gambia extends over both sides of the middle and lower Gambia river, with a surface area of 11.295 $km^2$, located between the parallels of latitude 13°3 and 13°5 North and the meridians of longitude 16°48 and 13°47 West.

The country, shaped like a glove finger, penetrates over 300 km into Senegalese territory along the river on a narrow width of 24 to 48 km, reaching 70 km on the coast at the estuary of the Gambia river.

It is an extremely flat country, barely varied by a few undulations which rarely exceed an altitude of 30 metres.

The smallest of all countries on the African continent, it is an independent state, a member of the Commonwealth since 1965 and a Republic since 1970. The capital is Banjul. Its borders with Senegal do not correspond to physical or ethnic realities. They originate from colonial times.

## 1.2 - THE CLIMATE

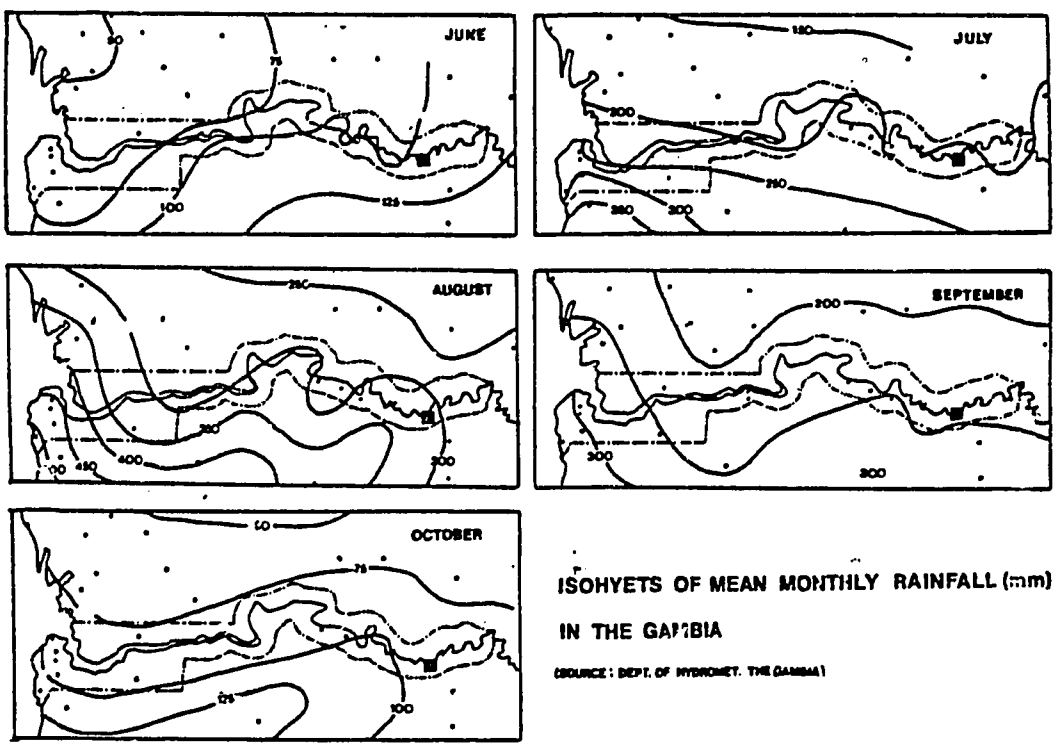
Gambia is part of the Sahelian zone and is a member of the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS) since 1974. Similarly to other Sahel countries, its climate is characterised by a long dry season which lasts from November until May. The rainy season extends from June to October with the maximum rainfall in mid-August.

.../...

Mean yearly rainfall is 1.100 mm in Banjul on the Atlantic coast, and declines progressively toward the interior to reach 843 mm at Jenoi (the future dam site of Yelitenda on the trans-Gambian road) and 869 mm at Sapu, close to Georgetown. It then rises again to the East, up to 1053 mm at lower Santa Su.

Rainfall is very variable from year to year as shown by the rainfall diagram at Banjul from 1886 to 1977 on the next page it has ranged from 600 mm during the great drought of 1973 to a high of close to 2000 mm. The diagram also shows that rainfall has been decreasing since 1875 ; a decrease of 15.5% is recorded for Banjul from 1875 to 1977.

Analysis of rain distribution shows that even in August, which is the crucial period for the development of crops, there is often insufficient rain to permit normal growth of vegetation.




ISOHYETS OF MEAN MONTHLY RAINFALL (mm) IN THE GAMBIA

(SOURCE : DEPT. OF HYDROMET. THE GAMBIA)

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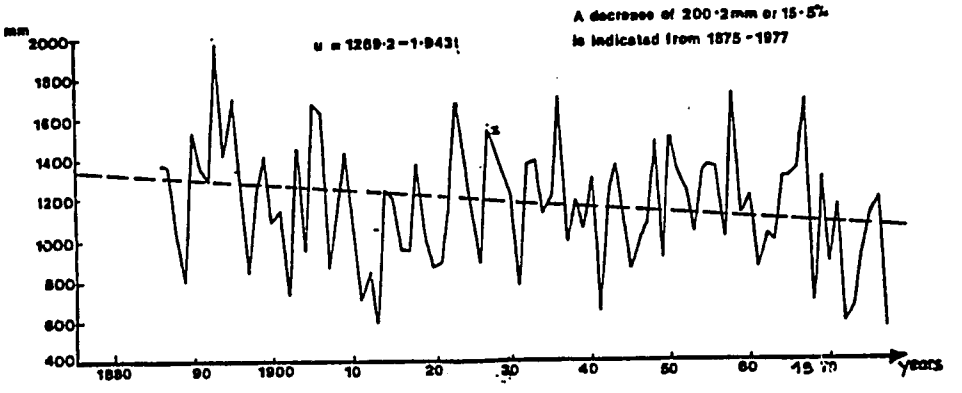
ANNUAL RAINFALL (mm) AT BANJUL 1886-1977 (92 years)




(Source: D.Whittenley Dept of Hydromet. The Gambia)

The great dispersion of rainfall in time and over space in spite of relatively abundant rainfall by comparison with other Sahel countries, explains why Gambian agriculture is very sensitive to poor climatic conditions and why the country has been so severely affected by the droughts of the past few years (1). The development of irrigated farming is thus fully justified.

The average temperature varies from 25° C in January to 30° C in May. However, from December to February, the minimum temperatures do not reach 15° C which has an effect on the behaviour of plants such as rice, which are very sensitive to cold (2).

1.3 - POPULATION

1.3.1-According to the 1973 census the population residing in Gambia was 496.500. In 1979, the authorities estimate the population at 572.000, i.e., an annual birth rate of 49 to 50‰ and a mortality rate of 29 to 30‰.

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Note (1) - For instance, in 1978, 90% of the land planted to groundnuts was damaged by lack of rain (statement made at the Amsterdam meeting, November 1978).

Note (2) - In December and January, the minimum mean temperature in Tambacounda in Senegal (at the Eastern extremity of Gambia) is 10° C.

.../...

In these circumstances, the natural growth of the population is 2% per year, immigration is estimated to be 0.8% a year presently, the rate of growth of the population is 2.8% per year overall. At this rate, the population doubles every 25 years.

The population density is 50 inhabitants per $km^2$ the highest among the Sahel countries, and indeed in West Africa (Senegal, 26 inhabitants per $km^2$ ; Mali, 5 ; Ivory Coast, 27 ; Sierra Leone, 43,... )

It may be observed that the population growth rate is slightly higher than was forecast in the "FAO Prospective Study" for Sahel countries in 1976, which estimated total population at 539.000 inhabitants in 1980, with an annual rate of growth of 2.2% for the 1975-1980 period. Predicted food requirements established in 1977 on this basis by the CILSS/Club du Sahel must be increased, as well as the targets for foodcrops and especially irrigated crops.

1.3.2- Gambian population trends

Population forecasts have been established on the basis of two main hypotheses : a constant fertility rate, and continuation of a higher rate of urban population (at a yearly rate of 5%). On the basis of these forecasts the population will increase to 1 million inhabitants by the turn of the century, with the following breakdown :

| Total population (inhabitants) | | of which | |
|---|---|---|---|
| | | Rural population | Urban population |
| 1973 | 496.000 | 372.000 | 124.000 |
| 1990 | 793.000 | 531.000 | 262.000 |
| 2000 | 1.058.000 | 688.000 | 370.000 |

Source : OMVG, Coode and Partners

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In 1979, the population was divided into ethnic groups as follows :

| | | | |
|---|---|---|---|
| - Mandingos | 42.3% | - Diolas | 9.5% |
| - Peuls | 18.3% | - Miscellaneous | 14.2% |
| - Ouolofs | 15.7% | | |

## 1.4 - AGRICULTURE AND LIVESTOCK

The Gambian economy is based on groundnut and cereal production and extensive cattle breeding.

### 1.4.1 - Agriculture :

Groundnuts are the dominant crop. They were brought into the country in the last century, and became the main crop occupying 61% of cultivated land. In years with average rainfalls production is 150,000 tons, with yields of 1.5 tons per hectare. It is the largest agricultural export item, and accounts for 90% of the country's aggregate export proceeds. Cotton production is very low, at some 300 tons of seed cotton.

Traditional foodcrops cultivated in the "highlands" are millet and sorghum as well as rainfed rice. In years of average rainfall, millet and sorghum production is approximately 45.000 tons, occupying 23% of cultivated land, with yields of 1 to 1.2 tons per hectare.

Rice is grown mainly on the alluvial soils of the lower marsh lands, or fed by rain, using the traditional method (Bantogaro). Given the uncertain climatic conditions, yields vary between 1 and 1.2 tons per hectare. The 1971 paddy crop yielded 41.000 tons, while in 1973, it fell to 25.500 tons. It was 42.100 tons in 1978.

Irrigated rice was harvested on 2200 hectares in 1978 with an average yield of 4.5 tons per hectare, but its development is quite slow. The share of irrigated rice in total paddy production has not yet reached 10.000 tons.

The table below summarizes the main agricultural data:

| Crops | Area (hectares) | % | Production (1000 tons) 1976-77 | 1977-78 |
|---|---|---|---|---|
| -Groundnuts (oil) | 106.610 | 61 | 169 | 128 |
| Sorghum | 12.516 | 7 | | |
| Early millet | 16.145 | 9 | | |
| Late " " | 9.165 | 5 | | |
| Cereals (millet + sorghum + corn | (42.000) | (23) | 45 | 45 |
| -Lowland or marshland rice | 13.722 | 8 | | |
| -Highland rice/Banto Faro | 7.623 | 4 | 23 | 42 |
| -Irrigated rice | 1.943 | 1 | | |
| Corn | 4.042 | 2 | | |
| Findo | 4.465 | 3 | | |
| Cotton | ? | | ≠0,3 | ≠0,3 |
| Total | 178.231 ha | | | |

Source : National Statistical Bureau

Cereal production is in heavy deficit. In 1977-78, the Gambia's requirements for cereal aid were 33.714 tons (1), and in 1977, net rice imports were 31.900 tons (2). In 1976, the estimated cost of rice imports was $ 6.322 million. Annual rice consumption per head is 84.2 kg, the largest among CILSS countries (Senegal, 55.8 kg per head, The Gambia is in third position among West African states after Liberia and Sierra Leone (2). The percentage of self-sufficiency in rice has decreased dangerously from 68.6% between 1965 and 1969 to 38.9% in 1976.

