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PREFACE

At the Third Conference of the Club du Sahel in Amsterdam in November 1978, the meeting recalled that the main objective of the development strategy of the Sahel is an increase in crop production. In the 1979 Work Programme, therefore, a dominant role is assigned to first generation rainfed and irrigated farming projects. The meeting has especially stressed the need to prepare a second generation programme of irrigated farming projects during 1979.

A Club du Sahel (FAC, USAID) and CILSS mission visited Senegal from May 16th-30th, 1979 in order to examine the present trend of irrigation and irrigated farming projects with Senegalese authorities, as well as to carry out a general review of the CILSS first generation programme, analyse prospects, and finally, compile the information and data necessary for drafting a second generation programme covering the 1980-85 period.

More concretely, the mission's objectives were to:

- analyse the main difficulties encountered in the light of experience acquired on existing perimeters, and to uncover the main constraints which are slowing down the development of irrigation at the farmer, perimeter management and national levels;
- make concrete proposals in order to do away with these constraints or fill the gaps which hamper the implementation of a true irrigation policy;
- identify studies and projects which are available or under way;
- compile all the data, given the general planning operations which have already been undertaken by the CILSS (the reports of the Working Group on "irrigated farming" in particular) and by national departments (pluri-annual plans), required to allow a set of new projects to be identified. With projects already available or under study, they will constitute a second generation programme, provided that the national authorities give their approval;
- specify the needs in executive staff at all levels (managers, accountants, agronomists, technicians, advisors, etc.) involved in this programme and determine corresponding requirements for training programmes;
- sketch out the schedule for studies to be undertaken to bring each of the projects selected up to the feasibility study stage.

In order to make this report more complete, a short review of the main characteristics of Senegal has been given, covering its agricultural and food policy, and placing irrigated crops in the context of the economy and national planning.

Irrigable land potential in Senegal is reviewed and the analysis of the main constraints on the development of irrigation has led to a general overview and then a draft proposal for a programme for the SAED, the largest Senegalese development corporation as regards irrigated farming, which is responsible for the development of the Senegal river valley.

Proposals are made for a short-term action programme, i.e. covering 1980-1985.

The document has taken full account of the data and views of Senegalese authorities, as well as the contents of official reports which have been consulted. Some tables or passages from these documents are reproduced here. Proposals have been made for short visits by missions of experts. These are necessary for the preparation and evaluation of these second generation projects. As regards irrigated wheat production, a proposal has been made for a regional project with some extensions to national level which could meet the objectives established in 1977 by the CILSS/Club du Sahel Working Group on Irrigated Farming.

SUMMARY AND CONCLUSIONS

1. Since 1977, Senegal has confirmed how dependent its agriculture is on rainfall(1), as it had to import more than 600,000 tons of cereal in 1977-78; production in this crop year covered only 43% of the country's needs. Food dependence is worsened by the rural exodus: the countryside cannot feed the towns any longer. They are large rice, wheat and sugar consumers and these crops can only be grown using irrigation.
 2. In order to reduce this dependence, the 5th Plan (1977-1981) allocates half the total budget of agriculture to irrigated farming (24.6 billion CFA francs out of a total of 50.8 billion), and has tried to accelerate the process of installing large dams regulating the Senegal river. The two large areas of irrigation development are the river region (70% of the investment in irrigated farming), and the Casamance.
 3. The SAED was to develop an average of 5,400 hectares a year, according to the Plan forecasts for the delta and the river valley (development with full water control). In 1979, halfway through the Plan, the pace has been no more than 2,000 hectares a year. This great lag vis-à-vis the objectives has several causes: delays in organising credits(2), supply difficulties and organisation and management problems of the Development Corporation.
 4. In the Casamance region, the development plan had given priority to the coastal Casamance (where the density of population is highest), with a hydraulic network comprising 5 anti-salt dams for the protection of large potential rice-growing areas against sea water. The studies on these 5 dams were delayed by reason of lack of funds and the fear that these developments could have dangerous consequences, such as the acidification of mangrove lands after they had been dried out. The Senegalese Government is aware of the problem and is going forward with a test operation: the Guidel dam and its associated agricultural development. This project will disclose the problems of rice cultivation on salt land, as well as the effect of anti-salt dams on the environment.
 5. The Government, in the light of delays in the execution of projects, low yields of irrigated crops, and the poor harvests of the last crop year for rainfed cultivation due to sparse rains, has decided to reduce the estimate of the 5th Plan. In June 1979, 2,793 million CFA francs were still to be found out of a total amount of 24,571 million for irrigated farming projects envisaged in the revised Plan.
- (1) And on groundnuts, which remains the major crop in spite of diversification efforts.
- (2) In spite of a very high financing ratio: 71% by comparison with initial Plan forecasts and 75% compared to the revised estimates (for irrigated farming).

At this same date, i.e. halfway through the Plan, the financial implementation ratio of the SAED was 26% for "old projects" and 41% for new projects; it was even lower at the SOMIVAC.

6. The CILSS first generation programme includes a large proportion of 5th Plan projects: its financing status is similar to that of the Plan. As of October 1979, it may be taken that approximately 60% of projects have been financed.

7. The present report has attempted to analyse the constraints slowing down the development of irrigation in Senegal today, and for this purpose, has focused on three main aspects:

- 1 - low yields obtained on recently developed perimeters with full water control and the low share of production marketed.
- 2 - the problems of maintenance of infrastructures and hydraulic projects.
- 3 - the low pace of development.

8. Paddy rice production(1) at the SAED was between 1.82 tons and 4.05 tons per hectare cropped, or between 0.77 tons and 2.19 tons per hectare planted in the last three crop years. This is far from an adequate return on costly development projects (1 to 2 million CFA francs). Lack of regular maintenance of the hydraulic network can cause deterioration calling for considerable rehabilitation work on developments such as those at DAGANA, NIANGA and BOUNDOUN, which have been operational for only a few years.

9. There is a need to give Development Corporations a solid and efficient structure or "muscle build", and to direct effort resolutely to intensive production, especially the services required for farmers, and the organisation of marketing and of agro-industrial activities. Organisation, forecasting and management ability are fundamental necessities.

10. The present period should therefore be viewed as a teething stage for normal exploitation to be achieved during the 6th Plan, by training the river farmers to carry out annual two-crop rotation which the Diama and Manantali dams will make possible.

11. The CILSS proposals for a second generation programme have been made in this framework. The corresponding studies, research(2), personnel training and structural support activities are of major importance. This is a provisional programme. Short missions scheduled in the near future will enable this programme to be improved and to evaluate its cost.

(1) In its preliminary study of the acreage to be developed in Sahel countries, the Working Group on Irrigated Farming has used an average of 3.5 tons of paddy per hectare (Ottawa).

(2) Agronomic research on wheat will have to be extended considerably if the objectives set are to be met (34,000 tons in 1990). A proposal has been made to this end.

CHAPTER I

I. PRESENT STATUS OF IRRIGATED FARMING IN SENEGAL

The Senegalese 5th Plan (1977-1981) provides for the development of irrigated farming, and projects an investment of 25 billion FCFA, i.e. approximately 6 billion a year or about half the agricultural budget (see Annex A, economic and agricultural data).

1.1 Possibilities

The reader may refer to the numerous documents covering this topic, especially the report "Irrigated Farming in Senegal", by the CILSS/Club du Sahel in May 1977. Only the most important features which will help in reading the report will be recalled here (see the table of irrigable land potential in Annex B).

1.11 Soil Resources

- a) In the Senegal river valley (left and right banks) a 1/50,000 survey was carried out on soil cultivation potential covering over 800,000 hectares of irrigable land of which almost 500,000 hectares on the left bank. Most of these clay soils (HOLLADES) are particularly suitable for rice farming. However, problems of salinity are met frequently up to nearly 300 km of the estuary, due to fossil salt water (Nouakchottian transgression), and to the penetration of the "salt front" which the DIAMA anti-salt dam will abolish in a few years time.
- b) There is a particular balance in the Casamance river, between fresh water supplied by winter rain and salt water which mounts the Casamance river and its main tributaries; this determines several types of soil use : fresh and salt water, rice plantations, sterile "tann" soils without any vegetation, and mangrove soils.

This balance has been upset in the last few years by an exceptional series of droughts. The influx of salt water has caused many traditional rice plantations to be abandoned.

In addition, soil desalination experiments have sometimes led to drying of soils with transformation of sulphides into sulphates; the increased acidity of the soils (with a PH sometimes declining to 3 and even to 2) has rendered them completely sterile.

There is presently no known way to reclaim thisland, and it is therefore necessary to continue the experiments now being performed, in particular at the Djibelor station. It is however believed that salt water submersion is less harmful to these soils than prolonged drought.

Attention has only recently been focused on these unsolved problems; it led the Regional Planification Unit of the SOMIVAC to propose establishing rice plantations as a priority in the fresh water areas located in the middle and upper Casamance as well as in the upper section of the Casamance's tributaries.

- c) Various types of soils can be found in the remaining areas of the country, with light soils dominant in the peanut crop basin, where their suitability for irrigation is determined pragmatically in the light of progress in harnessing water resources.

In general, the absolute need for adequate knowledge of the irrigation capacity of soils(1) and of their behaviour under various methods of cultivations, drainage and irrigation, should be stressed. Several projects had to be abandoned and some soils were even permanently rendered sterile through activity which was not appropriate, for the natural conditions of soils.

1

1.12 Water resources (see maps in Annex C).

The major part of Senegal has a Sahelian and sub-Sahelian climate, very little relief, and rainfall certain to be less than 600 to 700 mm per year. The flow of surface water is therefore very low and water resources available throughout the year are limited, apart from underground water table and the large rivers fed from their upper basins in Guinea and Mali : the Senegal and the Gambia rivers.

The Senegal river can therefore be divided schematically into four large areas, as regards the specific methods for harnessing them :

- a) The Senegal river valley and delta; various projects are being carried out by the OMVS (Diama and Manantali dams, navigation), and, in the long term, several hundred thousand hectares can be irrigated after embanking and pumping. (See map C.3)

(1) See for instance, the technical difficulties entailed by excess salinity of soil at Boundoum, North Kassak and Tellel.

- b) The Upper Gambia, which can be taken together with the Kayanga basin where the large Sambangalou and Kékréti projects are under study by the OMVG, and the Amambé project is under study by the SODAGRI.
- c) The Casamance river where rainfall of 800 to 1200 mm per year generate substantial water resources, in spite of a low rate of flow and the incursion of sea water.
- d) The rest of the country including in particular the peanut basin, Eastern Senegal and the Cape Verde peninsula where only the subsurface water deposits can be exploited; for the time being, their rate of renewal is hard to assess. Water from these subsurface deposits will be used in priority for human and animals drinking water, and to irrigate a few small areas for market gardening crops.

1.13 The need for large hydraulic dams (See map C.1)

- a) The Diama dam is 26km upstream from Saint-Louis on the main body of the Senegal river; it is submersible during floods - a so called "movable weir" whose function is to raise the level of the water upstream to 1.50 m and possibly to 2.50 m, in order to :
 - stop the intrusion of the "salt tongue";
 - build a water reservoir upstream (capacity : 250 million cubic meter at the 1.50 m level, 580 million m³ at the 2.50 m level);
 - improve the filling of the tributaries of the lower valley and the Delta, including, on the left bank, Lake Guiers and the Gorom-Lampsar axis. Eddy currents caused by the dam will be felt upriver as far as Demet, beyond Borghe, 400 km from Saint Louis at 1.50 m level, and as far as Vinding at the source of the Doue, approximately 500 km from Saint-Louis at 2.50 m level.

The dam will therefore have an impact on the whole Delta and lower valley comprising approximately 280,000 hectares of irrigable land. Its direct effect will be to irrigate some 75,000 ha all year round, within its area of influence.

The opening of the Diama site is scheduled for the end of 1979, and entry into service of the structure for 1983.

b) The Manantali dam

This dam is installed on the Bafing river in Mali, to regulate the flow. Its capacity will be 10 billion m³ and its main functions to :

- ensure a steady flow of 300 m³/second at Bakel,
- supply 800 GWH of electricity with guaranteed availability of 100 MW,
- break floods.