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Note (1) Figure submitted by the Gambia at the 3rd Club du Sahel meeting in Amsterdam, in November 1978.

Note (2) Source : WARDA yearbook July 1978.

## 1.4.2 - LIVESTOCK (1)

Family scale breeding, often associated with farming, represents a relatively large number of animals estimated at 290.000 heads of beef, 300.000 sheep and 300.000 goats. The size of the cattle population could increase considerably in the years to come (close to 800.000 head in the year 2000 ?) . In addition, family or industrially raised fowl should also be mentioned.

Estimated Gambian and freshwater fishing yields provide an additional 20.000 tons of food on average per year. This production is growing regularly.

## 1.5 - ECONOMIC AND FINANCIAL DATA

In 1976, the Gross National Product (G.N.P.) was estimated at 187.4 million dalasis divided among the various sectors as follows : (2)

| | | |
|---|---|---|
| - Agriculture, Fishing and Forestry | 113.9 million, ie. | 60 % |
| - Industry | 3.2 | 1.7 % |
| - Building | 7.5 | 4 % |
| - Transport and Commerce | 36.0 | 19.2 % |
| - Administration | 12.2 | 6.5 % |
| - Services | 14.6 | 7.8 % |

GNP per capita is some 340 dal., ie. approximately $ 170. (In Senegal, it is $ 300).

Revenues projected in the 1977-78 annual budget were 73 million dalasis, and outlays 80 million dalasis. The external debt was $ 49.3 million as of 31.12.76.

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Note (1) See the 1979 working documents of the Team.

Note (2) Presently, the Gambia grows neither wheat nor sugar cane.

Exports were 106 million dalasis in 1976-77, mainly groundnut derived products (oil).

Imports amounted to 169 million dalasis over the same period, of which almost a third consisted of food products (± 6.5 million per year for rice).

The 1975-1980 development plan schedules investments amounting to 145 million dalasis, of which 15% in agriculture (22 million dalasis).

1.6 - INFRASTRUCTURE AND INDUSTRY

Industry is practically inexistent except for groundnut processing and a small brewery.

Electricity production was 27 million KWH in 1975.

The road network is 1300 km long, of which 200 km of tarred roads. The deep water port at Banjul handles over 100.000 tons of cargo per year. Ocean-going ships of 3000 tons and 5.5 m draught can reach the groundnut shelling factory at KAUR on the Gambia river, 200 km upstream from Banjul. The river can be navigated up to Kuntaur, 250 km upstream from Banjul.

The Undum international airport, 12 km from the capital has contributed to the development of tourism in the country.

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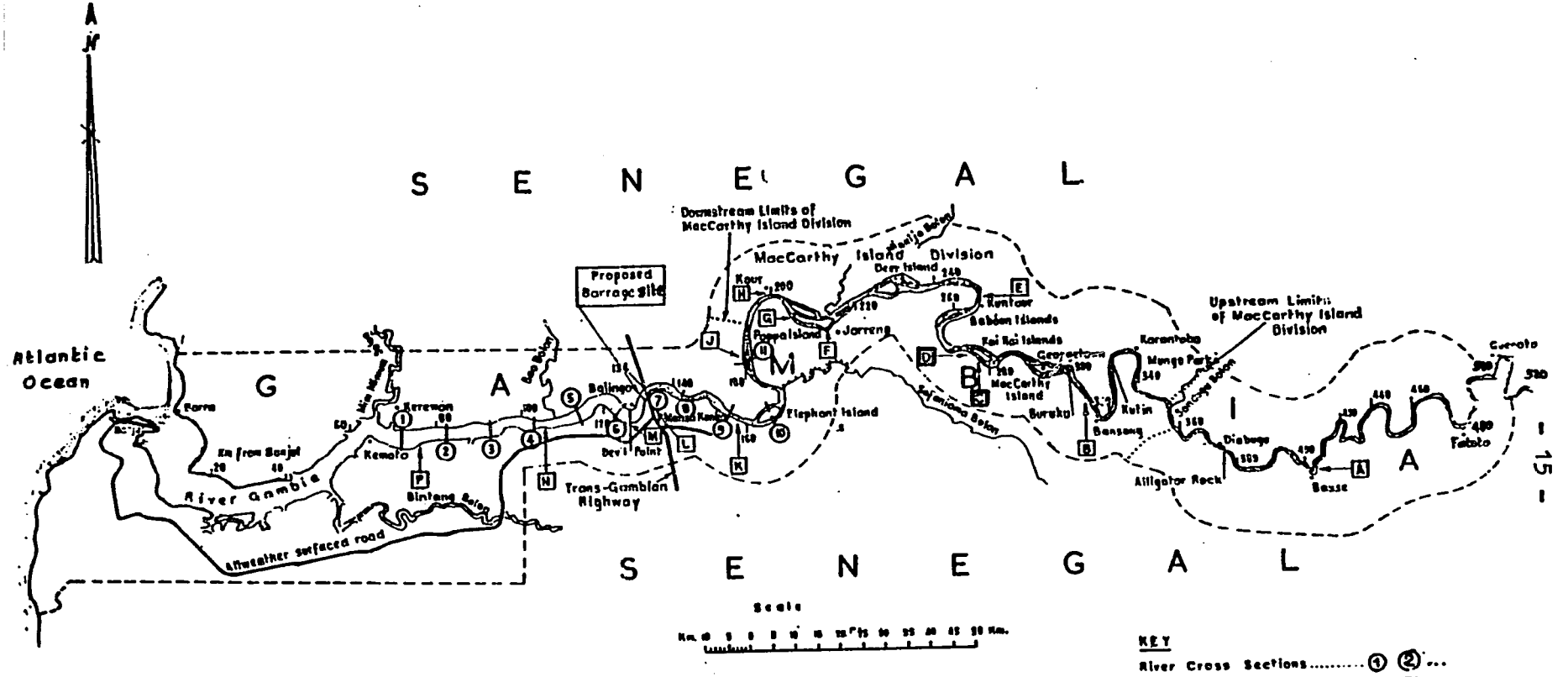
Note : 1 dalasis = approximately $ 0.46 ; $ 1 = 2.2 dalasis.




GENERAL PLAN OF THE GAMBIA

Coode & Partners, 1979

## CHAPTER II

## II - IRRIGATED CROPS - PRESENT STATUS

Rice is the largest irrigated crop. Fruit and market gardening crops are found only in the West of the Country, close to the capital, and are grown using water pumped from wells or boreholes.

Neither wheat nor sugar cane are produced at present in the Gambia.

### 2.1 - THE VARIOUS TYPES OF RICE CROPS

The Land Resources Division (Ministry of Overseas Development) has established the following classification :

- highland rainfed rice grown in the uplands using free drainage,
- rainfed or "Bantafaro" rice, grown on dry hydromorphic soil on low ground which is not usually submersed by the river and its tributaries, and on which streaming adds to the water supplied directly by rain,
- rice grown on freshwater marshland along the upstream two thirds of the river or in marshes which are further away from the lower bed of the river and reach various levels of submersion periodically through tides and river floods,
- rice grown in brackish water marshes, subject to tides. It is cultivated in the areas close to the estuary which are affected by salinity and on mangrove lands. Preliminary desalination through the washing action of rain water is necessary before sowing.
- rice grown on the riverbanks, in small perimeters supplied by a pump irrigated using modern techniques. This type of rice growing is performed on approximately 2200 hectares.

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## 2.2 - PRESENT PADDY PRODUCTION AND SHORT TERM NEEDS

2.2.1 - Paddy rice production was estimated to be 42.000 tons in 1978. This increase (by comparison with, for example the 1973-74 crop year which yielded 33.000 tons) owes more to readjustment of the statistical data than to an actual increase in production (1).

In 1978, 9900 tons of paddy were produced on the 2200 hectares of small perimeters irrigated by pumping, ie, an average yield of 4.5 tons per hectare, in general from a single annual crop.

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Note (1) A recent aircraft photographic survey displayed a larger surface area of rice grown under tidal conditions. By contrast, the surface area of highland and lowland rain-fed rice appears to have declined greatly during the drought.

.../...

## PRESENT RICE PRODUCTION IN THE GAMBIA

| | 1973/74 (1) | | | 1976-77 (2) | 1978 | | |
|---|---|---|---|---|---|---|---|
| | Area (thousand hectares) | Yield (tons per hectare) | Production (thousand tons) | Area (thousand hectares) | Area (thousand hectares) | Yield (tons per hectare) | Production (thousand tons) |
| Irrigated rice (A1/A2) | 1,6 | 3,9 (2,6/3,3) | 6,3 | 1,9 | 2,2 | 4,5 (4) (2,6/4,0) | 9,9 |
| Marshland rice (brackish water) (B1) | 5,0 | 0,7 | 3,5 | 13,8 | 5,0 (3) | 0,7 | 3,5 |
| Marshland rice fresh water (B2) | 4,0 | 1,7 | 6,8 | | 11,5 (3) | 1,7 | 19,6 |
| Banto-faro (B3) | 5,0 | 1,5 | 7,5 | 7,6 | | | |
| Highland rice (C1) | 10,0 | 0,9 | 9,0 | | 7,6 | 1,2 (5) | 9,1 |
| Total paddy | 25,6 | - | 33,1 | 23,3 | 26,3 | - | 42,1 |
| Husked rice production (65%) | | | 21,5 | | | | 27,4 |
| Imports | | | 18,9 | | | | 26,8 |
| Total rice consumption estimate | | | 40,4 | | | | 54,2 |

Note : (1) Study of phase 1 (1977), based on various sources of information.

(2) Agricultural census : National Statistical Bureau of the Gambia.

(3) Extrapolated from the 1972 aerial mapping survey and the Agricultural Census Statistics (ACS).

(4) Yields adjusted upward by reason of the information gathered in a recent inquiry.

(5) Average yield of bantо-faro and highland rice.

* It should be added that net imports of rice amounted to 31.900 tons.

2.2.2 - Projected demand for rice and other cereals

| | STATUS (1973-1974) | | 1990 | 2000 |
|---|---|---|---|---|
| Total population ('000) | 496 | | 793 | 1.058 |
| Consumption per head - rice (1) | 81 | | 109 | 126 |
| (in kg per year according to the FAO) - other cereals | 102 | | 91 | 84 |
| | 183 | | 200 | 210 |
| Aggregate demand - rice (1) | 40,4 | (21,5)+ | 86,5 | 133 |
| (thousand tons) - other cereals | 50,7 | (47,6)+ | 72 | 89 |
| | 91,1 | (69,1)+ | 158,5 | 222 |

+ effective 1973-74 cropyear production
(1) 1 kg of paddy = 0,65 kg of rice.

These projections show that even by doubling rice production in the coming decade (27.000 tons x 2 = 55.000 tons), the Gambia will nevertheless suffer a 30.000 ton rice deficit in 1990 (or 46.000 tons of paddy).

Cereal self-sufficiency for the year 2000 will necessitate a large effort to develop rice cultivation : demand for 13.300 tons of rice, ie. 205.000 tons of paddy, could be met by planting an additional 23.000 hectares (as compared with the status in 1979) of which 2/3 would be cultivated under two-crop annual rotation. This hypothesis corresponds to an average pace of development of 1150 hectares per year up to the year 2000, with an average crop yield of 4.5 tons of paddy per irrigated hectare.

These estimates are markedly different from those established by the "working group on irrigated farming of the CILSS/Club du Sahel in 1976-77, which corresponded to a low assumption.

.../...

Population growth is expected to exceed the figures set forth by the FAO in its 1976 "Prospects" survey by 15 to 20%.

It should be recalled that, to this cereal deficit, must be added 8000 to 9000 tons of wheat in 1990 and over 12000 tons in 2000.

Approximately 7000 tons of sugar are imported at present. In the year 2000, demand may be of the order of 15.000 tons.

## 2.3 - EXISTING IRRIGATION PROJECTS

### 2.3.1 - Jakhally and Patchar swamps.

This, the largest hydro-agricultural development in the Gambia, is located approximately 18 km downstream from Georgetown. It was implemented between 1950 and 1956 by the Commonwealth Development Corporation and covered 2900 acres (1173 hectares) of rice plantations.

The operation was a failure because of the inadequacy of the basic studies (hydrology and topography), the constraints associated with the labour force availability, and producer prices. Deficient drainage was the main technical defect.The development comprises a suction valve on the Jakhally Bolon and a pumping station at Sapu, with an earth-made canal more than 3 km long.

Intensive development of the land started using considerable machinery resources. Given the poor results, the project was stopped in 1956. Approximately 650 hectares are planted to rainfed rice, with yields of 2 tons of paddy per hectare.

.../...

In 1977, the Gambian Government took the decision to rehabilitate this development. A feasibility study was carried out in 1977-78 by Louis Berger International, financed by the Gambia and covering 1190 hectares in Jakhally (rehabilitation and improvement) and 1431 hectares in Patchen (extension).

The Netherlands (1) agreed to finance the implementation study for this development after some changes to the feasibility dossier, and this phase began in the summer of 1979. On the basis of the results, the Netherlands is prepared to envisage financing the rehabilitation work.

2.3.2 - TAIWAN mission projects

Between 1966 and 1974, a cooperative mission from Taiwan selected a number of sites on the banks of the river ; these sites are close to villages and the minimum cultivable surface area is 4 hectares. Each perimeter is divided into small allotments, with 15 to 25 allotments per hectare. Irrigation and drainage water flows from allotment to allotment by gravity.

All inputs were supplied the first year in order to endow farmers with some initial liquidity and sufficient resources to perform maintenance and purchase themselves the necessary products for the following crops. This system was not totally satisfactory and the second yearly crop was abandoned.

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Note (1) Commitment made by the the Netherlands at the Club du Sahel/CILSS meeting on crop production projects, Dakar, September 1978.

.../...

At the close of 1973, a total surface area of 1200 hectares had been developed in the two upstream Departments : the Mac Carthy Island Division and the Upper River Division. It is believed that approximately 90% of this surface area could be farmed in the dry season, using the hydraulic equipment already in place. This facility would allow 10.000 tons of paddy to be produced per year, with an average yield of 4.5 tons of paddy per hectare and per harvest.

2.3.3 - Projects financed by the World Bank
(ADP programme)

From 1973 to 1976, IBRD/IDA financed a programme whose initial objective was the irrigated development of 120 hectares of land. In practice, 580 hectares were developed, of which 75% is farmed producing a second crop in the dry season.

Individual allotments are larger than those of the Taiwanese perimeters ; at 8 to 15 allotments per hectare, each being supplied by an independent conduit.

The farmer's task is to smooth the ground and take care of the drainage system. The project also scheduled the creation of a cooperative for each perimeter, as well as the implementation of a system of agricultural credit (medium-term loans for the purchase of equipment, and seasonal credits for the purchase of inputs).

The production potential of the small IBRD perimeters is 4500 tons of paddy per year (assuming a yield of 4.5 tons per hectare and per crop as well as dual crop rotation on 75% of the surface area).

2.3.4 - Projects of the People's Republic of China

The mission reached the Gambia in 1976, and its task will continue until 1980 ; its objective is to develop 1200 hectares under irrigation and to consolidate and improve these perimeters as well as other existing perimeters.

.../...

As of the end of 1979, approximately 1000 hectares have been developed. The mission's present emphasis is on consolidation of these perimeters, because the implementation of new projects is impeded by land clearance problems and the provision of access ways.

These projects are similar to those of the ADP Programme financed by the World Bank. Each perimeter has a surface area of at least 8 hectares. Machinery is used for clearing land, smoothing plots and preparing the ground.

The production potential of the small Chinese perimeters is estimated to amount to approximately 7500 tons per year.

2.3.5 - The Hydrometeorological Service programme

This consists essentially of rehabilitating existing perimeters in 1979-80. In particular, it is intended to line 51 km of irrigation channels.

2.3.6 - Horticultural perimeters

Fruit and market gardening crops are mainly grown on family farms, in small gardens measuring 100 m2, watered either using buckets or a sprinkling-can, with water drawn from shallow wells. or surface water.

Several horticultural projects are under way : a 30 hectare spray irrigation project, supervised by the Department of Agriculture (1) and a set of small 1 hectare projects covering some 15 hectares...

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Note (1) "Brikama vegetable schemes" pilot project covering 20 hectares, sprinkler and gravity irrigated (vegetables and corn).

.../...

Demand for vegetables and fruit will grow, especially that of the urban population. A special effort will have to be made to foster the development of small market gardening perimeters irrigated using modern techniques (spray, drip-watering). Agricultural credit and the extension of modern techniques should help farmers to obtain the necessary equipment (small motorpumps PVC piping, etc.) and to establish producer cooperatives.



.../...

## CHAPTER III

## III - POSSIBILITIES AND CONSTRAINTS TO THE DEVELOPMENT OF IRRIGATION

### 3.1 - WATER RESOURCES

The country lies on both sides of the Gambia river ; it forms the middle and lower sections of the basin, and has a mean annual rainfall of 800 to 1100 mm. The upper basin located in Guinea and Senegal has a rainfall of up to 1250 mm.

These abundant but seasonal water resources are difficult to mobilise, whether from the river or its near-by "bolons". The whole Gambian section of the river is subject to tides beyond Fatato, and up to Goulombo, in Senegal, 526 km from Banjul (see map of the river basin on the next page).

The average annual flow at Goulombo is 9.1 billion m3, but it fluctuates ; a maximum of 14 billion m3 was recorded in 1974, a minimum of only 3.8 billion m3 in 1972. The very heavy flow during the rainy season, sometimes exceeding 2000 m3 per second, becomes almost nil between February and June, which induces the rising of the salt tongue to beyond Kaur, located 200 km from Banjul. In 1978, the salt tongue penetrated as far as Kuntaur, 256 km from Banjul.

Salinity rises upstream at a pace of about 15 to 20 km per month in the dry season. Recent measurements indicate that the process is intensified by the withdrawal of water for irrigation purposes. It has been assumed (1) that each m3 per second of water drawn for irrigation willincrease the speed at which salt water enters by 1 km per month. In these circumstances, the withdrawal of 10 m3/second during three months for the irrigation of 5000 hectares (2) of rice fields, would bring the salt tongue

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Note (1) This hypothesis was used by the Howard Humphreys Associate Bureau in 1974, but it is not based on precise measurements and needs to be confirmed.

Note (2) This area is very little greater than that of existing developments (approximately 3000 hectares developed in 1979) to which should be added those in Senegal (900 hectares in 1979.)

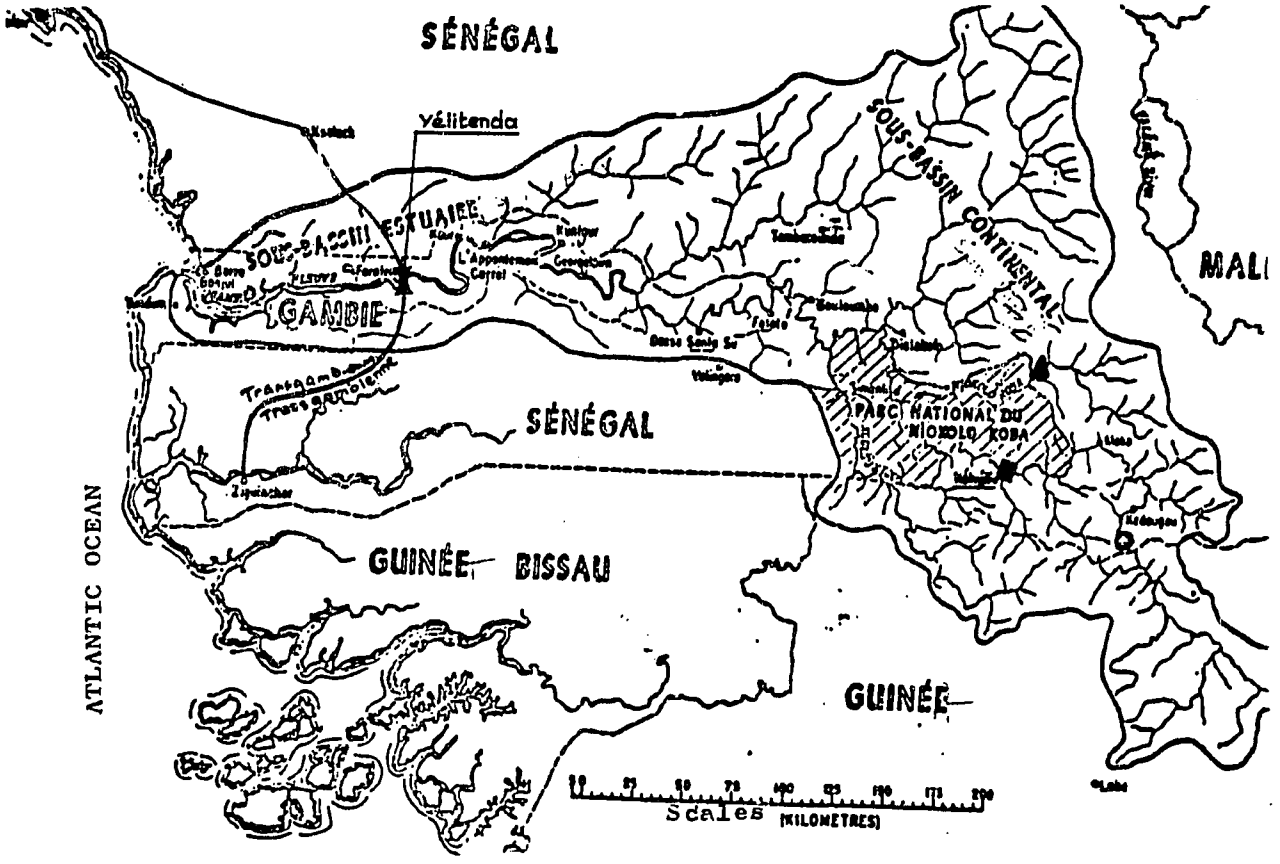
close to Georgetown, 280 kms from the mouth of the estuary and thus prevent irrigation in the Mac Carthy Island division, and especially the exploitation of the Jakhally, Sapu, Patchar, Kaur and Kuntaur projects.