After its completion which is forecast for the second half of the next decade, it will be possible to irrigate an additional 300,000 hectares under two-crop rotation.

c) Large hydraulic dams on the coastal Casamance and on the Gambia river are only at the earliest stage of feasibility study, and their main features have not yet been specifically determined. These are :

- the anti-salt dams on the coastal Casamance;
- Sambangalou, Kekreti and Yélitenda⁽¹⁾ dams on the Gambia river;
- harnessing of the Anembe and the Kayanga rivers.

1.2 Irrigated crops and national needs

1.21 Low and stagnant production

In a country whose water resources and irrigable land are among the greatest of the Sahel countries, it may be observed that irrigated crops account for a relatively small share of total crop production.

The crop year 1978/79 was relatively good and irrigated crops represented 24% of the aggregate food crop production, and 13% of total agricultural production (including peanuts for oil).

The table below allows rainfed and irrigated farming and their trend to be compared since 1973, and in relation to the Plan's objectives.

(1) The Yélitenda dam - bridge is on the Trans-Gambian axis and should be implemented during the next few years.

The table below allows rainfed and irrigated farming and their trend to be compared since 1973, and in relation to the Plan's objectives :

CROP YEAR	Thousands tons						Plan objectives for 1981	
	73/ 74	74/ 75	75/ 76	76/ 77	77/ 78	78/ 79	Target in 000's t	Achieve- ment ratio
Irrigated crops								
Paddy rice	65	105	125	106	62	128	300	42.5%
Tomato	3	6	13	17	13	15	94	16 %
Sugar			15	16	23	35	80	44 %
Fruit & vegetables	63	85	103	104	109	108	-	-
Rainfed crops								
Peanuts for oil	675	994	1450	1182	586	950	1200	79 %
Edible peanuts	-	-	-	14	18	31	63	50 %
Millet & sorghum	511	780	677	507	416	795	750	106 %
Corn	32	43	49	42	32	47	148	32
Cotton	33	40	43	47	38	34	66	57 %
Niebe				16	13	15	-	-

Source : 5th Plan, revised.

Scrutiny of the table shows that :

- Apart from sugar, irrigated crops output has been stagnant for six years, in spite of the magnitude of the hydro-agricultural projects implemented, in particular, in the region of the river. This is particularly evident for paddy rice; the 1978-79 crop represented only 24% of national needs (real consumption).
- The output of irrigated crops is altogether out of line with the forecasts in the 5 year plan for 1977-1981. The reasons for these differences will be analyzed in the next chapter which deals with constraints to the development of irrigated crops.
- Rainfed crops suffer large variations from one year to the next, induced in large part by climatic variability : the good millet and sorghum crop in 1978-79 made 100,000 tons available for marketing and created storage and distribution problems.

1.22 Unsatisfied needs

Most agricultural regions in Senegal are barely able to cover their need for cereals out of their own production. This perpetual deficit is greater in urbanized areas such as the Cape Verde peninsula and greater for irrigated (rice) than for rainfed (millet, sorghum, corn) crops.

The table below shows the projections of needs for cereals in Senegal up to the year 2000 :

Cereals	Annual needs per person (in kg)	Requirements in 1000 tons			Production 1976-1977	
		1977	1990	2000	1000t	coverage ratio %
Millet-sorghum	110.6	552	743	905	536	97.1
Rice	47.3	236	318	387	63	26.6
Corn	12.3	62	83	102	47	76.6
Wheat	27.9	139	187	228	0	0
Miscellaneous	12.2	61	82	100	0	0
TOTAL	210.5	1050	1413	1722	646	61.5

Source : FAO ONCAD - DGFA

These figures illustrate the size of effort to be made by the Senegal to eliminate its deficit in the coming years. Disequilibrium will be increased in the future, given the rate of population growth, which, according to a "low estimate", will increase from 5,490,000 in 1978 to 6,714,000 in 1990 and to 8,039,000 in 2000. Given the per capita needs assessed at 210 kg per year, total requirements would reach 1,722,000 tons, i.e. double the amount of the best harvest to date.

The present cereal deficit necessitates substantial recourse to imports as shown in the table below :

Thousands tons

Years	71/72	72/73	73/74	74/75	75/76	76/77	77/78
<u>Production</u>							
Millet-sorghum	577	319	536	775	640 n	507	422
Rice*	71	25	41	67	85	70	40
Corn	39	21	45	43	46	45	48
TOTAL	687	365	622	885	771	622	510
<u>Imports</u>							
Millet-sorghum	-	56	14	-	48	-	36
Rice	188	170	192	175	102	200	218
Corn	33	10	52	27	10	13	21
Wheat	105	95	105	61	105	120	201
Food aid (all cereals)	-	63	93	17	-	6	190
TOTAL	326	394	456	280	265	339	666
<u>Exports</u>	8	-	14	14	8	5	-
Availability	318	395	442	266	257	334	-
Coverage ratio	67.5%	47.7%	57.2%	75.7%	74.2%	64.5%	43.3%

* 65 kg of rice correspond to 100 kg of paddy rice.

Source : NOUAKCHOTT Colloque; figures from DSPA, ONCAD, WFP, FAO, R. HIRSCH-BABACAR BAH 1979.

For more than 20 years, Senegal has had a deficit in cereals and has had to import (or receive food aid) over 300,000 tons a year (426,000 tons of rice and wheat in 1973-74, 666,000 tons in 1977-78). The aggregate coverage ratio was 75% in 74/75 and 75/76 which were good agricultural years, but declined to 43.3% in 1977/78.

1.3 Existing Operations and Development Corporations

In Senegal, the implementation and management of hydro-agricultural projects is handled by "Development Corporations"(1), each of which carries the responsibility for developing a given area :

- a) The SAED "Société d'Aménagement et d'Exploitation des Terres du Delta" (Delta Land Development and Exploitation Corporation), whose task is to develop the Region of the Bakel river and Department;
- b) The SOMIVAC "Société pour la Mise en Valeur de la Casamance" (Casamance Development Corporation which covers the Casamance;
- c) The SODAGRI "Société pour le Développement Agricole et Industriel" (Agricultural and Industrial Development Corporation), whose activity lies in the regions of the Kayanga and Amembe rivers, in collaboration with the SOMIVAC ;
- d) The SODEFITEX "Société pour le Développement des Fibres Textiles" (Development Corporation for Textile Fibres) which covers Eastern Senegal and part of the Upper Casamance.

1.31 The SAED (St. Louis) - See maps C3 and C4 in Annex C

This is the largest development Corporation in terms of investments managed to date. In May 1977, the SAED was exploiting 9320 hectares of cereal cropland, of which 3020 hectares had been developed to the "tertiary" stage and 6300 hectares to the "secondary" stage. The 5th Plan provides for consolidation to the "tertiary" stage of the latter, during the 1977-1981 period.

It should be observed that in the Senegal valley, controlled submersion ("primary" and "secondary" development), has been progressively abandoned, given the unforeseeable variability generated by the irregularity of rainfall and river flooding. Accordingly, only projects in which there is complete water control and which require pumping are now envisaged for irrigation and drainage. Operating costs for these projects are very high (between 2 and 5 CFA francs per m³ pumped), and the upkeep of pumping stations is a pre-condition for reliable development. For several reasons, the operation of these structures has not always been successful, entailing several cases of heavy crop loss.

- (1) Private developments are few and far between and cover only a few hundred hectares : SOCAS for tomatoes, the fruit and vegetable tracts of the NGOs... The special case of BUD SENEGAL on the Cape Verde Peninsula was not examined.

Hence, despite the recent development of many areas (the large Telel dam, Lampsar, Thiagar in the Delta; Dagana, Nianga, Guede, Aere, Lao, Matam, and Bakel in the valley), cultivated acreage has declined in the past few years, by reason of progressive abandonment of "primary" developments in which control of water proved inadequate (1).

A - TERTIARY DEVELOPMENT CARRIED OUT AS OF 30.06.1978

Source : SAED

BASIN	Developments (hectares)				
	Cumulative Total 30/6/76	1976 1977	Cumulative Total 30/6/77	1977 1978	Cumulative Total 30/6/78
Savoigne	300	-	300	-	300
Boundoum	2,240	160	2,400	-	2,400
Kassack-sud	270	-	270	-	270
Thiagar	300	400	700	238	938
Large Telel dam	400	140	540	487	1,027
Colonat Richard-Toll	680	90	770	-	770
Ndombo-Thiago	90	105	195	177	312
TOTAL DELTA	4,280	895	5,175	842	6,017
Dagana	1,700	300	2,000	-	2,000
Nianga	500	144	644	106	750
Guede	182	190	371	24	395
Aere-Lao	-	200	200	250	450
Matam	320	150	470	280	750
Bakel	95	5	100	150	250
TOTAL S.A.E.D.	7,077	1,884	8,960	1,652	10,612

The 5th Plan had projected the development of 5,400 hectares annually. However, a rate of 2,000 hectares a year only was achieved in the course of the first half of the Plan. Among the causes of this delay should be stressed, in particular, insufficient credit, delays in making finance available, the inadequacy of certain studies (2), difficulties of supply, poor management and executive staff, and a degree of overcentralization. In the revised Plan the rate of development has been readjusted to 3,000 hectares per year.

- (1) The cultivated area covered by "primary" developments had fallen to only 1,300 hectares in 1977/78 and 800 hectares in 1978/1980.
- (2) For instance, the inadequacy of the studies performed at Boundoum, where the soil was found to be excessively saline.

For the 1979-1980 campaign, the SAED has projected the irrigation of 10,000 hectares equipped at tertiary level.

B. By contrast, the village perimeters installed in 1975-76 as an experiment meet a need felt by farmers and are growing rapidly. In 1978-79, 74 village perimeters were under cultivation in Guede, Abre, Lao, Matam and Bakel covering 1,780 hectares, of which 1,000 are out of season. This is the only dual rotation operation under SAED auspices.

For example, an investigation into 4 areas in the Matam region (1), pointed out the interest of these operations which were carried out with the help of the population :

- an average yield of 4.2 tons of paddy rice per hectare, with a maximum of 7.6 tons/hectare;
- investment costs below 300,000 CFA francs per hectare, with operating costs of 70,000 francs per hectare.

This operation is being followed up and for the 1979-80 crop year winter irrigation of 2,570 hectares of village perimeters, ranging in size from 15 to 45 hectares, is projected; they will be equipped with 165 motorpump units.

(1) See the report "La Participation Paysanne sur les Périimètres Villageois d'Irrigation par Pompage de la Zone de MATAM" by S. Fresson (OECD, April 1978); French only.

C. PRESENT PRODUCTION OF THE SAED

The two main crops are rice and tomatoes.

The operating results for the two last harvest periods are shown in the table below :

Period	1977/78	1978/79
<u>Area planted (ha)</u>		
Winter produced rice	7,400	8,670
Tomatoes	793	905
Off-season rice	924	681
Miscellaneous	259	280
Total	9,376	10,536
Areas out of production (ha)(1)	3,700	1,760
<u>Production t.</u>		
Paddy rice	14,570	24,600
Tomatoes	12,000	10,000
<u>Quantities marketed t.</u>		
Paddy rice	4,360	9,300
Tomatoes	10,500	7,300

Source : SAED

D. PRODUCTION TREND SINCE 1965

The 5th Plan had forecasted production of 50,000 tons of paddy rice and 90,000 tons of tomatoes in 1978/79, but the production in that year was only 24,600 tons of paddy rice i.e. respectively 45% and 11% of targets

- (1) "Areas out of Production" : several losses of crops have occurred by reason of defective water supply affecting the system for "tertiary" developments through breakdown of the pumping station, and in the case of "primary" and "secondary" developments through lateness of the flood season.

Accordingly, the objectives for 1981, originally set at 114,000 tons of paddy rice, 90,000 tons of tomatoes, have been reduced to 70,000 and 40,000 tons.

Scrutiny of the table above shows that a great effort will have to be made in order to meet even these two lower targets by 1981.

Trend of paddy rice and tomato production since 1965

Year	Paddy rice			Tomatoes	
	Cultivated Land (ha)	Production (t)	Volume marketed (t)	Production (t)	Volume marketed (t)
1965/66	6,300	10,620	5,000		
1966/67	9,300	15,000	8,500		
1967/68	9,642	12,693	6,100		
1968/69	8,800		500		
1969/70	9,100	16,380	10,850		
1970/71	10,012	5,000	4,500		
1971/72	10,451	10,000	7,000	900	
1972/73	10,362	6,000	2,600	1,500	1,125
1973/74	9,900	10,380	600	3,053	
1974/75	8,365	19,145	8,000		4,968
1975/76	9,041	6,995	5,200	12,738	7,832
1976/77	9,216	20,205	7,913	17,360	10,216
1977/78	8,431	14,760	4,360	12,000	10,213
1978/79	9,600	24,600	9,300	10,000	7,300

Source : SAED

1.32 THE SOMIVAC (Ziguinchor) : see map C5 in Annex C

1.321 Present status:

The SOMIVAC, created in 1976, was designated by the 5th Plan as the instrument for transforming the Casamance into the first agricultural region of Senegal since, by 1981, it was to become the largest producer of rice, corn and cotton, and the second largest producer of oilnuts, millet and sorghum. The estimated investment to be made in the agricultural sector - mainly for the development of irrigated crops and especially rice - is approximately 13 billion CFA francs, i.e. over a quarter of total.

In 1977, 7,000 hectares of the Casamance region were under irrigation for rice farming, producing approximately 21,000 tons of paddy rice of which 17,000 tons from the RIZ-SEDHIOU operation, covering over 5,000 hectares of rice fields (see the table below).

There is a substantial lag vis-à-vis the targets set by the 5th Plan. They were readjusted in June 1979 to the levels shown in the table below :

Projects	Imple- ment- ation	Initial status 1876/77			Targets 1980/81		
		Area (ha)	Yield t/ha	Product- ion (t)	Area (ha)	Yield (t/ha)	Product- ion (t)
<u>Coastal Casamance</u>							
Nyassa Guidel	1977	-	-	-	pm	-	pm
Bignona	1978	-	-	-	pm	-	pm
Soungrougrou	studies	-	-	-	pm	-	pm
PIDAC	-	2,000	2	4,000	6,000	3	18,000
Chinese mission	-	-	-	-	3,500	3	10,000
<u>Middle Casamance</u>							
Sedhiou	-	5,000	3.4	17,000	12,000	2.3	25,000
<u>Upper Casamance</u>							
Sodefitex, irrigated	1979	30	4	120	500	4	2,000
Sodefitex, rainfed	-	3,000	2.5	8,000	3,500	2.5	6,000
Traditional crops	-	55,000	1	55,000	42,000	1.25	50,000
SENERIZ (SODAGRI)	1979	-	-	5,000		3.5	17,000
TOTAL		65,030	1.3	84,000	72,500	1.3	128,000

Source : 5th Plan as revised

The original Plan was that rice production would double in the Casamance region, to reach 153,000 tons in 1981, with the execution of irrigation projects covering a surface area totalling 35,000 hectares.

In 1979, it was found that :

- none of the feasibility studies for the dams projected had been completed and the methods for exploiting land "protected" against salinity had not yet been settled;
- 1977/78 was a dry year with disastrously low yields in the projects executed by the SPR and PIDAC;
- Independently of the drought, rice production is stagnant and even declining in the lower Casamance region.

1.322 SOMIVAC Programme

During its first three years of existence the SOMIVAC has mainly been occupied with :

- drafting an overall Development scheme for the Casamance, for the RPU (Regional Planning Unit) whose initial contents have just been published in the form of working documents (See map C5);
- the coordination of projects under way, in particular the Projects : "Riz Sedhiou" (SRPI) renamed the "Sedhiou Rural Project" (SRP II) and the PIDAC intermediate agricultural development project for the Casamance;
- the study of the general development scheme for the Lower Casamance and the study of the large anti-salt dams;
- continuation of the Guidel project and implementation of the Kalounayes project.

The various features of this programme will be examined successively below :

000 A - The Casamance Development Master Plan

The initial conclusions drawn by the Regional Planning Unit are that rice cultivation should be developed on "fresh water" lands and that medium and high altitude valleys should be developed rather than attempting to conquer the salt mangrove soils, whose crop yields depend largely on the weather conditions.

It also found that one of the basic constraints is socio-economic in nature : a local shortage of labour by reason of low productivity and that research and experimentation should be pursued in this field.

Outline of the general scheme is already available and the work is being pursued in the following directions :

- reinforcement of the SRP II and PIDAC projects (see paragraph B below);
- coordination of studies and experimental actions carried out in the Lower Casamance region, especially on anti-salt dams;
- search for and identification of a site for an impounding dam upstream from Kolda. A specialized investigatory mission has been requested for this purpose (see Chapter IV).

B - SEDHIOU Rice Project "SPR II" and PIDAC Project

The two projects are being carried out through extension services and supply of advisory personnel, with the following financing features and objectives :

Project	PIDAC	SPR II
Financing	UNDP then USAID	IBRD and CCCE
Farmers advised 78/79	5,650	10,113
<u>Paddy rice production</u> <u>1978/79</u>		
Area farmed (ha)	2,369	8,476
Production (t)	5,685	24,678
<u>1980/81 Objectives</u>		
Area (ha)	8,476	11,805
Production (t)	24,678	25,221

Source : 5th Plan as revised.

C - Study of the Development Master Plan for the Lower Casamance

The study will be financed by USAID and should begin soon within the framework of the Casamance Regional Development project, worth over 23 million dollars. It will mainly involve the provision of technical assistance to the SOMIVAC, the PIDAC programme and ISRA (the Senegalese Agronomic Research Institute).

It will be necessary to secure suitable coordination between this study and the Casamance Development Master Plan drafted by the Regional Planning Unit (RPU), especially as regards the four anti-salt dam projects.

D - The major anti-salt dams on the Casamance river

The construction of four large dams is presently projected on the Lower Casamance river, their purpose being to protect approximately 70,000 ha of mangrove land from the incursion of sea-water, in order to make them fit for rice cultivation. These are :

- the Bignona dam
 - the Soungrougrou dam
 - the Kamobeul dam
 - the Baïla dam
- } (see their location on the map in the annex)

These four projects are presently at the feasibility study stage. Financing sources and their main characteristics are given in the table below :

Dam	Bignona	Soungrougrou	Kamobeul	Baïla
Surface involved	8,000 ha	16,000 ha	24,000 ha	25,000 ha
Donor	People's Rep. China	OPEC OPEC	Abu Dhabi	USAID
Cost of survey	-	237 MF	237 MF	US\$800,000
Beginning of survey	October 78	Nov. 78	April 79	1979
Surveying organisation	-	Soned Sogreah	BCEOM- IRAT	L. BERGER Internat.

E - Development of the Guidel valley

This experimental operation close to Ziguinchor should enable 1,950 hectares of salty mangrove soil to be reclaimed using an anti-salt dam. In parallel, "fresh water" rice cultivation and unirrigated crops will be planted over 5,000 ha.

The following elements will be financed :

		Donor
- dam and buildings	542 million F CFA	ADB
- development of land extension personnel	680 million F CFA	CIDA
- operating costs	624 million F CFA	BNE

External financing is being sought to cover the National Equipment Budget's portion of the total investment requirements.

The project is considered as a test for the protection of 70,000 ha of mangrove soil with rice growing potential in the Lower Casamance. By reason of the many difficulties arising in this development operation, an associated programme of research is envisaged, extending over two three years periods, including hydrology, hydrogeology, agronomics and breeding, fishing and agriculture, forestry and health-related investigations. Financing sources are being actively sought (see part 4.222, Chapter IV).

F - The Kalounayes project (see map C6 in Annex C)

The project covers approximately 10,000 ha of unirrigated crop and 1,500 ha of rice fields located in 5 valleys penetrating the plains like glove fingers; the region is densely populated and isolated during the winter.

The aims of the project are to open the region to the outside world by a dam road, and to protect the rice fields of the lower plains against salt, in parallel with projects for the the provision of extension services and monitoring personnel.

Financing is sought for costs of an estimated amount of 2.451 millions CFA francs (see chapter IV for details). A preliminary mission will have to be sent to the location.

1.33 SODAGRI

The Senegalese Agricultural and Industrial Development Corporation (SODAGRI) is in charge of the hydroagricultural development of the Anembé basin. Within ten years, it should have developed and be managing on a corporative basis 25,000 ha of land irrigated by a dam, and provided the farmers of the basin with extension services covering approximately 15,000 ha of rice fields.

Feasibility study of this region showed that a reservoir of 250 million m³ could be constructed on the Anembe river which is a tributary of the Kayanga. It would allow "make-up" irrigation over 25,000 ha of rainfed rice crops and full irrigation of 5,000 ha.

The technical survey is being financed by the Electrowatt Engineering Department in the sum of 1.4 billion CFA francs.

In the shorter run, the SODAGRI is envisaging the development of 4,000 ha of rainfed rice cultivation in village areas, with a target yield of 15,000 tons of paddy rice. The cost of this operation is estimated at 1.6 billion CFA F with a further 450 million for a rice processing plant of 10,000 t per year and 250 million CFA francs for a cattle fodder factory.

Farming would be on a corporative basis (régie) over 300 ha, starting in 1980, and extension personnel would be available covering traditional crops over 1,800 ha (1 extension agent per 150 ha.).

1.34 SODEFITEX

The main task of SODEFITEX is the development of rainfed cotton and foodcrops (rice, corn) farming, as well as animal breeding in eastern Senegal and the neighbouring districts.

As ancillary developments, it has installed pumped water supply to village perimeters along the Gambia river and its main tributaries; the European Development Fund will finance the F 350 million total cost for developing 750 ha annually from 1977 to 1980. The pace of development is projected as follows :

100 ha in 1978
250 ha in 1979
600 ha in 1980

Approximately 1,000 ha could then be added over the 5th EDF period 1981-1985.

1.4 The Fifth Plan and the Development of Irrigated Farming

1.41 Agricultural policy

Four main features dominate Senegalese agriculture:

- the importance of peanut cultivation which accounts for 75% of agricultural exports, 30 to 55% of total exports and 80% of the cash earnings of the rural population;
- a structural foodcrop deficit which places a heavy burden on the balance of payments(1);
- the impact of weather conditions on agricultural production with three major droughts in 9 years;
- excessive concentration of population density in the peanut producing basin.

(1) A food supply programme was established in 1975. Its aim was to allow the cereal deficit to be reduced to less than 100,000 tons per year, and fully meet sugar needs.

In order to remove these constraints, agricultural policy has been extended in several new directions:

- diversification of export products: cotton, edible peanuts, truck farming,
- improvement of cereal yields,
- development of irrigation with water control.

The Government has taken on the task of improving water control and productivity in all the basins of the Senegal river delta which have already been developed, and also, of developing a sufficiently large acreage to derive substantial benefit when the large hydraulic dams now under construction are flooded (Diama and Manantali dams). It is hoped, finally, to provide each part of the country with equal scope for development.

Moreover, the "Readjustment" provides for a set of measures to be implemented by the Government during the second half of the Fifth Plan, in particular:

- the definition of a consistent scale of agricultural prices,
- improvement of storage, processing and marketing of products (millet bread),
- development of agricultural statistics,
- creation of a centre for agricultural mechanisation and follow-up of the training effort,
- restructuring of Development Corporations.

Accordingly, in the Fifth Plan, half the agricultural budget is devoted to irrigated farming, i.e., 24.6 billion CFA francs out of a budget of 50.8 billion.

1.42 A difficult start to the Plan; insufficient rainfall (1977-1979)

Exceptionally poor climatic conditions left their mark on the first phase of the Plan, causing a severe decline in agricultural production in 1977-78 and affecting crop quality in 1978-79.

In the winter of 1977, the whole country experienced inadequate rainfall; useful rain fell late and was very badly distributed in space and over time.

With a rainfall deficit of 40 to 50%, this winter was one of the worst years of the drought cycle affecting the country. The cereal deficit in Senegal in 1978 was estimated at 180,000 tons.

(1) Figure given at the Club du Sahel Conference in Amsterdam, November 1978.

The 1978-79 harvest, by contrast, seemed promising with early, regular and abundant rainfall. However, out of season rain, which occurs rarely, fell in December 1978 and January 1979 and damaged the quality of a crop which there had been reason to expect abundant. The regions of the River and Louga were in deficit.