Given these facts, and allowing for the relative imprecision of the hypothesis, the case for installing regulating dams on the Gambia river is clear. It will be examined below in § 3.3.

Underground water deposits, although not very well reconnoitred could be quite large in the general water table of the extremity of the continent. This water is of good quality and is presently raised through boreholes to supply the population in drinking water and also to irrigate several market gardening perimeters in the Banjul region. If used rationally it should be possible to avoid its contamination by the salt tongue. The present cost of developing underground deposits does not allow large scale development to be envisaged, and in particular, for cereal production.

THE GAMBIA RIVER BASIN

Legend : ▲ Niokolo Koba dam site ■ Keketi dam site
● Sambangalou dam site --- Frontier
~ Boundary of the Gambia river basin




3.2 - SOIL RESOURCES

3.2.1 - Agricultural land potential was studied in 1976-77 by the LRD (Land Resources Division, Ministry of Overseas Development. 18% of the land surface, ie, approximately 18000 hectares is presently cultivated. The classification of soils according to their suitability for cultivation is as follows :

.../...

| | Surface area (1000 hectares) | % |
|---|---|---|
| . Uncultivable land | 355 | 34 |
| . Marginally cultivable | 126 | 12 |
| . Cultivable, but with reserves | 148 | 14 |
| . Cultivable | 326 | 32 |
| . Irrigable | 81 | 8 |
| | 1.036 | 100 |

At present, a little less than 3% of irrigable land is actually irrigated. Approximately 22% is farm or fallow land ; the remainder is used as pastureland in the dry season. There is thus a large reserve of uncultivated land.

On the other hand, great pressure is imposed on the Uplands, which are traditionally kept fallow for long periods : in the last few years, fallowing has had to be shortened, impairing fertility. There is already a scarcity of land in the Mac Carthy Island and in the Upper Division.

In general, the Gambian alluvial soils are clay with insufficient natural drainage : they are perfectly suitable for rice plantation, either with a submersion system, or using irrigation with full control over water, and drainage. Their development using rainfed cultivation is limited to the highest terrains.

3.2.2 - 96% of the land surface classified as irrigable (or 78.000 hectares of a total area of 81.000) is located in the two departments upstream from Mac Carthy Island and Upper Division, i.e. upstream from the Yelitenda dam site, which will carry the transgambian road accross the river (see map § 3.1).

It should be stressed that soils subject to tidal movements and on which rice is presently grown, covering approximately 9000 hectares and producing on average 10.000 tons of paddy per year, are very sensitive to prolonged drought : there is a risk that sulfides in the soil might change into sulphates, which would induce a sudden fall of the PH down to 4 or even 3, thus sterilizing these soils once and for all.

.../...

It should therefore be kept in mind that any variation in the present flow of water caused by a hydraulic development, especially a change in the magnitude of tides along the Gambian section of the river, could entail serious changes in present farming practices (tidal effects on irrigated rice), and in the nature of soils which could at the limit lose all agronomic value.

## 3.3 - LARGE REGULATING DAMS PROJECTED ON THE GAMBIA RIVER

These dams are considered, and studied, by the Organisation for the Development of the Gambia river (OMVG), formed jointly by Senegal and the Gambia. 77% of the 78.000 km2 river basin lies in Senegal, 14% only in the Gambia (almost the whole country) and 9% in Guinea. The largest share of water resources is drawn from the Upper basin of Guinea, on the North side of the Fouta Djalon (see map of the river basin in § 3.1.).

Four hydraulic dam sites are presently under study :

1 - The Yelitenda anti-salt dam-bridge in the Gambia.
2 - The Niokolo Koba reservoir dam in Senegal.
3 - The Kekreti reservoir dam in Senegal.
4 - The Sambangalou dam reservoir in Senegal.

### 3.3.1 - The Yelitenda anti-salt dam-bridge

This would be located 130 km upstream from Banjul, at the existing ferry crossing on the Kaolack-Farafenni-Ziguinchor road and would perform three functions :

- store fresh water originating from the upper and middle basin.
- control rising salt water
- allow a passageway for the transgambian road in addition to the ferry) linking Dakar to the Casamance.

.../...

This dam alone would allow approximately 24.000 hectares of rice to be irrigated in double annual crop rotation, which is in principle, enough to satisfy the demand for rice in the year 2000 (see § 2.2.2 - above).

The project feasibility study (1) was submitted in April 1979.

The dam is 600 m long, is formed by a compact embankment with a concrete super structure equipped with 155 apertures for the passage of floodwaters, with a navigation lock, fitted with bottom valves for the movement of salt water upstream in order to regulate upstream levels during high tides at a height sufficient to maintain rice growing land under water with tidal movements (over 5000 hectares) and thus, prevent their sterilisation (see § 3.2.2. above).

The cost of the dam estimated at 1978 prices is 138 million Dalasis (US$ 65 million). The work would take some 4 years.

3.3.2 - The NIOKOLO-KOBA dam

This reservoir dam is located in Eastern Senegal, at the border of the Niokolo Koba National Park (see map in § 3.1. above).

This dam, 16 metres high, would create a useful reservoir of 180 million m3, without affecting the annual flow of the Gambia river, of which the Niokolo Koba is a tributary.

This dam is estimated to cost US$ 3.3 million.

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Note (1) By Coode and Partners, and Peat, Marwick, Mitchell and Co, financed by the United Kingdom, Ministry of Overseas Development. See the sketches annex A1.

.../...

3.3.3 - THE KEKRETI DAM

This is also a reservoir dam, located on the Gambia river in Senegal, 60 km West of Kedougou.

With a reservoir at level + 80 m, its storage capacity would be 4.9 billion m3, which could be used for electricity output (160 million KWH per year) and for the irrigation of approximately 60.000 hectares in Senegal.

According to the conclusions of the study performed under UNDP auspices, the use of the Kekreti dam for irrigation and salinity control -without the Yelitenda anti-salt dam- would enable 53.000 hectares to be irrigated, of which 29.000 in Senegal and 24.000 in the Gambia. It would also provide a sufficient flow downstream to keep the quality of the water at the level required to continue irrigating upstream from PK 170 (Elephant Island Division, 40 km upstream from Yelitenda, see map in chapter 1).

According to the UNDP (1), the advantage of this solution would be to "meet the agricultural objectives of the anti-salt dam without losing the rice growing marshlands in the Gambia, while providing substantial irrigation in Senegal, and with the same hydro-electrical output." (2).

The estimated cost of this dam is US$ 103 million.

3.3.4 - The SAMBANGALOU dam

This dam is also located in Senegal on the Gambia river upstream from Kekreti. It would create a reservoir, the major part of which would be in Guinea. The regularised flow would be lower than at Kekreti. It would allow 29.000 hectares to be irrigated and yield an electricity output of 690 million KWH per year.
This project is estimated to cost ± 143 million US.

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Note -1- Report of the multidisciplinary multidonor UNDP mission, 1979.

Note -2- This possibility is not mentioned in COODE and PARTNERS' report ; it is therefore worth examination, and if appropriate, confirmed by a complementary study.

.../...

3.3.5 - Summary table of dam characteristics

| | Potential irrigable land(hectares) | Energy produced Other advantages | Cost estimate in US$ millions |
|---|---|---|---|
| Yelitenda anti-salt dam-bridge | 24.000 | Transgambian road | 65 |
| Niokolo Koba Dam | 12.000 | - | 3.3 |
| Kekreti Dam | 53.000 | 160 million KWH | 103 |
| Sambangalou Dam | 29.000 | 690 million KWH | 143 |

Feasibility studies for these developments should be continued, emphasizing their respective drawbacks and advantages, in order to obtain a rational selection of priority projects by the OMVG. This choice conditions the development of irrigated farming and especially rice plantations in the Gambia.

## 3.4 CONSTRAINTS TO THE DEVELOPMENT OF RICE FARMING

Independently of the large regulating dams on the river, which condition the future, the development of rice cultivation is presently hindered by a number of difficulties.

### 3.4.1 - Problems related to Development Schemes

Pumping stations are installed along the riverbanks or on the tributaries,"bolons". Motorpump units generally made in China or Germany, drive through 30 to 70 litres per second. They have 7.5 to 25 horsepower diesel engines and it can be observed that they have a very short life, due to insufficient maintenance and the effect of vibrations. (In order to reduce costs, the anti-vibration concrete support base is generally not cast).

.../...

In small perimeters, irrigation networks are unlined, inadequately maintained, and in bad condition. There are major water losses, and this has a serious effect on operating costs. It is intended to line them progressively (1).

Drainage is often a problem because of topography and the proximity of the river, especially during the rainy season. Drainage structures, whose construction is often left to farmers have defects, and their operation in average or rainy years is unknown, as they have been constructed in the last five years, which were very dry.

It should also be mentioned that water requirements for rice are not sufficiently well known and this warrants thoroughgoing studies and experiments. At present, a rough estimate of requirements stands between 12.500 and 20.500 m3/hectare for a dry season harvest. Real efficiency per plot and losses in the network are both unknown.

3.4.2 - Farming methods and double annual crop rotation

During the dry season in 1978, only 1700 hectares (2) were planted to off-season rice, whereas 3880 hectares could be used for double cultivation.

Even in the rainy season, all developed tracts are not utilized : 2200 hectares only in 1978 (see § 2.2.1 ).

Farming methods for two harvest rice growing are as follows :

. preparation of the soil by ploughing or with the rotavator in January and July (at farmers' request) and planting of seedlings.

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Note (1) It would be interesting to compare, from an economic and technical standpoint, the various types of linings for channels : cement, aluminium, plastic, butyl, etc.

Note (2) These 1700 hectares are the small perimeters developed by the Taiwan mission, the ADP programme (IBRD perimeters) and those financed by the Chinese People's Republic

. replanting 15 to 25 days later (at the 4-leaf stage of growth) with a spacing of 15 x 20 cm. In practice, farmers tend to prefer a 20 x 25 or 25 x 25 cm spacing, which lowers density and yield.

. four pass fertilizer application, weeding.

. harvest in November and at the end of May.

The main problems encountered in two-harvest cultivation of rice can be summarized as follows :

- difficulties of performing dressings at the right time, in spite of the existence of an agricultural machinery centre, at Sapu, and the presence of an Agricultural Assistant (AA) for each centre grouping several cooperatives. The AA monitors the peasants with the help of a demonstrator for each cooperative (problems of maintenance of agricultural machinery, lack of spare parts).

- the sensitivity of rice to cold from November to January, which can lower yields markedly. Research is being performed into cold-tolerant varieties of rice (1) which would allow seasonal cycles to be broken, while preserving the tastiness of the product.

- delays in off-season replanting pushes harvesting back to after the arrival of the first rains, causing problems of mechanical harvesting, decreasing yields and mildew (2). The lag in planting the second crop exposes it to the cold weather.

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Note (1) In mid-November, the temperature falls to 15° C with minima of 12° C.