Halfway through the Plan period, the general picture is that rainfed farming (peanut, millet)(1), is in line with the target, the result of action to train farmers and post-crop improvements. It should be observed, however, that the favourable trend of rainfed farming owes more in 1979 to the area cultivated than to yields which are not improving at the desired pace.

By contrast, irrigated farming (rice, tomato, wheat) is undergoing worrying delays due to the problems of operating and controlling the large hydro-agricultural master plans. The financial obstacles cited often mask the underestimation of the problems that would arise in mobilising human resources.

The Fifth Plan as drafted looked for an increase from 9,000 to 33,000 hectares in the areas developed by the SAED and of 15,000 ha. in the Casamance region. In 1979, the halfway point, only 4,000 ha. had been developed by the SAED.

1.43 The revised objectives for irrigated farming in the Fifth Plan (1980-81)

The Fifth Plan had to be readjusted at the halfway stage(2) in order to re-focus the aims of projects as a function of the new priorities which had emerged, especially in the regional master plans for the River and the Casamance. In addition, inflation, delays in the pace of development and lags in the mobilisation of financing had to be taken into account.

The irrigated crop estimates were readjusted downwards for rice and large-scale tomato production.

The aggregate volume of paddy rice was adjusted downwards from an initial forecast of 300,000 t. to a lower estimate of 228,000 t., with areas reduced from 125,000 ha. to 106,000 ha., and expected yields reduced from 2.4 to 2.2 t/ha.

The initial estimates for large-scale tomato crops were reduced by 51%, from 90,000 to 44,000 tons over an area reduced from 4,500 ha. to 3,300 ha. (yield adjusted downwards from 20 to 14 t/ha)(3).

- (1) The rise in millet production has meant marketing more than 100,000 tons and has generated storage and disposal difficulties.
- (2) The production objectives for rainfed crops have been maintained: peanuts (1,200,000 t), millet and sorghum (750,000 t), but lowered for corn (142,000t to 80,000 t) and for cotton (66,000 to 59,000t).
- (3) Present fresh tomato production of the SAED is 150,000 t, with a yield of 10 to 12 t/ha.

The forecasts for sugar cane development have proved accurate with 35,000 t. of sugar produced in 1978/79. Self-sufficiency in sugar is projected for 1981 with sugar production of 75,000 t. (10% of the weight of sugar cane harvested).

1.44 Revision of SAED objectives

The projected pace of development of 5,000 ha. a year was ambitious and was not achieved. From 1977 to 1979, the SAED developed only 2,000 ha/year. For the second half of the Plan, the projected annual pace of development is reduced to 3,000 hectares.

Details of the readjustment of the Plan for the SAED are given in the table below:

SAED: Revision of the Fifth Plan

Source: SAED

Project	OBJECTIVE in hectares			Remarks
	Initial	Revised	Achieved	
Major Tellel Dam	1,300	1,800	1,540	N° 2 project as distributed Debi and Lampsar in process of signature
Debi	1,100	1,100	-	
Lampsar	2,200	2,000	-	
Ndombo-Thiago	800	800	-	Preliminary agreement
Matam-Aere-Lao	1,500	1,300	800	
Matam Phase II		1,520	-	In process of signature
Dagana (c)	500	500		Under construction 79/81 operation
Bakel	1,800	1,800	130	Under way Financing secured Under way Under way
Amorphil isle	600	600	250	
Nianga (c)	1,300	1,300		
Kassack Nord	800	200		
Thiagar	250	405		
Saldewala	1,087	1,087		
Ngalenka	300	300		
Demet	3,220	3,220		
Bakel (solar pump)		130		
Guede (basin)	820	820		
Falemé				
Ronq Jeune				
TOTAL:	17,877	19,082	2,720	

The corresponding feasibility and execution studies will be carried out using funds allocated by the World Bank for this purpose: feasibility study covering 50,000 ha., and execution of 15,000 ha.

The projected developments will be undertaken following a "short and medium-term action Programme", which should nevertheless be updated in the light of the latest conclusions of the OMVS (see chapter V below).

1.45 Revision of the SOMIVAC objectives

This downward revision is necessary because of the great delays caused by the under-assessment of the problems attached to the development of mangrove soils protected by anti-salt dams. A solution of these problems calls for a programme of research and preliminary studies into the impact of anti-salt dams on the environment.

The Guidel dam, which will be a test, has been partially financed by the African Development Bank and CIDA. The lag in the study of the 4 anti-salt dams has affected the whole programme. Furthermore, these last few years have shown that the yields obtained under monitored rainfed rice cultivation are greater than those expected from rice grown on mangrove soil.

At the present time, the Plan forecast for the areas to be developed has been reduced by at least 10,000 ha. The readjusted target for 1981 is for 22,000 ha. of developed land and 45,000 ha. under traditional crops covered by extension services (see part 1.32 above).

1.5 Longer Term Objectives

The Working Group of the Club du Sahel on Irrigated Farming has forecast that of the total irrigable potential of the Senegal river estimated at 267,000 ha., 155,000 ha. (1) will have effectively been irrigated by the year 2000, therefore approaching food self-sufficiency (paddy rice surplus of 88,000 tons, wheat deficit of 185,000 tons).

The Government of Senegal starting from the status as of the end of 1978, (approximately 12,000 ha. developed with full water control) aims at reaching 70,000 ha. by the end of 1989, of which 60,000 ha. of large perimeters and 10,000 ha. of small, scattered, village perimeters. This objective implies an average development pace of 5,400 ha. per year (2).

It is anticipated that, within this period (1979-1989), the Diama and Manantali dams will guarantee the year-round flow of water necessary for irrigation along the Senegal river, and that off-season cultivation can be carried out on almost two-thirds of the areas developed.

(1) The SAED is in charge of most of these 155,000 ha., apart from the Richard-Toll sugar plantation.

(2) As mentioned earlier, this pace of development is an optimistic estimate inasmuch as, up to now, the SAED has developed no more than 2,000 ha. a year.

These aims were the justification for the two dams at Diama and Manantali. Everything must be done to ensure their success, which will depend upon how these hydro-agricultural operations are designed: integrated development schemes executed with and for the farmers using suitable processing equipment and marketing techniques, realising sufficiently attractive producer prices, and with development management structures that can meet these needs.

Concerning yields, the Irrigated Agriculture Working Group has used the average of 3.5 t. of paddy rice per hectare for a yearly crop, and in the medium term, a second yearly crop would interest two-thirds of areas under total water control.

CHAPTER II

I. CONSTRAINTS ON THE DEVELOPMENT OF IRRIGATED FARMING

The main constraints which have been identified and analysed will be discussed in this chapter, drawing on documents and reports written on the topic:

- CILSS/Club du Sahel documents(1)
- specific reports (2) on projects such as the report on missions to the SAED, Senegal (IBRD, FAC, CCCE, November 1978).

The main constraints are recalled below with most emphasis on the aspects given the least attention in recent documents.

2.1 Physical constraints

2.11. Unforeseeable changes in production in "secondary" and "primary" developments in the Senegal valley have progressively led to these areas being abandoned. This type of development will have completely disappeared by the end of the Plan, transformed into developments based on full water control (see part 1.31 in chapter I).

2.12. Pedological constraints

A number of projects in the Senegal river valley and the Casamance went awry by reason of inadequate soil studies (see part 1.11, b and c).

Pedological studies should be carried sufficiently far before the feasibility studies are presented; however, the corresponding credits must first be opened.

The same is true of geotechnical studies as they are indispensable for the design and the installation of irrigation systems and hydraulic dams.

2.13. Crop constraints; some solutions

The latest results as regards the agricultural exploitation of tracts in the Senegal river valley and applied agroeconomic research have shown that:

- Intensive farming cannot be carried out securely in the North of Kayès without irrigation, given the irregularity of rainfall.

(1) Report of the Working Group on Irrigated Farming on the Senegal. (May 1977); Overall Report on Irrigated Farming, May 1977.

(2) See report by S. Fresson "Village perimeters of the Matam region (OECD, April 1978), French only.

- Farmers planting fast growing rice with a 110 to 125 day cycle should obtain a yield of 5 to 6 tons per hectare out of season and 4 to 5 tons during the winter.
- Two cereal crops can be grown on a single plot in a year, provided that planting is carried out at the right time; in an experiment, three ploughed crops with a "Dag Pag" nursery, replanting and "minimum harvesting" were grown with yields of over 7 tons per crop.
- Three tons of wheat per hectare can be grown North of Matoum if the grain is sown before December 15th; wheat yields are nevertheless very sensitive to irrigation techniques.
- If it is sufficiently watered, rice can grow not only on clay (Hollaldés) lands but also on protruding banks of the "Fondés".
- Drainage of salt lands sets a number of difficulties and has led to certain plots being abandoned (Tellel dam, Richard Toll).
- It is difficult to scare birds off which rules out some crops such as sorghum in the hot dry season notwithstanding its agronomic potential.

2.14. Need for large hydraulic dams and cost of equipment

The development of agricultural potential necessitates, as was seen earlier in part 1.13, the construction of large hydraulic dams such as those at Diama and Manantali, and the anti-salt dams on the Casamance.

These dams require heavy investment, i.e., specific orientations in agricultural policy. However, the "posteriori" justification of these choices implies intensive irrigated farming securing an annual production.

Even before these large dams were built, considerable investments were made in hydroagricultural projects: 33 billion CFA francs for approximately 12,000 ha. in the area covered by the SAED (for details on SAED development costs see annex B2).

2.2 Human Constraints in Irrigated Perimeters

The two basic objectives pursued by the Government through the agricultural policies written into the plan are recalled here:

- (a) intensive cereal production, especially irrigated rice.
- (b) controlling rural depopulation.

Paradoxically, the experience of these last few years in the Senegal river delta is that these two objectives can be in conflict. It has been observed in this area that:

- . Intensive, large scale production of rice is easier to carry out on heavy "holladé" soils, on generally flooded land: it requires large perimeters(1) and considerable mechanisation. Villages lie far from these areas and their relocation causes problems.
- . Achieving the second objective would imply locating developments close to villages, on light non-flooding soils (Fondé). Notwithstanding, the trend in small villages is to limit production to cover local needs only.

2.21. The Social aspect is one of the basic elements of a hydro-agricultural development project.

(a) The main problems encountered in the Senegal River Valley are: settlement of land, the land ownership situation, de-motivation of the labour force, repayment of costs, modes of cultivation, and labour productivity. The questions were thoroughly investigated in the "OMVS Socioeconomic Project" which is now nearly completed; they are briefly reviewed below:

- settlement of land: in order to simplify procedures, the first Delta lands to be developed were uncultivated (although there was some animal breeding); Settlers were installed in newly built villages which were not always well adapted and this led to a deterioration in relations among the local population, labour shortages and movements of productive manpower. An outline of the overall scheme was drawn up by the OMVS on the basis of a thorough demographic study, in order to match the progress of development with the availability of nearby manpower resources.
- land ownership: irrigation is most readily carried out on "oualo" lands which can be flooded, and earlier were cultivated after the season. The land rights of owners, insufficiently taken into consideration, resulted in animosity which hindered the cultivation of development areas; priority now appears to be given to the development of light non-flooding "fondés" soils, with later and progressive settlement of the "holladé" lands, support of "Oualo" cultivations.

(1) 1,000 to 3,000 hectares.

- demotivation of labour force: management responsibilities are almost entirely in the hands of the sponsoring organisations, and centralisation of procedures hampers rapid and adequate action when unpredictable production difficulties occur. In addition, the population often has a passive attitude toward irrigated farming and takes no initiatives for the improvement or even the maintenance of developments. Working on irrigated perimeters constitutes a complete change in farmers' lives.
- operating costs: these are high and can reach two tons of cereal per hectare cultivated, which implies very high yields. There is a low rate of repayment (50% on average⁽¹⁾) which leads to coercive action by the sponsoring organisation, which is itself not always in a position to meet its obligations (obsolescence of modes of cultivation, shortage of inputs, pumping station breakdowns causing losses, etc).
- modes of cultivation and productivity: this aspect largely conditions the relationships between the sponsoring organisation and the farmers. Delays in ploughing and other cultivation activities for which the development corporation is responsible has an effect on the introduction of crops and on yields. Animal traction cultivation has not been generalised in the Senegal valley up to now. Furthermore, there are limits to fully manual cultivation in small village perimeters.

It is accepted that some mechanisation is necessary; however, these are problems in identifying the most suitable types of equipment, their use, management, and upkeep which have not yet been solved. Experimentation and applied research in this field⁽²⁾ should be continued.

- (b) In the Casamance region, the first conclusions of the UER are that low labour productivity weighs heavily on the development of rice crops; the yields being too low, a large percentage of the working population emigrates; new methods of cultivation should be developed as well as mechanization.

-
- (1) Farmers' total debt is over 600 million CFA francs and the repayment ratio is 37% for paddy rice and 50% for tomatoes.
- (2) The Faneye and Guédé research departments offer possibilities in this field.

- (c) Small village perimeters with a high farmer participation ratio have produced excellent results as regards the cost per hectare of investment, operating techniques and yields. The Matam projects are therefore rated among the most productive development operations carried out by the SAED, with a yield of 5.2 t/ha. of paddy rice in 1976-77 and 6.2 t/ha. in 1977/78. Production is however only for local needs. An effort should now be made to increase marketing, which the SAED estimates presently absorbs only 5% of total production of village perimeters.

2.22. Changeover from traditional methods to irrigated farming

On the basis of investigations carried out in the Senegal river valley, the traditional farm holding comprises 10 people, of whom four work half-time (400 to 500 working days yearly), farm 2.7 ha. of "oualo" (post-flood-season crops : sorghum, corn, niébé), and 1.7 ha. of "dieri" (in dry areas; basically, small millet) with an annual average output of 2 to 2.5 tons of cereal. The "opportunity cost" of a day's work can be assessed at 5 kg. of cereal, i.e. approximately 300 CFA francs at market prices.

The switch to irrigated farming involves great changes in the land tenure system, agricultural techniques and dependence on the outside world (mechanisation, purchased inputs), the number of working hours, etc.

On the large perimeters, this task was only possible through the provision of large numbers of monitors and with major recourse to mechanisation. However, the managing organisations were unable to install the methods of cultivation in time, and to this day, given the additional problem of water supply, two-crop rotation has not been introduced on a large scale.

Once the OMVS projects are operational, this changeover will be possible in the densely populated Senegal middle and lower valley without major upheavals by developing village areas of 20 to 50 ha. provisionally, providing :

- that the areas are located mainly on the banks of "fondé" lands which are sufficiently high not to have to withdraw "oualo" soils from use for growing post-flood season crops and to provide protection against occasional heavy flooding possibly with the construction of low embankments.
- that the agricultural techniques used are simple enough: a maximum of one or two new techniques can be introduced in the first years, e.g., a rice-rice, rice-corn system.
- that developments begun on the basis of 2,500 to 5,000 sq. meters per family should rapidly be extended to approximately 1 hectare, which possibly involves extension of the development area.

- that the labour force is mainly devoted to agricultural work, which requires limited mechanisation for the upkeep of the hydraulic system and of the plots, with a medium-powered tractor and the associated implements per 50 hectares approximately.
- that during the transitional period, when the area is being developed, farming be subsidized.
- that, in the long run, the changeover to large perimeters is projected, using machinery and dynamic management.

2.3 Constraints associated with management and development of perimeters

The study and implementation, and the subsequent farming and management of irrigated perimeters were entrusted to National Corporations, each with its own zone of development activity: the SAED in the Senegal river valley, the SOMIVAC in the Casamance region, the SODAGRI in the Kayanga region and the SODEFITEX in the Eastern Senegal and the Upper Casamance river.

Productivity and therefore the return to hydro-agricultural projects depend on the quality of the activity of the Development Corporations, as well as their management. The SAED is the oldest and largest of these Corporations. It has recently encountered great difficulties in the implementation of irrigation projects, in farming (rice crops and large-scale tomato production)(1), processing and marketing of products.

The main constraints experienced by National Development Corporations will now be examined in the light of the SAED's experience.

2.31. Services expected by farmers

Farmers working irrigated land have a right to expect service of the requisite quality, at the right time, from the Development Corporation in return for the sometimes very high fees they pay for these services.

- Services for mechanized cultivation methods should be adequate and provided at the previously fixed dates in the agricultural calendar. Lateness in ploughing and the preparation of the soil has an effect on the date of planting and can have a catastrophic impact on yields.

- In order to fulfill its commitments to farmers, the development corporation should be in possession of a sufficiently large amount of agricultural equipment, establish rigorous planning and organisation and carry out maintenance.

(1) A recent analysis of the position of the SAED was drafted by a combined mission of the FAC, CCCE and IBRD in November 1978.

- Inputs must also be supplied at the right point of time in the agricultural calendar: fertilizer, agricultural equipment, seeds of good quality, pesticides and other treatment products(1).

- Agro-industrial activities, such as processing of paddy at the rice plantation, should be so performed as to provide the farmer a service and secure a return to the plant.

It is from the first two services - working the earth, ground levelling, supply of inputs - that originate (to a large extent) the low yields obtained in tertiary project areas of the SAED during the last three crop years 1975/76, 1976/77, 1977/78, when the results were(2):

- Yields of paddy rice in t/ha. planted :	0.77	2.19	1.96
- Yields of paddy rice in t/hectares harvested :	1.82	3.46	4.05
- Ratio of areas harvested to areas planted (3) :	0.43	0.63	0.43

These figures are very low. The most serious impact of these results is probably the effect on the farmer: it gives him a reason not to pay his debts, abates his initial motivation and his trust in the notion of profit-yielding, intensive production, imparts to him the mentality of a passive recipient and leads him to prefer to market a growing proportion of his production through parallel channels.

- Yields in tons marketed per hectare planted :	0.23	0.86	0.59
- Yields in tons marketed per hectare harvested :	0.55	1.36	1.21

Measures should be taken to change this.

2.32 Water supply and the maintenance of hydraulic projects

It is known that to obtain high rice farming yields water must be supplied in the amount required, at the right time and for the necessary period, that plots must be adequately partitioned and the drainage network operating properly.

(1) The factors of production are heavily subsidized: approximately 40% for ploughs and almost 70% for compound fertilizers : the farmer pays 25 francs/kg. for compound fertilizers and 35 francs/kg. for urea. By reason of non payment of debts, provision of fertilizers which had reached 100,000 t. in 1976/77 has since fallen back; it is believed that chemical fertilizer is used on only some 10% of the total crop. Storage of fertilizers may raise difficulties (ref. SAED).

(2) Figures taken from the FAC, IBRD, CCCE report, November 1978.

(3) Very low increase of producer prices per kg. for paddy during the last 6 crop years: from 23 CFA francs (73-74) to 41; 41.5; 41.5; 41.5; (1978-79).

Water regulation is a basic task as is careful maintenance of hydraulic systems and installations.

The experience gained these last few years in Senegal in large perimeters with full water control shows that these two functions are, in fact, not sufficiently well understood in the field(1).

This is true not only for large projects and on a smaller scale, for small village perimeters for which maintenance of pumping stations is a fundamental necessity (2).

As an illustration, for several reasons, including lack of maintenance of hydraulic structures and poor water regulation are the most telling, the SAED estimates that there was a loss of 3,700 hectares in crop year 1977/78, for a total area sown of 9,376 hectares, i.e. 40% of the area !

2.33. Design and implementation of projects

(a) These two tasks are being performed at present by Development Corporations such as the SAED and the SOMIVAC.

Inadequacies in basic studies (topography, pedology, geotechnology, hydrology (3)) have spoiled results. The SAED now envisages calling in sub-contractors to perform project studies.

(b) The implementation of SAED development projects, as has been seen earlier (part 1.43 and 1.44) was shown below 2,000 ha. annually. The reasons given in the revised Plan (p. 58) are:

- lack of financing or delays in putting together a financing package;
- insufficient credits (e.g., the Thiagar basin);
- technical problems;
- delays in supply of equipment.

There are probably other reasons too, such as the complexity of the work to be done and problems related to the organisation and profitability of a National Corporation.

It might be a good idea to call in private firms for the execution of development projects, in order to enable the Development Corporations to get down to their main and priority task, which is production.

- (1) The SAED projects, for instance, are not in a good state, as is noted in the FAC-World Bank-CCCE report: "Some perimeters (Dagana, Nianga, Boudoum) have so deteriorated that simple maintenance is no longer enough to bring them back to standard"
- (2) Upkeep, inspection and repair of motorpumps in village perimeters are performed by a SAED mechanic.
- (3) The Hydrology of the Senegal river has been ascertained but that of its tributaries is still inadequately known.

(c) Cost of projects

The SAED estimates that project costs are approximately 1,000,000 F/ha. for large projects and 220,000 F/ha. for village perimeters.

Details of cost components are given in Annex B. It appears, however, that costs are understated as regards large projects, and that actual costs are much higher(1).

(d) The problem of project coordination

Responsibility for the development and exploitation of development perimeters was given to Development Corporations - SAED, SOMIVAC, SODAGRI, SODEFITEX - for reasons of efficiency. These Corporations belong to the Ministry for Rural Development.

By contrast, basic studies (research) and regional planning are carried out by the Ministry of Equipment and regional organizations such as the OMVS, OMVG, WARDA, while applied research is performed by ISRA (the Senegalese Agronomic Research Institute).

Coordination of projects has proven to be difficult. Some basic long-term surveys (hydrology, hydrogeology, pedology) are found not to be sufficiently thorough when project proposals are forwarded to the financing sources.

The strengthening of certain central technical departments would be helpful as well as the establishment of multi-year research programmes.

2.34. Constraints associated with management and organisation

(a) Good management enables the "state of health" of a project to be ascertained and maintained, and production capacity to be exploited to the best effect.

To be useful, accountancy should be clear and practical, adapted to the size of the unit and available at all times to executives throughout the hierarchy. Objective, yearly, operating accounts allow the weak spots in the organization to be identified, so that the corresponding rectifying measures can be taken(2).

Good management should make rigorous financial organization possible, together with realistic budget forecasts and an objective assessment of the capacity of the Development Corporation to absorb credits: failures in this regard were condemned in the revised Fifth Plan (see p. 76).

- (1) Reassessment of these estimates should be carried out in the light of the investments already made and the area developed so far (33 billion CFA francs for approximately 12,000 hectares).
- (2) To our knowledge, the SAED did not publish an official report on agricultural production for crop years 1977/78 and 1978/1979.

(b) In many perimeters, accounting is hampered by the fact that farmers leave their irrigation fees unpaid. Experience has proved that coercion alone does not suffice. The farmer's ability to pay his debts depends chiefly on the yields he obtains. This is an area in which the services yielded by the Development Corporation must be beyond reproach(1).

(c) Organisational problems

"All regional development corporations are presently confronted with organisation and management difficulties caused by rapid growth. The SODEVA employs a staff of 1,800 and SAED expenditure is forecast at 18 billion CFA francs during the Fifth Plan... It is therefore necessary for these corporations to review their organisation and their strategy..." (Revised Plan p. 77)(2).

In particular, excessive centralisation can paralyse initiative and dynamism at the various levels of decision-taking which are an indispensable tool of agricultural production.

2.35. Constraints associated with advisory personnel - Training

The Fifth Plan attaches much importance to the training of agricultural advisers(3). A National Centre for the Application of Irrigated Farming was created this year at the SAED(4) (the N'Diaye centre) and a National Rural Development Institute has just been opened.

Most Development Corporations are short of well-trained personnel(5). Proposals on training will be made later in chapter IV.

As regards management of the existing stock of irrigation projects, it has been acknowledged that foreign technical assistance is necessary in the initial phase, linked with programmes for training national staff in the framework of projects.

The experience gained in existing projects shows that the introduction of an appropriate management structure calls for more time and resources than had been foreseen.

(1) The rate of repayment to the SAED is below 50% (see details for crop year 1977-78 in annex B).

(2) See the IBRD-FAC-CCCE mission to SAED report pages 15 to 24.

(3) See revised version of Fifth Plan, (p. 78).

(4) See the BDPA survey financed by the FAC-CCCE; "Problems of training at the SAED" - 1977.

(5) See also the IBRD, FAC, CCCE report p. 10, part 32.

CHAPTER III

III. STATUS OF THE CILSS FIRST GENERATION PROGRAMME

3.1. A Preliminary Comment

There is some ambiguity as to the contents of the CILSS "first generation programme". This programme comprised 16 projects in 1977. Four additional projects were added in 1978-79 bringing the number to 20(1).