Note (2) Varieties with a short cycle of 110 days are thus sought: V Kong Pao is a variety which fulfills these conditions well, but objections are expressed as to the quality of its grain.

.../...

- poor smoothing of plots, heavy infiltrations, lack of maintenance of pumping units , weeding and onslaughts by grain-eating birds are barriers to dry season farming. During the wet season, rice is subject to several diseases, and drainage is often inadequate during this period.

- lack of credits and the low level of producer prices.

- competition with groundnuts in June and July delays the dry season crop and therefore, plantation of the rainy season crop.

In short, for the reasons stated, double annual harvesting has failed for practical purposes. The cultivation intensity ratio rarely exceeds 1.1. It should be observed that the second cash crop in which the farmer always places confidence is groundnuts.

Gambian farmers have nonetheless proved that they can accept the discipline and the efforts involved in double harvesting, and that they can digest the first "technological package" very well (replanting fertilizing, weeding, etc.)

3.4.3 - Operating costs

Estimates in 1979 for a rice field of one hectare, harvested once, are as follows :

| | |
|---|---|
| - soil preparation ..... | 148 Dalasis per hectare |
| - seeds ..... | 21 |
| - irrigation costs ..... | 247 |
| - fertilizer ..... | 53 |
| - manpower | |
| 291 days at 2.50 Dal/day .. | 728 |
| | 1.197 Dalasis per hectare |

It can thus be inferred that at the present market price of 0.44 Dalasis a kg of paddy, it is only possible to obtain a positive net income with a yield superior to 2.7 tons per hectare.

.../...

## 3.5 - PROSPECTS FOR OTHER IRRIGATED CROPS

In 1979, rice is still the only irrigated crop that is marketed to any significant extent. Horticulture is still at the handicraft and family worker stage.

Nothing much has been undertaken yet in the way of agronomic research to introduce new irrigated crops into the Gambia.

Nevertheless, the government authorities think that it might be of interest to experiment with other irrigated crops :

a) Cereals : Wheat (for human consumption),
corn and sorghum (for cattle fodder).

Demand for wheat has been rising since 1977 (5000 tons) ; it could reach 8000 or 9000 tons in 1990 and over 12.000 tons in the year 2000. In this connection, we recall the interest of a regional research and experiment project on irrigated wheat in CILSS countries, for which proposals were made in the report "Irrigated Farming in Senegal", CILSS/Club, October 1979.

It will soon be necessary to resort to irrigated fodder production to face the foreseeable increase in livestock numbers (800.000 head toward the year 2000 ?), which will inevitably grow in line with the population. The team had proposed the figure of 16.000 hectares of cereal-fodder perimeters to be prepared by the year 2000 (2).

b) Industrial crops such as cotton and sunflower.

c) Sugar cane to satisfy the population's growing demand for sugar (1) (3890 tons were imported in 1975-76 and 7090 tons

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Note (1) It should be observed that the team's 1977 projections like those of FAO in 1976) are already out of date and should be thoroughly updated.

Note (2) See the report on Irrigated Farming in Gambia, CILSS/Club du Sahel (May 1977) page 30.

.../...

in 1976-77 ; demand in the year 2000 may well exceed 15.000 tons) and for use as beef fodder (cane stems, molasses). A sugar perimeter of 22000 hectares could be envisaged after the entry into service of the regulating dams on the river.

## CHAPTER IV

## IV - STATUS OF THE FIRST GENERATION PROGRAMME

The first CILSS programme for the development of irrigated farming in the Gambia is relatively limited. It includes 4 projects :

- development of the plains of Jakhally and Patchar
- improvement and extension of small irrigated perimeters
- infrastructures for these two projects (rice processing plant, roads, etc.)
- a study on the integrated development of the Gambia river basin.

The status of this programme as of October 1979 is summarized in the table at the end of the chapter. Each project will be examined in detail below.

### 4.1 - DEVELOPMENT OF THE PLAINS OF JAKHALLY AND PATCHAR

This project which involves the redevelopment and extension of approximately 2600 hectares net, was mentioned earlier in § 2.3.1. The study submitted by Louis Berger International is under examination.

A new feasibility study has been undertaken by the Netherlands. Approximate cost : 500.000 Dalasis.

A preliminary estimate of the cost of development work yields a figure of 65 million Dalasis, i.e. 25.000 Dalasis per hectare.

Observation : the salt tongue reached Kuntaur in 1978, approximately 25 km downstream from the location of the project. It is questionable whether a second dry season harvest can be obtained on these 2600 hectares until the regulating dams enter into service.

.../...

## 4.2 - REHABILITATION AND EXTENSION OF SMALL PERIMETERS

The total area of small irrigated perimeters developed by the Taiwan mission, APD/IBRD programmes and the Chinese People's Republic was 2000 hectares in 1978 (1).

Nevertheless, the whole area developed was not farmed ; only approximately 1700 hectares were cultivated in the dry season and approximately 200 hectares in the rainy season.

A few new perimeters were developed by the Chinese People's Republic in 1979 in the framework of that country's aid programme.

In 1977, a programme was devised for the improvement and extension of small irrigated perimeters at an estimated cost of 16.3 million Dalasis (i.e, US$ 7.41 million); it involved :

- studies ..... 300.000 Dalasis
- consolidation of the existing 500 hectares ..... 3.000.000
- development of a further 1000 hectares ..... 10.000.000
- advisory personnel services for perimeters ..... 3.000.000

In 1978, this programme executed using aid provided by the Chinese People's Republic included :

- 34 Chinese experts, of which two engineers specialised in irrigation and 7 in rice cultivation;
- a team of 44 Gambians, of which 10 Agricultural Assistants (AA);

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Note (1). For details see annex A2 "Irrigated rice development project in 1978" ; total land surface was exactly 4939 acres or 1998 hectares (1 acre=0.4047 hectares).

.../...

- a considerable amount of machinery, including in particular eleven MF 135 tractors, 130 motor-tractors, 300 motor-pumps, five D4 bulldozers, etc.

At present, the important thing is that the actions undertaken, for which records, moreover, are often difficult to compile, be completed in order to effectively move to a double harvest on all developed perimeters, and to follow up the experiments now under way. The activities to be pursued can be summarized as follows :

- drainage and improvement of levelling at a unit cost of 700 dalasis per hectare over 1950 hectares ..... 1.370.000 dal
- lining of main channels and repair of water distribution systems : 1000 dalasis per hectare .. 1.950.000
- reinforcement of advisory staff ; first estimate of cost ..... 3.000.000
- programme of experiments on cold-resistant varieties at Sapu ..... 550.000
- miscellaneous and contingencies ..... 730.000

Total = 7.600.000 Dal
i.e, $ 3.46 million US

This figure is approximate. A short-term mission (1) could draft a detailed programme of action and evaluate the specific costs involved.

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Note (1) This two week on-the-spot mission would include at least one agronomic engineer and one structural engineer and would cost approximately 60.000 Dalasis or US$ 27,000.

.../...

4.3 - INFRASTRUCTURE : RICE MILL AND ACCESS ROADS

This project, which has not yet been set in hand, and for which no financing arrangements have yet been made, should be integrated with the two preceding projects ; formulation and estimation could be performed during the mission proposed above.

A provisional assessment of this project is :

- Rice mill, 15.000 tons per year ... 1.760.000 Dalasis or $ 800.000
- Road infrastructure ..... 3.340.000 Dalasis or $ 1.518.000

4.4 - STUDIES ON THE INTEGRATED DEVELOPMENT OF THE GAMBIA RIVER BASIN

These studies are now performed under the sponsorship of the Organisation for the Development of the Gambia river (OMVG), created in 1977 at Kaolack.

Since 1977, two studies have been undertaken :

4.4.1 - "The Gambia river basin development survey", executed under UNDP sponsorship by multi-disciplinary missions, with the participation of USAID and CIDA in particular. These led to :

- an "action programme" in April 1977,

- in 1979, the preliminary draft of the final report ; some of its conclusions on irrigation have been mentioned earlier in chapter III.

The study process should result by end-1979 or early 1980 in the definition of a "Scheme for the Development of the Gambia river basin".

.../...

4.4.2 - "Study of a dam on the Gambia river estuary (Phase II)

This feasibility study was completed in April 1979 and contains the elements pertaining to construction of an anti-salt dam-bridge at Yelitenda, 130 km upstream from Banjul.

The estimated cost of this dam is US$ 75 million. (See chapter V below).

## 4.5 STATUS OF THE CILSS FIRST GENERATION PROGRAMME

- Irrigated Farming -

I : Preliminary interest, under study
II : Marked interest, cofinancing
III : Firm commitment

1 US $ = 2.2 dalasis

| PROJECT | Estimate of costs | | Financing | | REMARKS |
|---|---|---|---|---|---|
| | Thousand dalasis | Thousand US $ | Source | Type of interest | |
| 1. Development of irrigation in the area of Jakhally and Patchar swamps: | | | | | Area: about 2,600 ha. Phases I and II already studied by Louis Berger Int. (1977-1978). Banjul meeting, 1st March, 1979. Study underway. |
| (a) New feasibility study for phases I, II, III | 500 | 250 | Netherlands | III | Estimated cost (25,000 Dal. per ha. = 65,000,000 Dal |
| (b) Development of the perimeters | (65,000) | | FRG<br>IFAD<br>AfDB<br>Netherlands | II<br>II<br>II<br>II | interest, total amount US $ 25 million |
| 2. Rehabilitation of 50 small irrigated perimeters (well watered) totalling 1,500 ha. and the development of 1,000 hectares of new perimeters | | | Netherlands | II | Netherlands will perhaps finance the whole project, depending on the results of the study. Irrigated perimeters - small perimeters. |
| | | | IBRD | I | IBRD has financed the existing small perimeters. |
| | | | USAID | II | Mixed farming for about US $ 3.00 M. |
| | | 7,409 | ADF<br>PRC | II<br>II | Study for small dams. People's Republic of China interested in new small perimeters |
| 3. Infrastructure relating to the two irrigation projects described above: | | | | | |
| (a) a rice mill of 15,000 tons per year | | 800 | | | Integrated to the two projects described above |
| (b) rehabilitation of access routes | | 1,518 | | | |
| 4. Study on the irrigated development of the Gambia River | | 911,000 | UNDP<br>USAID<br>CIDA | III<br>III<br>III | Study on the development of the Gambia River realised in 1978 |
| (a) Yelitenda barrage (Gambia estuary) | | | | | |
| - Studies | | | UK | III | Studies realised (U.K.) |
| - Development | | 75,000 | KFW | III | West Germany's commitment for DM 50 million |
| | | | FED | III | FED UC 8 million |
| | | | UK | III | UK commitment for £10 million |
| | | | USAID | III | USAID commitment for US $ 15 million, but not before October 1980 |
| (b) Kékréti and Sambangalou barrages: studies | | | | | |
| - phase A: preliminary studies | | 2,290 | RFA | III | West Germany committed CFA F. 492 million, start-up scheduled for November 1979 |
| - phase B: execution studies, design; tenders dossier | | | | | |
| (c) Basic studies for Senegalese and Gambian sections | | ? | FAC | I | Preliminary interest expressed by France |
| - Topography, scale 1/10,000th | | | | | |
| - Pedology, scale 1/50,000th | | | | | |
| (d) Master plan for the whole basin | | ? | USAID | III | Meeting of interested donors scheduled for April 1980 |
| (e) Institutional support to the OMVG for technical studies | | ? | FAC/<br>USAID<br>RFA<br>UNDP | I<br>I<br>I | |

## CHAPTER V

## V - PROPOSALS FOR A SECOND GENERATION PROGRAMME (1980-85)

### 5.1 - PRELIMINARY OBSERVATIONS - ORIENTATIONS

The feature of the first CILSS programme was the emphasis on studies : feasibility studies, general surveys for the development of the Gambia river basin, and a study on regulating dams for the river.