These 20 irrigated farming projects - including training programmes in this field - do not always correspond to those listed in the Fifth Plan under the same name.

To avoid this difficulty, the status of irrigation projects in Senegal will be summarized in two tables which complement each other:

- (i) Status of the first generation projects, as of October 1979.
- (ii) Financing of irrigated farming projects scheduled in the Fifth Plan (5th four year plan, as revised in June 1979).

3.2. Status of Senegalese Irrigation Projects

In general, these projects are lagging far behind the Plan estimates. The reasons for this have been given in previous chapters (§ 1.4, chapter II).

The annual rate of development at the SAED has been below 2,000 hectares a year, against a forecast of 5,000(2).

At the SOMIVAC, the delays in the feasibility studies for large anti-salt dams affected the programme at large. A further factor was inadequate pedological information as regards the exploitation of mangrove lands after their "protection" by anti-salt dams.

Shortage of financing and delays in assembling credit packages were one of the main reasons for this lag against the targets set.

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- (1) See the table on following page "Progress of the first generation projects of the CILSS".
 - (2) The CILSS/Club Working Group on "irrigated farming" had recommended that in the short term, Senegal should increase its annual rate of development to reach a pace of 6,100 ha. of new lands opened up and 2,000 ha. improved by 1982 (overall report, p. 38).

3.3 A Review of the Financial Forecasts of the Fifth Plan; their status on June 30th, 1979

After revising the Plan, the aggregate volume of financing for Agriculture was increased from 47.6 to 50.8 billion CFA francs, of which 37.8 billion have been organised: 5.6 from internal financing sources and 32.2 from external sources (2/3 from bilateral donors and 1/3 from the multilateral sector).

As of June 30th, 1979, the situation as regards financial implementation was as follows:

in. billion CFA francs	Revised forecasts	Financing secured (foreign)	Settled as of June 30 1979	% imple- mented
Rainfed farming	21.0	14.8	9.4	47
Irrigated farming	24.6	18.4	7.4	30
Horticulture	5.2	4.6	2.7	52
	<u>50.8</u>	<u>37.8</u>	<u>19.5</u>	<u>38</u>

The table on page 37 gives the estimates of the readjusted Fifth Plan for irrigated farming, as well as the financial implementation ratio as of June 30th 1979. This is very low (between 14% and 41% for SOMIVAC and SAED projects respectively), except for the Richard Toll sugar plantations for which expenditure was fully up to target (private sector, CSS).

REVISED 5TH PLAN FINANCIAL ESTIMATES AND FINANCIAL IMPLEMENTATION
AS OF 30TH JUNE 1979

(billion CFA francs)

Region and large irrigation projects	ESTIMATES		Implemen- tation ratio (%)	FINANCING			
	Initial	Revised		Internal		External	
				Total	of which	Total	of which
1. <u>River (1)</u>							
SAED projects in course	17.4	11.6	26	2.3	1.8	9.3	8.0
New SAED projects	-	3.9	41	0.2	0.2	3.7	3.2
OMVS	1.0	0.5		0.5	0.5	-	-
CSS	1.0	1.0	100	1.0	-	-	-
	<u>19.4</u>	<u>17.0</u>		<u>4.0</u>	<u>2.5</u>	<u>13.0</u>	<u>11.2</u>
2. <u>Casamance</u>							
SOMIVAC projects in course (PIDAC-PRS dam)	5.8	2.5	14	0.5	0.5	2.0	1.8
New projects (parallel research, outlines)	-	1.0	-	-	-	1.0	0.7
SODAGRI (Anembé)	-	3.4	15	1.0	0.7	2.4	2.3
Bao Bolon SODEFITEX	1.0	-	-	-	-	-	-
	<u>6.8</u>	<u>6.9</u>		<u>1.5</u>	<u>1.2</u>	<u>5.4</u>	<u>4.8</u>
3. <u>Other (Bao Bolon, SODEFITEX</u>	1.9	0.7	50	0.1	0.1	0.6	0.2
T O T A L	28.1	24.6		5.6	3.8	17.8	16.2

(1) It should be recalled that almost 70% of the "irrigated agriculture" budget is earmarked for the River region, whence the importance of implementing the OMVS programme rapidly.

3.4. Financial Implementation in the Agricultural Sector

The initial estimates were for 47.666 million CFA francs; they were revised to 50.792 million of which 37.854 million CFA francs have been secured. Expenditure in the first two years amounted to 19.5 billion; the following observations and related considerations are worth mentioning :

- the ratio of finance secured to total required is very high: 79% of the initial estimates, 74% of the revised estimates. The ratio for rainfed agriculture is similar to that of irrigated farming (71% and 75% of estimate);
- 85% of the credits secured have been provided by external sources, 2/3 from bilateral donors (20.6 billion) and 1/3 from multilateral sources (11.6 billion);
- halfway through the Plan period, disbursements actually made cover 38% of the revised estimates and 50% of the resources secured. This average ratio conceals a disparity between rainfed agriculture programmes, (implementation ratio: 47%) and those for irrigated agriculture (30%). The gap is wider if consideration is limited to projects underway: a financial implementation ratio of 62% for rainfed agriculture and 24% for irrigated agriculture. Disbursements on rainfed agriculture programmes are in line with the rate projected in the Plan, but there are major delays in the irrigated agriculture programmes.

Although the ratio of foreign commitments to either forecasts or requests is high, it appears that effective disbursement on these credits is slow, being hindered by lengthy administrative procedures on the part of both donor countries and the recipient. The other main reasons for the delay are the country's absorptive capacity at administrative level, the management structures of projects, personnel bottlenecks and inadequate motivation of labour in the field.

STATUS OF THE CILSS FIRST GENERATION PROGRAMME

- Irrigated Farming -

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

1000 M \$ = 1 million dollars EU

PROJECT	Estimate of costs		Financing		REMARKS
	Million CFA F.	Million US \$	Source	Type of interest	
<u>SENEGAL RIVER DELTA</u>					
1. Improvement and extension of Delta basins, i.e. approx. 6000 ha.		20.217			
a) N'Dombo-Thiago (800 ha.) - survey + Khouma	1.028		FAC	III	US \$0.36 million for the N'Dombo-Thiago and Khouma studies
- work			FAC/CCCE	III	US \$4.3 million for the development of 800 ha. at N'Dombo-Thiago
b) Morphil island (600 ha.)	440		Netherlands	III	US \$1.6 million from the Netherlands - 250 ha. developed - Extension of the project under study by the Netherlands
c) Tellel large dam (1800 ha.)	2.257		FAC/CCCE	III	1540 ha. have been developed CCCE commitment for \$ 6.9 m. for 2200 ha.
d) Thiagar (1300 ha.)		1.900	FAC	III	US \$1.9 million from FAC; 485 ha. in area C remain to be financed (see project 19)
e) Boundoum (2400 ha.) North Kassak	650	2.800	FAC/CCCE	III	US \$2.8 million from FAC
- phase I : 200 ha. for 250m. CFA F.			FAC/CCCE	III	US \$1.2 million from the FAC for the first 200 ha.
- phase II: 600 ha. for 400m. CFA F.			?		To be financed
f) Djerba basin (surveys)			FAC	III	US \$0.22 m. from FAC for studies
2. Creation of 3000 ha. of sugar perimeters Phase I : 2000 ha. (1979-81)	1.500	18.913	private project	CSS	Perimeter developed in the M'Bilor basin made available by the SAED
3. Creation of 300 ha. cereal plantations (Débi-Lampsar)	7.700		IDA FAC OPEC IDA KFAED	III III III II II	US \$ 20.000 m.) Débi-Lampsar US \$ 0.600 m.) perimeter US \$ 1.000 m.) Projected for the OMVS irrigated agriculture programme US \$ 5.5 m. for Débi-Lampsar
<u>SENEGAL RIVER VALLEY</u>					
4. Development of Basins of					
a) Dagana 2900 ha.	1.639		IBRD	III	300m. CFA F. remain to be found for the development of 500 ha. (area C)
b) Nianga:phase II (area C)	2.000	6.340	Germany	III	Agreement for 1.4 m. CFA F.
c) Matam :phase I			FED		Already financed by FED
c) Matam :phase II 1520 ha.	1.629		CCCE	III	In 1977, \$3.2 m. credit for Matam and Podor areas.
			CCCE	III	In 1978, financing of feasibility study of small perimeters
			USAID	III	Feasibility study-improvement of 1000ha. at Matam and extension to 2000 ha.
Matam area			USAID	III	USAID envisages a project of approx. 5000 ha. in the Matam area (\$ 20m.)
d) Bakel (1800 ha.)		5.900	USAID	III	USAID credit underway - small perimeters
Senegal Valley			Kuwait Fund	II	Senegal River Basin, \$ 75.000 m.
<u>OUTSIDE DELTA AND VALLEY</u>					
5 a) Niayes region - Cape Verde (400 ha.)	-	-	-	-	?
b) Bas-Saloum, 500 ha. of small perimeters	to be assessed		Germany	III	Interested in financing of 5 ha. pilot project. Assessment after studies.

PROJECT	Estimate of costs		Financing		REMARKS
	Million CFA F.	Million US \$	Source	Type of interest	
c) Forest and pasture land (500 ha.)	-	-	USAID	I	Would be interested in small-scale cereal farming
<u>COASTAL CASAMANCE</u>					
6.a) Guidel dam	1.870		AfDB CIDA	III	Commitment for 567 m. CFA F. Commitment for 680 m. CFA F. Request made for 624 m. CFA complementary financing. USAID financing 300 ha. of fruit and vegetable plantation at Wassadou. Construction postponed.
7.b) Guidel area(860 ha.)				III	
c) Nyassa dam	1.125		-	-	?
8. Improvement of 1250 ha.					
9. Study and construction of the Bignona dam	2.650		China	III	2500 m. CFA F. will be provided by the People's Republic of China. Project implementation now being prepared
10. Surveys of the Bafla and Kamobeul dams	180		USAID	III	Feasibility study is being executed by Louis Berger started in 1979; duration: 18 months. Abu Dhabi and Qatar appear interested in financing work on the Bafla dam
a) Bafla dam, 2500 ha. of salt land					
b) Kamobeul dam, 2400 ha. of salt land	260		ABU DHABI	III	Credit of 210 m. CFA F. secured. 50m. CFA F. shortfall by reason of the fall of the \$. Feasibility studies are in the hands of BCEOM-IRAT
<u>MIDDLE CASAMANCE</u>					
11. Improvement of 1000 ha.		3.369	USAID	III	IRD in Casamance
12. Development of an additional 2000 ha.		10.869	USAID IDA	III III	IRD in Casamance 6.3 m. \$) Sedhiou Rural Development (PRS II) 3.2 m. \$) opment (PRS II)
<u>UPPER CASAMANCE</u>					
13. 500 ha. of new perimeters	725		?	III	Credits secured. Study being implemented
14. Small irrigated perimeters in the Senegalese basin of the Gambia and Koulountou (14 perimeters - total of 750 ha. in the initial stage)	350		FED	III	250 ha. developed up to now by the SODEFITEX. Study undertaken by an OMVG multidonor mission.
15. Agro-industrial investments for associated industries		27.439	-	-	?
<u>CASAMANCE BASIN</u>					
		23.710	USAID	III	\$ 23.71 m. "Casamance Regional Development Project"; support to SOMIVAC and PIDAC; survey of Casamance development; training.
			KUWAIT	I	Development of the Anambé basin.
16. <u>TRAINING</u> : Training centers for monitors on irrigated farming methods:	800		FAC/ CCCE	III	The SAED-sponsored N'Diaye center replaces the projected center in Diagambal \$ 4.53 m. project underway covering management and equipment maintenance training, construction of workshops and purchase of equipment.
a) N'Diaye center				III	
b) Ziguinchor center		?	USAID	III	Within the framework of the USAID Casamance project.

cont'd

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PROJECT	Estimate of costs		Financing		REMARKS
	Million CFA F.	Million US \$	Source	Type of interest	
<u>ADDITIONAL PROJECTS to be financed:</u>					
17. Rehabilitation of the Ronq, Thiagar and Diawar pumping stations	1.250				Presented at the end of 1978 and in 1979; part of the CILSS second generation programme. Technical specifications and summary of requirements. Request conveyed by the CILSS to potential sources of funds. A mission for technical formulation is required.
18. Completion of the Boundoum perimeter (615 ha.)	290				To be financed.
19. Completion of the Thiagar area (485 ha.)	270				To be financed.
20. Integrated rural development of the <u>Kalounayes Region</u>	2.451 to be confirmed		COSOC	III	47 m. CFA F. secured for anti-salt equipment of bridges in Kalounayes. Request for short term technical assistance made by the CILSS to the AfDB (identification study to be taken up again, feasibility study).

FINANCING OF IRRIGATION PROJECTS IN THE 5TH PLAN (1977-81)
(four year plan, as revised in June 1979)

million CFA francs

P R O J E C T	Irrigated area target (ha.)	Cost of project	Plan estimates		Financial implemen- tation (%) to 30.6.79	Financing			Observations and credits to be obtained	
			Initial	Revised		Internal		External		
						Total	of which BNE	Total		of which secured
River region, SAED a) projects already in hand										
Tellel dyke	1,800	2,257	1,650	2,257	74	557	557	1,700	CCCE	
N'Dombo Thiago	800	2,391	2,391	1,028	2	100	100	928	CCCE	
Thiagar	485	270	550	270	0	-	-	-	FAC	
North Kassak	650	650	650	250	0	-	-	250	IBRD	
Lampsar	2,200	7,700	2,680	3,000	15	600	600	2,400	KUWAIT	
Debi	1,100	300	300	300	0	75	75	225	-	
Dagana	500	300	300	300	0	300	300	780	CCCE	
Niang	1,300	1,430	1,430	930	0	150	150	700	NETHER- LANDS	
Small perimeters, Matam Aéré	1,300	771	258	771	50	71	71	400	USAID	
Small perimeters, Morphil Island	600	441	265	441	55	41	41	700	FAC-	
Small perimeters, Bakel	1,800	1,900	300	962	40	192	192	770	CCCE	
Ronq Jeunes	300	100	100	100	0	15	15	85	NETHER- LANDS	
Grand Matam, surveys	2,800	2,800	2,800	150	0	-	-	150	USAID	
Training: phase I	790	790	696	590	0	100	100	490	CCCE	
phase II	400	400	696	300	0	60	60	240	CCCE	
N'Jerba basin									to be financed, 240 (IBRD)	
Collenghal Bakel		Postponed to the 6th Plan								
Small perimeters, Guédé										
TOTAL, projects already in hand	12,835	22,200	17,358	11,649	26	2,261	2,261	9,388	1,375 to be found	
b) new projects										
Demet basin survey	-	3,200	-	100	0	-	-	100	BOAD	
Guédé basin	-	842	-	842	25	42	42	800	CHINA	
Small perimeters, Ngalenka	-	329	-	239	0	33	33	206	IBRD	
Bakel solar pump	-	311	-	311	50	-	-	311	FAC-	
Intensification of rice plantation	-	3,124	-	1,238	100	-	-	1,238	USAID	
Reconstruction of pumping station	-	1,400	-	400	0	-	-	400	FAC	
Aéré Lao 2 (village peri.)	-	225	-	225	0	25	25	200	CCCE	
Matam 2 (village perimeter)	-	1,629	-	400	0	75	75	325	-	
Saldewala	-	2,000	-	p.m.	0	-	-	-	-	
Nder Basin	-	228	-	184	0	-	-	184	-	
TOTAL, new projects	-	13,299	-	3,339	41	175	175	2,980	400 to be found 200 (ABEDA) 184 (IBRD)	
TOTAL SAED		35,499	17,358	15,588		2,436	2,436	13,152	784 to be found 2,159	

CHAPTER IV

IV. PROPOSALS FOR A SECOND GENERATION PROGRAMME (1980-1985)

4.1. Priorities related to irrigation projects

(a) The Senegalese authorities have requested that priority be given to the financing and execution of the first generation programme, consisting of 16 irrigated farming projects(1). In the river valley and in the Casamance region, several projects of this programme have not yet been financed in part or in full (2).

Details of credits secured or expected for this programme are given in the table "Status of CILSS first generation projects".

(b) Some irrigation projects of the Fifth Plan not included in the CILSS first generation programme should be implemented as a priority; these have not yet been executed through lack of commitments or have only been partially financed. Details of commitments secured or sought for these projects are given in the table "Financing of irrigated farming projects in the Fifth Plan".

The status as of June 1979 of the financial implementation of the Plan shows a total volume of funding requirements of 2.793 million CFA francs, of which 2.059 million are for the River Region (SAED).

4.2. Project Proposals for a Second Generation Programme (1980-1985)

4.21. River Area (SAED)

4.211. Rehabilitation of the RONQ, THIAGAR and DIAWAR pumping stations (CILSS project n° 17)

This project is important, for the three pumping stations are presently subject to frequent breakdowns. These stations irrigate 5,170 hectares (with a further potential of over 6,000 hectares) and supply Saint-Louis with drinking water.

A brief project identification document (dated 20th October, 1978) estimates the cost of this project at 1.25 million CFA francs (see CILSS/7889/1).

- (1) Additional projects 17, 18, 19 and 20, entered in the closing part of 1978 and in 1979, are also included in the CILSS second generation programme.
- (2) It should be observed that the Casamance project for five anti-salt dams was delayed partly through lack of commitments but mainly for fear of the dangerous effects which could be generated by these dams, such as acidification of mangrove lands after they had been dried out. The Government has therefore been cautious and taken the decision to make an initial test with the Guidel dam.

Detailed formulation of this project, required as a first step would be performed by two experts on mission for a month (see part 4.322).

4.212. Completion of the BOUNDOUN hydro-agricultural perimeter (615 ha.) - (CILSS project n° 18, irrigated farming)

Funds provided by the FAC have allowed a first phase of development of 2,400 hectares area in Boundoun to be completed. An additional 615 hectares are still to be developed; a study is available; (it was carried out during the first phase up to the feasibility study stage).

The commitments sought for this project amount to 290 million CFA francs, (see project identification document CILSS/7889/2, 20th October, 1978).

Invitations to tender for the implementation of this project can be issued shortly.

4.213. Completion of the THIAGAR hydro-agricultural project (485 ha.) (CILSS project n° 19, irrigated farming)

A first stage covering 938 hectares (of which 250 ha. in 1977-78) was executed with Senegalese and FAC financing. In addition, 485 ha. still remain to be developed. A PID on the subject is available; it was carried out during the first phase up to the feasibility study stage.

The funds sought for this project amount to 270 million CFA francs. As in the case of Boundoun, invitations to tender for the implementation of this project can be requested shortly.

4.214. Development of the N'der basin (River Region, SAED) (CILSS project n° 21)

In this basin, which is presently used for rice growing under water control, a 150 ha. perimeter with total water control could be developed with pumped irrigation after the construction of a dyke for protection against floods. The development would be of the SAED small village perimeters project type and would call for human resources for the work to be performed on the tract.

Two methods of development were studied, technically different and offering different possibilities of production.

Estimated costs and funds required are as follows:

- Variant 1: 223 million CFA francs
- Variant 2: 119 million CFA francs (1)

(1) Financing for the N'der project has been requested from IBRD within the framework of "small rural sector aid projects" (RED).

The most urgent financial requirement is 45 million CFA francs to carry out studies and to repair the protecting dyke.

An immediate preliminary mission for pedological studies is requested (see part 4.333 below).

A brief project outline of the RED (33 pages) is available at the CILSS.

4.215. Rehabilitation of the BOUNDUM, DAGANA and NIANGA perimeters (CILSS project n° 22)

According to the November 1978 report of the FAC-IBRD-CCCE mission, "the Dagana perimeters (3,000 hectares, of which 2,000 had been developed in June 1978), BOUNDUM (2,400 hectares net) and to a lesser degree NIANGA (750 hectares) have reached a state of deterioration such that repairs have to be carried out rather than maintenance".

Real rehabilitation projects should be prepared for these perimeters to define the measures to be taken to ensure normal maintenance in future; in particular, to identify the necessary composition of maintenance teams(1).

As a first step, a mission including, among others, rural engineers and a team of topographic experts will study the feasibility of undertaking the proposed rehabilitation (see part 4.321 below).

This mission will also make an estimate of the cost of the rehabilitation of these three perimeters.

4.216. Construction of SAED headquarters in Saint-Louis (CILSS project n° 23)

This project consists of the construction of a building to house some 65 offices.

A rough estimate by the SAED appraises this project at 450 million CFA francs.

A preliminary mission will be sent for a short period to lay the basis for a financing proposal (see part 4.337).

4.217. SAED short-term programmes (CILSS project n° 24)

This broad heading includes development projects not yet studied, which the SAED will have to carry out in the near future as part of the Sixth Plan; it comprises both small village perimeters and large irrigation projects.

(1) See p. 25 of FAC-IBRD-CCCE report.

These projects will be part of the CILSS second generation programme (1980-1985).

This programme, derived from the overall guidelines should be brought up to date by a special mission (see part 4.311).

A large programme of project studies, for which financing has been granted, in particular by the World Bank, should soon be undertaken.

4.22. Casamance region (SOMIVAC)

4.221. Integrated rural development of the KALOUNAYES region (CILSS project n° 20, irrigated farming)

This project, originally designed as a series of small complementary operations of the "human advancement project" type, was revised because it had serious gaps.

The new formulation should be drafted by a special mission requested by SOMIVAC (see part 4.331 below).

A provisional estimate of this revised project calls for an investment of 2,450 million CFA francs over five years, broken down as follows:

Road network and hydro-agricultural development	1,220
Training and health	160
Extension services	301
Production factors	770
	<hr/>
	2,451 million CFA francs

The mission's task will be to confirm this figure, after specifying the basic road, dyke and structural requirements, crop patterns and the market for agricultural products.

4.222. Associated research programme for the development of GUIDEL (SOMIVAC) (CILSS project n° 25)

This project is of course linked with CILSS project n° 7, "Guidel perimeter". It is included in the second generation programme because it is a new project which responds to the cautious approach taken by the Senegalese Government, which believes that the test dam of Guidel be built with its associated hydro-agricultural development and should be completed before undertaking anything more ambitious, in order to obtain as much information as possible on the behaviour of these protected soils and on the other effects of an anti-salt dam.

Commitments are required for this programme amounting to 1.676 million CFA francs, broken down as follows:

"Associated research programme for the development of GUIDEL"

million CFA francs

Activities	Phase I	Phase II	Total
Hydrology - Hydrogeology	64	118	82
Agronomy - livestock	379	454	833
Fishing & agriculture	268	257	525
Forestry	124	75	199
Health	22	15	37
TOTAL	857	819	1.676

Source: RED

4.223. Survey of reservoirs and irrigable land in middle and upper Casamance (CILSS project n° 26)

In line with the new orientation, a special effort should be made to develop irrigated farming (rice growing), on "freshwater" land at first, i.e., in the Casamance basin upstream from Kolda.

As a first step, a mission for the identification of sites for reservoirs and irrigable land is scheduled as recommended in the Casamance region Rural Development Master Plan (see part 4.321 below).

This mission will establish the terms of reference and the programme of feasibility studies to be undertaken between 1980 and 1985. It will provide an approximate estimate of cost.

4.23. Other projects: supporting organisational structures

4.231. Support for the Rural Equipment Directorate (RED)
(CILSS project n° 27)

A 30-page report in which funds for this project are requested defines the two components involved:

- three year availability of technical assistance personnel in six different disciplines;
- financing of a building and various equipment, amounting to 109 million CFA francs (see part 4.41 below).

4.3. Short Term Activities

These are basically short missions to update programmes on projects, to help Senegalese authorities with a study, or to draft the terms of reference for the preparation of a feasibility study or a project implementation schedule.

These missions were requested by national authorities, and, for some of them, the specific terms of reference for development have already been settled. (These are identified by the sign *).

They have been classified into three families:

- 1 - Updating and finalisation of general master plans
- 2 - Rehabilitation of SAED projects
- 3 - Other missions.