These preliminary studies were and are necessary for planning the development of irrigation in the Gambia.

The second generation programme (1980-85) will follow-up and consolidate the first, with additional agronomic research and experiments, and a start made on basic surveys which allow a major medium- and long-term programme for the development of irrigated farming in the Gambia to be prepared.

The main goals of this second generation programme are as follows:

1- Rice self-sufficiency to be achieved by the year 2000, when 205.000 tons/year of paddy will be produced (133.000 tons of rice), which necessitates the development of a further 23.000 hectares (1) (see § 2.2.2.).

2 2- Large-scale development of irrigation will only be possible after regulating dams on the Gambia river become operational, which will not occur before 1985.

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Note (1) It is implicitly taken that such a yield can only be obtained on irrigated perimeters.

.../...

3- The Gambia is part of a natural region zone (the river basin) and is a member of the OMVG. Its development programme must take into account that of the neighbouring regions in Senegal ( Casamance, Sine Saloum and Eastern Senegal).

5.2 - SHORT-TERM RECOMMENDATIONS

5.2.1 - The main recommendations (1) of the Gambian Rural Development Programme (RDP) 1980-85, are as follows :

1- In the field of manual, animal drawn or mechanised rice farming, it is necessary to gather exact information on farming methods, modes of cultivation, work-times, etc.

2 - Internal problems of small irrigated perimeters : the poor quality of hydraulic networks and the lack of maintenance (especially as regards drainage) the scattering perimeters and the permanent difficulties of access, supplies of inputs and marketing difficulties. All these problems appear to be causes of the low pace at which development has progressed.

3 - Agronomic research and experimentation must be performed, in particular to seek varieties of rice which resist cold ; into water requirements of crops ; into planting of other irrigated cereals such as wheat and corn for the development of fodder cultivation for beef cattle ; and into the promotion of market gardening.

5.2.2 - In the short-term (1980-85), pending the installation of regulating dams on the Gambia river, it is possible to increase rice production :

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Note (1) See "Preparation working paper N° 2, Irrigation Development, 1978".

.../...

1 - By developing new perimeters, drawing additional fresh water from the river : however, it is known that the salt tongue will rise further as a result, and that rice crops have already been destroyed in Jarreng by the intrusion of salt at the end of the dry season ; or

2 - By intensifying production on existing perimeters with improved use of water, but chiefly, generalising rice farming during the rainy season on all developed perimeters.

The Gambian authorities have made their choice (1) by proposing that further major extension of irrigated areas be suspended after completion of the work being carried out by the Chinese mission (PRC) in 1980, and that the programme of future developments be worked out after, and on the basis of the results of the studies on regulating dam on the Gambia river.

5.2.3 - A training programme should be drafted as an urgent matter and implemented to secure medium and long term irrigated crop development. The figure of 23.000 to 24.000 hectares of new perimeters is a measure of the development and management effort to be made by the year 2000. Training will consist of on-the-spot advising services (from the pilot farmer to the higher level executive), and care should be taken to avoid the "bureaucratisation" of advisory staff. The present shortfall is quite large (2). At least 100 middle and upper level advisors will have to be trained in the decade of the 1980's. (3)

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Note (1) See "Irrigation Development, Preparation Working paper N° 2".

Note (2) See the "report on training needs in the Gambia, CILSS/USAID/BIT mission April 1978.

Note (3) For details of requirements, see the report on Irrigated Farming in the Gambia, May 1977 (indicative figures).

.../...

## 5.5 - YELITENDA ANTI-SALT DAM-BRIDGE AND ASSOCIATED DEVELOPMENTS

5.3.1 - The feasibility study available provides for a dam to permit irrigation of approximately 24.000 hectares in the long term. To start off, 3 "sample zones" are scheduled over 3900 hectares :

- at SANKWIA 900 hectares near Yelitenda, on the left bank.
- at KAUR 350 hectares, 200 km from Banjul on the right bank
- at KUNTAUR 1650 hectares, 250 km from Banjul on the left bank.

The map and table on the next page contain details of these proposals.

5.3.2 - The main features of this programme are summarized in the table below :

| | Sankwia | Kaur | Kuntaur | Total |
|---|---|---|---|---|
| Intensity of farming (%) | 100% | 175% | 175% | - |
| Expected yield (tons per hectare cultivated) | 2,5 | 5,0 | 5,0 | - |
| Development cost (Dal/hectare) | 5.230 | 13.597 | 20.131 | - |
| Areas to be developed (hectares) | | | | |
| - Phase I | 900 | 350 | 1.650 | 2.900 |
| - Phase II (up to the year 2000) | 2.100 | 8.800 | 10.350 | 21.250 |
| Total (hectares) | 3.000 | 9.150 | 12.000 | 24.150 |
| Development costs (M. Dalasis) | | | | |
| - Phase I (as of 1978) | 4.7 | 4.7 | 33.2 | 42.6 |
| - Phase II (as of 1978) | 11.0 | 117.5 | 208.0 | 336.5 |
| Total (Million Dalasis) | 15.7 | 122.2 | 241.2 | 379.1 |
| Expected paddy production on completion of development (tons) | 5.200 | 80.000 | 105.000 | 190.200 |

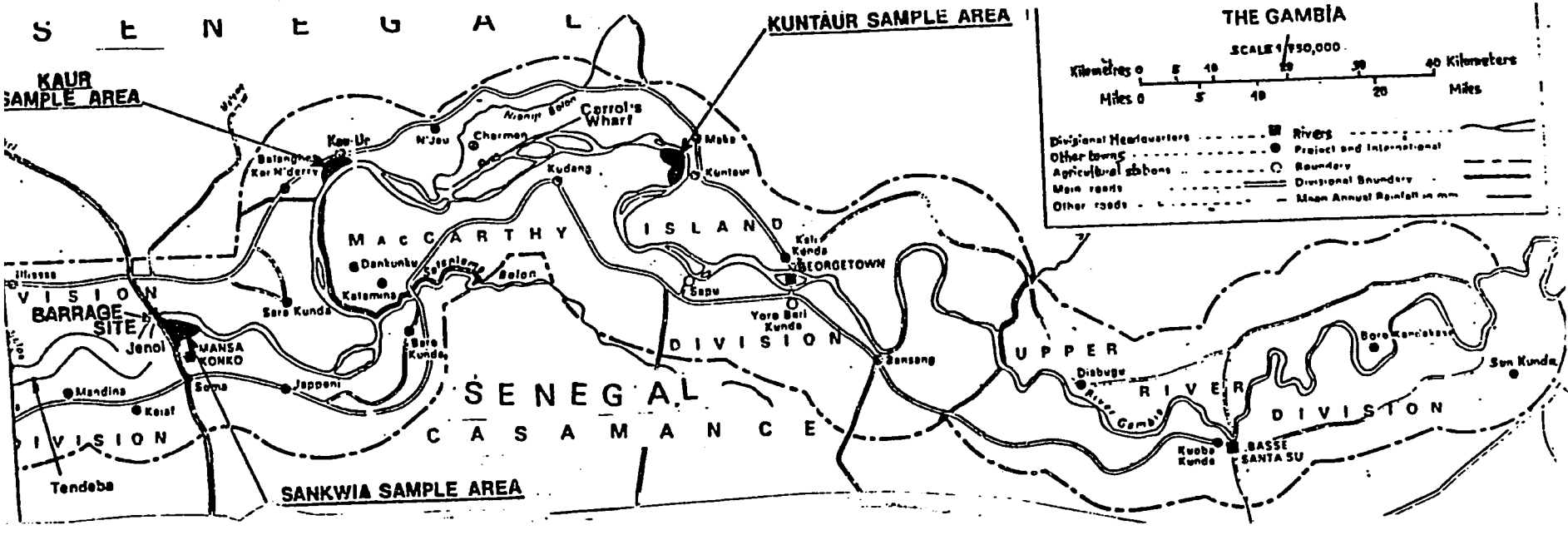
.../...

5.3.3 - The best schedule would be to achieve simultaneously the entry into service of the regulating dam and the completion of phase I of development of the three perimeters.

The following scenario is possible : from 1981 to 1985, construction of the regulating dam, together with the phase I hydro-agricultural development of the three perimeters, then, at the beginning of 1986, entry into service of the dam, and the plantation of 2900 hectares of rice fields.

This scenario implies that a choice must be made very soon as to the type of regulating dam to be built. If the Yelitenda anti-salt dam is selected, the execution studies will have to be undertaken very rapidly.

.../...


S E N E G A L
KAUR SAMPLE AREA
KUNTAUR SAMPLE AREA
THE GAMBIA
SCALE 1/250,000
Kilometres 0 5 10 20 30 40 Kilometers
Miles 0 5 10 20 Miles
Divisional Headquarters
Other towns
Agricultural stations
Main roads
Other roads
Rivers
Project and International Boundary
Divisional Boundary
Mean Annual Rainfall in mm
Kau-Ur
Balangha
Kar N'derry
N'Jau
Charmen
Arenji Bolon
Carrol's Wharf
Mako
Kuntaur
Kudang
MacCARTHY ISLAND
Kafu Kunda
GEORGETOWN
Sapu
Yoro Bori Kunda
DIVISION
Dantunku
Kalamina
Sare Kunda
Bolon
VISION
BARRAGE SITE
Jenol
MANSA KONKO
Sare Kunda
Sona
Jappani
Mandina
Keisf
DIVISION
Tendeba
SENEGAL
CASAMANCE
SANKWIA SAMPLE AREA
Sansang
UPPER RIVER DIVISION
Disbugu
River Gambia
Kuoba Kunda
BASSE SANTA SU
Bora Kanchaba
Sun Kunda

49

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## RECAPITULATIVE TABLE OF PROPOSALS FOR DEVELOPMENT

| SAMPLE REGION | DEVELOPMENT SCHEME PROPOSED | COST (D/Hectare) | YIELDS (TONS/Ha) Present | Future | FARMING INTENSITY RATIO | TOTAL AREA DEVELOPED | SOILS | CALCULATED COST OF WATER (D/Ha) | COST OF WATER AS % OF ADDITIONAL INCOME GENERATED BY THE PROJECT | ESTIMATED YIELD |
|---|---|---|---|---|---|---|---|---|---|---|
| SANKWIA 900 hectares downstream from the dam | Dykes and valves | Investment: 5230 Operation and Maintenance: 46 Management : 35 | 0.7 | 2.5 | 100% | 5000 hectares | As Bs | 235 | 30 | 9.1 |
| Upstream from the dam | Simulation of tidal movements | | 1.7 | 1.7 | 100% | Conservation of existing tidal rice fields, ie, approximately 11500 hectares | As Bs B | - | - | - |
| KAUR (350 hectares) | Dyke, pumping stations, water circulation channels and drains | Investment: 13297 Operation and maintenance: 91 Management : 165 | 1.7 | Rainy season 4.5 Dry season 5.5 | 175% | 9160 hectares (2840 hectares should have been developed by 1981 by the PRC with a total area of 9160+2840=12000 hectares). | Bs B | 756 | 21 | 6.2 |
| KUNTAUR (1650 hectares) | Completely mechanised project, including pumping stations, water circulation channels, drains, preparation work and infrastructures | Investment: 20131 Operation and maintenance: 317 Management : 409 | Mechanised Rainy season 5.0 Dry season 5.0 | | 190% | 12000 hectares (to be divided equally between the three types of farming after initial development | C D | 981 | 23 | 7.5 |
| | | | Medium Scale Rainy season 5.0 Dry season 5.0 | | 175% | | | 1036 | 28 | |
| | | | Small Rainy season 4.5 Dry season 5.5 | | 175% | | | 1202 | 29 | |

The estimated cost of establishing the technical specifications is approximately 3% of total cost of work, ie. 5.5 million Dalasis :

- execution study of the dam and ancillary structures 4.2 million Dalasis
- execution study of phase I hydro-agricultural developments over 2900 hectares ..... 1.3 million Dalasis

With a 10% rate of inflation, the execution of these projects between 1981 and 1985 would necessitate the following financing:

| $ 1 US=2.2 Dalasis | Cost of dams as of 1978 (million Dalasis) | Outlays from 1981 to 1985 | |
|---|---|---|---|
| | | million Dalasis | US$ millions |
| Regulating dam | 138 | 225 | 105 |
| Hydroagricultural developments (phase I, 2900 hectares) | 42.6 | 70 | 32 |
| Total | 180.6 | 295 | 137 |

5.3.5 - The 15-year period between 1986 and 2000, would be devoted to the implementation of phase II hydro-agricultural developments, i.e, 21.250 hectares at an estimated cost of 336 million Dalasis at 1978 prices (on average, 23 million Dalasis per year in 1978 prices).

.../...

## 5.4 - DEVELOPMENT OF THE GAMBIA RIVER BASIN

### Programme of basic studies

OMVG member countries have begun a full development programme of land potential and hydraulic and human resources covering the full 77.850 km2 of the basin, of which 14% is located in the Gambia.

The studies carried out by the UNDP between 1977 and 1979 have examined several hypotheses for the development of irrigated and rainfed farming, corresponding to several sets of options. The investigations which are continuing should soon result in the definition of a development strategy.

Basic studies must thus be carried out now to gain better knowledge of the land, water and human potential of the basin. The OMVG has established a programme to this end.

### 5.4.1 - Topography and mapping

This project would cover the whole 77.850 km2 of the Gambia river. The terms of reference, drafted in 1979, enumerate the work to be performed :

- precision measurement of levels with first order chanelling of water along the river and second order progress in development zones
- geodesic precision chanelling the length of the river
- a set of aerial photographs
- mapping of the whole basin at 1/50000
- mapping of development zones at 1/10000 ie, an area of approximately 100.000 hectares considered to be potentially irrigable.

The mapping and topographic work would be performed by the UNDP for the Gambian section.

.../...

5.4.2 - Podology

A 1/125000 scale map for the classification of soils was established in 1973-74 by the Land Resources Division of the MOD.

In zones considered suitable for irrigation -ie, an area of approximately 100.000 hectares (gross) in the Gambia - a 1/50000 podological map is required for the classification of soils in terms of their suitability for different crops, similar to the map drawn of the Senegal river valley (SODAGRI project, 1973).

We propose a two-week mission on-the-spot, comprising a senior podological engineer and a project engineer, to assist Gambian personnel in drafting the terms of reference for this activity.

5.4.3 - Hydrology

The hydrological studies started by the UNDP programme (UNDP, REG/60) including 33 measuring stations should be pursued.

This project requires support in the form of equipment and observation infrastructures, and in operating costs, over 4 years. The cost is estimated to be US$ 300,000 (64 million CFA Francs). A request for financing has been submitted to France (FAC) for this project.

5.4.4 - Agronomic research and experiments

A Gambian programme of agronomic research and experiments should be prepared as a complement to and in close relation with the work carried out in this field in the Gambia, in Senegal (Djebilor), by the OMVS, by the ADRAO, etc.

.../...

A two-month mission of 5 experts is proposed to this end.

5.4.5 - Study of the impact on the environment

The OMVG has established the terms of reference of a general environmental survey of the Gambia river basin, including :

- a biological, physical and chemical research programme (see the COODE AND PARTNERS Study, Volume 5, appendix C2).

- a programme of research into public health and animal health covering in particular the effect of foreseen hydraulic developments on human and animal diseases, disease vectors, epidemiology, the control of contagious diseases, sanitary installations and nutrition.

- studies of the influence of anticipated developments on the environment, ecological balance, animal life, demography, fishing, etc.

As a first approximation, the estimated cost of this general environmental survey is between US$ 1 and 2 million.

5.5 - UPSTREAM DEVELOPMENT STUDIES (from the Yelitenda dam)

These studies relate to the two reservoir dams of KEKRETI and SAMBANGALOU (see § 3.3.3 and 3.3.4 above).

Before envisaging their actual construction and seeking the corresponding finance (1) the technical and economic specifications must be completed, namely, feasibility and optimization studies of the regulating dams.

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Note 1 - Present estimate of cost for these two dams is :
- Kekreti $ 103 million (1974 prices)
- Sambangalou $ 143 million (1974 prices)

.../...

5.5.1 - Feasibility studies : Kekreti and Sambangalou

The OMVG has already drafted the terms of reference defining and assessing this work. They are summarized in the table given below :

| | KEKRETI | SAMBANGALOU |
|---|---|---|
| Compilation of basic data | 40 | 50 |
| Topography of sites and reservoirs | 200 | 300 |
| Geological studies | 100 | 150 |
| Geotechnical reconnaissance | 200 | 350 |
| Hydrological and regulation study | 100 | 100 |
| Studies of dam and ancillary structures | 150 | 200 |
| Study of electrical power plant and high voltage cables | - | 150 |
| Economic and financial studies | 60 | 60 |
| Total | 850 | 1.360 |
| General total | US $ 2.210.000 or 4.850.000 Dalasis | |

The cost of the two execution studies, to be carried out later, would be similar, ie. a total of approximately $ 2.2 million for the two dams.

The feasibility studies would last for about two years, and it is hoped that they can be completed by 1982. West Germany is understood to have allocated DM 4 million for this purpose.

5.5.2 - Study for the optimization of regulating dams

This study is absolutely necessary to establish the order of priority for the construction of the large hydraulic regulating dams scheduled at Yelitenda, Kekreti and Sambangalou.

.../...

A mission of experts could assist the OMVG in drafting the terms of reference of this study. This mission would last three weeks and include 1 project engineer, 1 civil engineer specialised in dams, 1 hydrologist and 1 agro-podologist. The study would cover in particular :

- the rising of the salt tongue as a function of different scenarios of regulated flows, slackwater flows and withdrawals for irrigation.

- detailed inventory of the sites which could be developed and the possible time sequence of developments.

- a general energy market survey for urban (Dakar, Banjul, etc.), industrial (Falémé mines) and agricultural requirements.

- needs for agricultural products in the Gambia and Senegal (analysis by region).

- the list and a logical time chart of the studies to be executed in the short term to complete the projects by 1990, as well as the definition of associated activities to be carried out (training, communications, etc.)

5.6 - INSTITUTIONAL SUPPORT TO THE OMVG

At present the High Commissariat of the OMVG requires institutional support of a minimum of 3 higher level experts. They would help in drafting the terms of reference and the follow-up of studies, the coordination of activities in course, the reception and analysis of specifications, programming, etc.

5.7 - SHORT EXPERT MISSIONS

Several missions covering specific tasks have been proposed above. Other supporting missions to Gambian departments would be necessary, in particular for :

.../...

- preparing a 6-year practical training programme on irrigated farming and rural development (1980-85), integrated with Gambian structures and existing projects.

- lay the ground for a Rural Engineering Service, which would be responsible for hydro-agricultural development studies, and managing and supervising work. It would be the Gambian opposite number of the OMVG for regulating dams and the development of the basin (1).

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Note (1) The creation of a National Bureau of Irrigation, proposed in the Report on Irrigated Farming drafted by the CILSS/Club du Sahel in May 1977, should doubtless be envisaged at the end of the second programme, ie. in 1985, when the anti-salt dam and the first large perimeters will enter into service, by which date existing projects will call for a solid operating and management structure.

.../...

THE GAMBIA

PROPOSALS FOR A SECOND PROGRAMME, 1980 - 85.

| Project title | Estimate of Costs | | Period |
|---|---|---|---|
| | Dalasis thousands | US$ thousands | |
| 1. Yelitenda anti-salt dam bridge and associated hydro-agricultural developments (phase I, 3 pilot perimeters) | | | |
| a) Execution study of the dam bridge and ancillary structures. | 4.200 | 1.910 | 1980 |
| Study of the three pilot hydro-agricultural developments over 2900 hectares. | 1.300 | 590 | 1980 |
| b) Execution of the Yelitenda anti-salt dam-bridge. | 225.000 | 105.000 | 1981-85 |
| Execution of the 3 pilot hydro-agricultural developments over 2900 hectares. | 70.000 | 32.000 | 1982-85 |
| 2. Programme of basic surveys of the Gambia river basin : Topography, cartography, podology hydrology, agronomic research, environmental study | 8.800 | 4.000 | 1980-83 |
| 3. Study of developments upstream from Yelitenda | | | |
| Optimization studies of regulating dams | 1.100 | 500 | 1980 |
| Dam feasibility studies - Kekreti | 1.870 | 850 | 1981-82 |
| - Sambangalou | 3.000 | 1.360 | 1981-82 |
| Execution study for one of these two dams | 4.400 | 2.000 | 1984-85 |

.../...

| | | | |
|---|---|---|---|
| 4. <u>Technical assistance and other</u> | | | |
| Institutional support to the OMVG | | | |
| 3 experts over a period of 4 years | 3.080 | 1.400 | 1980-83 |
| Short expert missions | 1.100 | 500 | 1980-83 |
| Training (programme to be specified) | 2.200 | 1.000 | 1981-85 |
| 5. Completion of the 1st programme (pro mem.) | | | |
| 5.1- Development of Jakhally and Petchar, 2600 hectares | | | |
| . Feasibility study : financed, under way | p.m. | p.m. | 1979-80 |
| . Work (date of completion according to the regulation study). | 65.000 | 29.500 | 1981-83 |
| 5.2- Rehabilitation and extension of small irrigated perimeters | 7.600 | 3.500 | 1979-81 |
| 5.3- Rice mill and access roads | 5.100 | 2.320 | 1981-83 |
| Total | 403.750 | 186.430 | |

Rounded estimate of cost of the 2nd programme :

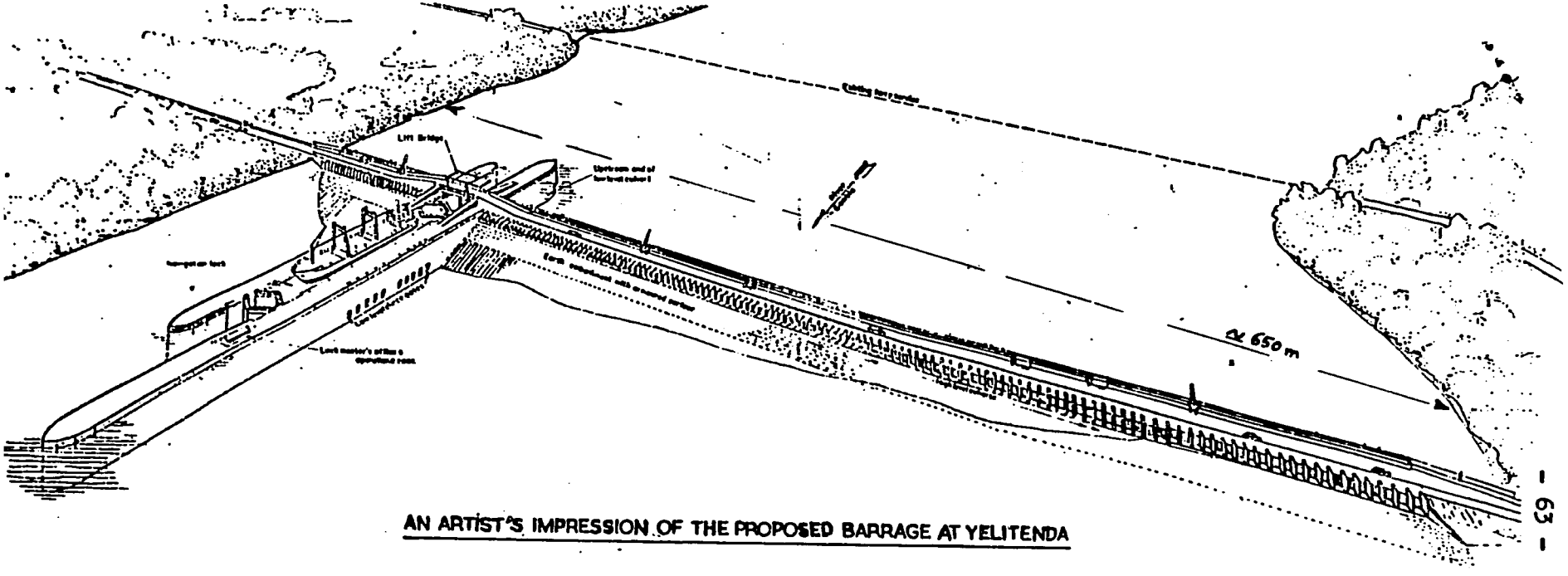
405 million Dalasi

or ₵ 186 million

.../...

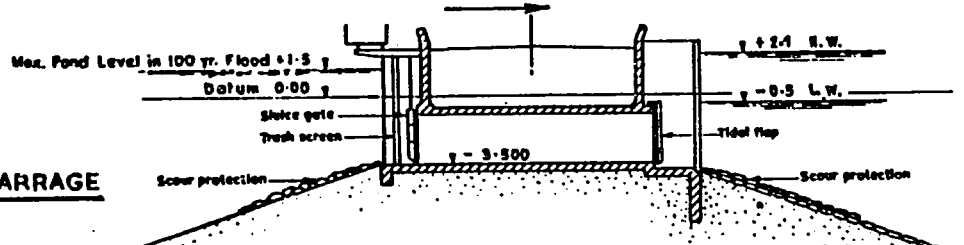
IRRIGATED FARMING IN THE GAMBIA

ANNEXES

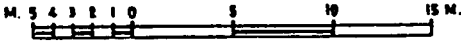


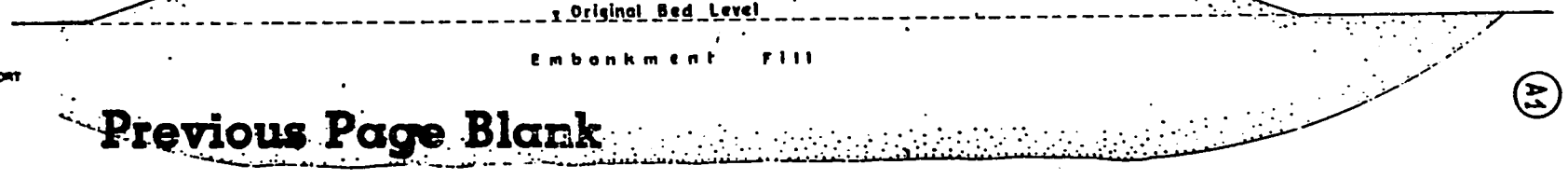

AN ARTIST'S IMPRESSION OF THE PROPOSED BARRAGE AT YELITENDA






TYPICAL SECTION THROUGH BARRAGE




GAMBIA BARRAGE REPORT

(A1)

## IRRIGATED RICE DEVELOPMENT PROJECT

### IN 1978

| | SOCIETY | ACREAGE |
|---|---|---|
| 1. | Jarreng | 50 |
| 2. | Kerr Biron | 30 |
| 3. | Ngawar | 26 |
| 4. | Sotokoi | 39 |
| 5. | Jafai | 125 |
| 6. | Kundang | 104 |
| 7. | Sinchu Gundo | 20 |
| 8. | Kerewan Demba Ubai | 36 |
| 9. | Kunun Ku | 10 |
| 10. | Tuba Demba Sama | 13 |
| 11. | Sambel Kunda | 20 |
| 12. | Jahally | 89.5 |
| 13. | Medina N'Fally | 42 |
| 14. | Brikamanding | 58.6 |
| 15. | Brikamaba | 14 |
| 16. | Wellingara | 58.5 |
| 17. | Saruja | 96.55 |
| 18. | Kerewan Fula Kunda | 60.1 |
| 19. | Kerewan Mandiaka Kunda | 64 |
| 20. | Taifa | 19 |
| 21. | Sinchu Yoro | 22 |
| 22. | Fulla Bantang | 25 |
| 23. | Tabanani | 75.5 |
| 24. | Konko Fula | 4 |
| 25. | Wuring Kunda | 33 |
| 26. | Tumani Fatty | 10 |
| 27. | Nema | 24 |
| 28. | Faraba | 52.8 |
| 29. | Sankule Kunda | 102 |
| 30. | Georgetown | 154.6 |
| 31. | Y.B.K. | 7 |
| 32. | Boroba | 70 |
| 33. | Keser Kunda | 35 |
| 34. | Korop | 15 |
| 35. | Buruko | 37 |
| 36. | Tuba | 13 |
| 37. | Sololo | 38 |
| 38. | Bansang | 78 |
| 39. | Bantanto | 25 |
| 40. | Digir Kunda | 20 |
| 41. | Librass | 20 |
| 42. | Kerewan Dumbokono | 61 |
| 43. | Dobang Kunda | 65 |
| 44. | Chagel | 32 |
| 45. | Sara Pateh | 22 |
| 46. | Sara Foffie | 61 |
| 47. | Cha Kunda | 60 |
| 48. | Santanto | 31 |
| 49. | Sinchang Faramba | 21 |
| 50. | Sara Samadi | 20 |
| 51. | Sinchu Samba Jawo | 20 |
| 52. | Silleri Kunda | 28 |
| 53. | Sara Sawadi | 20 |
| 54. | Batti Ndarr | 18 |
| 55. | Wassu | 27 |
| 56. | Jakaba | 21 |
| 57. | K.T.R. Fula Kunda | 15 |
| 58. | Baigally Tenda | 17.5 |
| 59. | Baigally Suba | 11 |
| 60. | Sukuta Jaka | 85 |
| 61. | Kai Hai | 36 |
| 62. | Jarume Kuta | 12 |
| 63. | Manna | 20 |
| 64. | Jaremeh Koto | 36 |
| 65. | Banni | 29.6 |
| 66. | Kunting | 36.2 |
| 67. | Dobo ADP | 18.2 |
| 68. | Sami Medina | 12.5 |
| 69. | Sami Omai Jala | 9 |
| 70. | Medina | 34 |
| 71. | Bayaba | 14 |
| 72. | Tondi Kunda (Mandinka) | 14 |
| 73. | Karantaba Dutokoto | 14 |
| 74. | Karantaba Tobokoto | 22.5 |
| 75. | Karantaba Tukulor | 34 |
| 76. | Banfany Nyalli | 14 |
| 77. | Koli Kunda | 22 |
| 78. | Lamin Koto | 9 |
| 79. | Salikenni | 15 |
| 80. | Basse | 38 |
| 81. | Danfa Kunda | 242 |
| 82. | Chamoi | 17.5 |
| 83. | Allungbari | 325.5 |
| 84. | Kambe | 34 |
| 85. | Numuel | 60 |
| 86. | Gambissara | 93 |
| 87. | Hella Kunda | 42.1 |
| 88. | Bakadagi | 27.6 |
| 89. | Kossimar | 42.5 |
| 90. | Tabajang | 40 |
| 91. | Dasnbading | 13 |
| 92. | Jeelangel | 20 |
| 93. | Sincha Sare | 13 |
| 94. | Koro Jula Kunda | 19 |
| 95. | Demba Langel | 20 |
| 96. | Sabu Sire | 12 |
| 97. | Prai | 16.5 |
| 98. | Badari | 23 |
| 99. | Kulari | 39 |
| 100. | Tuba Kawsu | 11 |
| 101. | Sare Alpha | 49 |
| 102. | Suduol | 57 |
| 103. | Niankui | 39 |
| 104. | Njaibi | 14.5 |
| 105. | Naude | 11.5 |
| 106. | Diabugu | 76.6 |
| 107. | Dasileme | 19 |
| 108. | Jakaba | 24 |
| 109. | Passonto (Misera) | 27.5 |
| 110. | Chanfally | 34 |
| 111. | Bajon Koto | 54 |
| 112. | Banni | 15 |
| 113. | Tisbatu | 55 |
| 114. | Kerewan | 85 |
| 115. | Madina Koto | 20 |
| 116. | Limbanbala Bambo | 16 |
| 117. | Timbanbulu Jamadu | 22.5 |
| 118. | Baja Kunda | 26 |
| 119. | Tambasansang | 53 |
| 120. | Demba Kunda | 30 |
| 121. | Koba Kunda | 16.5 |
| 122. | Kundam | 26.5 |
| 123. | Koli Kunda | 15 |
| 124. | Timbinto | 8 |
| 125. | Sifula | 8 |
| 126. | Sotuma Sere | 14 |
| 127. | Sotuma Samba | 36 |
| 128. | Mama Sutu | 13.8 |
| 129. | Chamoi Wuli | 26 |
| | TOTAL (acres) | 4,939.2 |
| | = 1.998 hectares* | |

* 1 acre = 0.4047 ha.

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Irrigated Farming / The Gambia

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