4.31. Updating and finalisation of SAED and SOMIVAC master plans

4.311. Updating of short and medium term SAED programme

The SAED and medium term development programme was drafted in 1976 and brought partially up to date in 1978. This programme should be reupdated on the basis of the principles laid down in part 4.42., taking special account of:

- the development choices of the OMVS;
- the revision of the Fifth Plan in 1979;
- operating results of the last few years
- the results of studies presently underway covering the rehabilitation of perimeters and the feasibility of new developments.

This one-month mission would require an agro-economic engineer, a rural engineer and an agro-industrial expert. It should result in the definition of development hypotheses, criteria of choices and a long term development scheme embodying a programme of short-term studies (approximately 3 years) and medium term work (5 to 7 years).

This work should be executed in close collaboration with the OMVS and the SONADER, which has undertaken similar work in Mauritania.

The cost of this mission, including a publication containing the updated programme is estimated at 14 million CFA francs.

4.312. Identification of reservoirs and irrigable land in middle and upper Casamance for the SOMIVAC

This mission would be undertaken to follow up the recommendations of the Casamance agricultural development scheme. It would necessitate a rural engineer, an agro-pedologist, a hydrologist and a geotechnician for one month. Development of irrigated perimeters is presently limited essentially to coastal Casamance, protected by anti-salt dams; for better balance they should be extended to the upper basin. Exploration for dam sites would be undertaken in the area upstream from Kolda.

The cost of this mission is estimated to be 12 million CFA francs.

4.32. Rehabilitation of SAED plant and equipment: formulation of projects

4.321. Rehabilitation of the DAGANA, NIANGA and BOUNDUM perimeters

As per the conclusions of the FAC-IBRD-CCCE report (November 1978), the Dagana (3,000 hectares), Nianga (750 hectares) and Boundum (2,400 hectares) perimeters are in need of total rehabilitation.

A rehabilitation project should be drawn up including:

- an examination of the initial project (basic investigations, hydraulic operation, building principles...).
- an inventory of the status of projects (current situation).
- a feasibility study of the rehabilitation project (repair and improvement).
- detailed topographic surveys allowing a prior estimate of acreage of projects to be made.
- compilation of a consultancy file listing the terms of reference for the execution of projects (invitations to tender from firms, or public corporations).
- definition of maintenance operations and the methods of executing them.

As a first step, a mission including a rural engineer and a technician with experience in land development together with a team of topographic experts and a draughtsman, could carry out these tasks in a month's work on site.

The cost of this mission, including the topographic survey and the issue of the invitations to tender, is estimated at 15 million CFA francs.

4.322. Modernization of the RONQ, DIAWAR and THIAGAR pumping stations

This project, for repair of the three stations, was submitted to the CILSS by the Senegalese authorities at the Dakar meeting in September 1978 on the financing of crop production projects. A short three page PID was included.

It is therefore now necessary to formulate this project in detail.

These three stations fed supply water to the large tributaries of the Delta area as well as the Saint-Louis water supply (see map C4 of the Senegal river delta in the annex). These were installed in 1969, but now suffer frequent breakdowns, and their size (Ronq, 17 cu. meters per second, Diawar 7 cu. meters per second, Thiagar 3.5 cu. meters per second) makes maintenance difficult. Renovation of these stations is projected, taking into account:

- the submersion of the Diama dam in 1983-84;
- the reinforcement of the Saint-Louis electrical power plant and the presence of a 30 KW line to Ross-Béthio;
- plantations on new perimeters in the delta.

A one month mission of experts including an electro-mechanical engineer and rural engineer will :

- determine hydraulic characteristics of the large Delta tributaries and in particular, the Gorom Lampsar axis, in relation to the management of the Diama water reservoir;
- define the characteristics of the pumping stations;
- study the possibility of electrical power supply;
- draft the terms of reference for drawing up invitations to tender for contracts for civil engineering, electro-mechanical equipment and the medium voltage line.

The cost of this mission is assessed at 8 million CFA francs.

4.33. Miscellaneous expert missions

These short missions by experts were requested by the Rural Equipment Directorate (RED), except for two missions, requested by SAED and SOMIVAC.

4.331. Integrated rural development of the KALOUNAYES region (SOMIVAC)

A feasibility study has been carried out on this project, but it had gaps as regards advisory personnel; marketing and the cost of expensive infrastructure was underestimated (roads and anti-salt dams).

The decision was taken to reformulate three aspects of the study:

- 1 - to return to the identification study in order to review the design of the project;
- 2 - to review the feasibility study of the first three year phase: roads and dams, irrigation, training and extension services;
- 3 - to undertake market research into perishable products (vegetables, fish, fruit).

This work will be executed by a mission of experts, including :

- | | | |
|----|--------------------------|---------|
| 1. | 1 agro-economist | 3 weeks |
| | 1 rural engineer | 2 weeks |
| 2. | 1 agricultural economist | 1 month |
| | 1 rural engineer | 2 weeks |
| | 1 agronomist | 1 month |
| 3. | 1 economist | 3 weeks |

The cost of this mission is estimated to be 10 million CFA francs.

4.332. Socio-economic evaluation of development potential of salt lands in the BIGNONA region (SOMIVAC)

The future Bignona anti-salt dam would allow 8,000 hectares of salt land to be irrigated for rice farming. It is necessary to obtain information on local farmers' needs for new rice land, and to appraise their annual new land development capacity. This work requires a three month mission by an agro-economist specialised in rice farming and a sociologist.

The cost of this mission is assessed at 15 million CFA francs.

4.333. Pedological survey of the N'DER basin (river region) RED

A development with full water control similar to a "village perimeter"(1) has been envisaged for this basin, which presently grows submerged rice, with a low yield.

(1) A 33 page PID was prepared in January 1978.

As a first step, it is indispensable to gain knowledge of the soils' characteristics, and its agricultural potential.

A week's mission on site (plus two weeks for the report) of a pedologist would make it possible to obtain(1):

- rough maps of soils and of the basin (approximately 166 hectares)
- recommendations as to the development of land;
- possible crops.

Costs of analysis and travel would amount to 586,000 CFA francs and the total cost of this mission can be estimated at 600,000 CFA francs(1).

4.334. Definition of a pilot salt water irrigation project in the FIMELA-FATICK region (RED)

This region, located at the North of the Saloum delta, has large areas of saltwater land, on which small truck farming perimeters have already been tested.

A mission would allow tests to be appraised and would assess water and irrigable land potential, as well as to find the most farmable spot for the cultivation of a pilot truck farming perimeter and to draft a preliminary technical and economic project.

It would require the presence of a podologist(1) on the site for one week and a month of office work. Costs of analysis and travel would amount to 210,000 CFA francs.

The cost of this mission is estimated to be 250,000 CFA francs.

4.335. Use of solar energy for pumping irrigation water (RED)

There are, as yet, no operational applications of solar energy for irrigation(2). The terms of reference of a project drawing on all the experiments carried out elsewhere should be drafted.

Work of this kind requires the assistance of an expert on solar energy.

The cost can be assessed at approximately 3 million CFA francs.

- (1) The authorities would like to have the services of Mr. LOYER, a pedologist who works at ORSTOM/Dakar. His salary would be paid by ORSTOM.
- (2) A solar pump is being built at Diré (Mali) for the town's water supply and irrigation of a 100 ha. perimeter (P = 75 KW). It should be operational by the end of 1979.

4.336. Survey of actual water consumption on SAED perimeters

It is essential to know what really is the water consumption of SAED irrigation projects for both technical and economic purposes, to compare it with the theoretical requirements for the crops concerned. A mission will define the practical methods for technical measurement, the analysis of apparent and actual consumption, as officially recorded or informally estimated and assessment of the cost of water.

An agronomic engineer with experience of irrigation should be needed for a month. The cost of this mission can be assessed at 5 million CFA francs.

4.337. Construction of SAED headquarters in Saint-Louis

The SAED headquarters would be built on an available 12 hectare site and would comprise approximately 65 offices. The preliminary cost estimate for construction to be performed by the SAED is 450 million CFA francs.

A month's mission by an architect would enable the basic schedule of construction activities to be established in liaison with SAED authorities.

This mission can be assessed as costing approximately 5 million CFA francs.

4.338. Formulation of a project for a technical library at the Ministry of Equipment (RED)

The services of a documentalist are required to establish lists of technical and equipment books, to give advice on the organisation of the library and to evaluate the cost of the operation.

Duration of mission : 1 month

Its cost is estimated at approximately 3 million CFA francs.

4.339. Preparation of an agricultural and industry programme for SAED

SAED agricultural and industrial activities in processing and packaging of crops (rice, tomatoes) implies important changes and adapting to the production of new perimeters.

The two rice mills currently working at Richard-Toll and Ross-Bethio, do not operate satisfactorily and their reorganization is required(1). Others should be built, but they would no doubt be smaller to allow a better distribution in the area.

The tomato processing plant at DAGANA also has numerous problems(1).

(1) See FAC-IBRD-CCCE report (November 1978) by J. du Lac.

A one month mission by an engineer specialized in agro-industry (rice, tomatoes) would prepare this programme after a detailed analysis of the situation and suggest measures to make these activities profit-earning(1).

Estimated cost of the mission = 4 million FCFA.

4.4. Proposals relating to national coordination as regards irrigation

Coordination is undertaken by the Planning Department, whose task is to prepare documents of synthesis which are periodically brought up to date. This was the groundwork for the updating of the 1977-81 Fifth Plan in May 1979, on which the previous chapters are based.

Nevertheless, for purposes of decentralisation, many studies and technical project examinations are being undertaken under the sponsorship of development corporations. Through lack of facilities in the central department, coordination between the various projects is sometimes difficult to carry out at national level, which is the only official point of contact for donors and regional organisations such as the OMVS, the OCLALAV, WARDA, etc.

In addition, the technical responsibilities for multi-disciplinary programmes are divided between several ministries and this sometimes considerably slows down the process of drawing up project identification documents.

Without going into the institutional problems which have already been thoroughly studied by national officials (a restructuring of the SAED, creation of the SOMIVAC, etc.) a few practical proposals which have been formulated are mentioned below: support for the National Rural Equipment Directorate, the placement of outline development schemes on an official basis, and the implementation of associated multi-disciplinary programmes in several fields.

4.41. Support for the Rural Equipment Directorate (RED, Dakar)

The Rural Equipment Directorate is the agency in charge of the execution of government policy on hydro-agricultural development and rural infrastructures. Its activities lie upstream as well as downstream of agricultural production proper.

The Rural Equipment Directorate has not as yet received human material and financial resources commensurate with the importance of its tasks, which can be summarized in the three following broad categories:

- participation in the drafting and follow-up of agricultural policy, which involves having available a certain stock of project and survey potential.

(1) It would be interesting to experiment with certain types of small decorticators which have recently appeared on the market.

- contracting out work on hydraulic development and rural infrastructures and assisting the Ministry of Plan and the Ministry of Cooperation to secure funds.
- contracting out certain projects.

In order to strengthen its ability to perform its future tasks, a three-stage plan improving its facilities has been established :

- Stage 1 (4 years): creation of a Rural Equipment central survey office.
- Stage 2 (6 years): reinforcement of regional departments.
- Stage 3 (3 years): transformation of the central survey office into a Rural Equipment Technical Centre.

Implementation of stage 1 involves:

- financing a building and various equipment at a cost of an estimated 109 million CFA francs.
- recruitment as supernumerary staff of six technical assistants and 11 national engineers over a four year period, following the programme defined on the next page.

Technical assistants

Senegalese engineers

First year

- | | |
|---|--|
| 1 specialist in soil mechanics, civil engineering and reinforced concrete | 1 agronomic-cum-rural engineer or a Rural Equipment engineer |
| 1 agro-economist | 1 agro-economist |
| 1 topographical specialist | 1 topographical specialist |

Second year

- | | |
|---|--|
| 1 agronomic engineer specialised in cryogenics, storage and agricultural industries | 1 agronomic engineer specialised in cryogenics or a rural engineer or a Rural Equipment engineer |
| 1 hydraulics expert specialised in hydrology | 1 hydraulics expert or a Rural Equipment engineer |
| | 1 hydrologist |

Third year

- | | |
|---|--|
| 1 rural engineer specialised in irrigation and drainage | 1 rural engineer |
| | 2 agronomists or Rural Equipment engineers for storage and agricultural industries |

Fourth year

- | |
|---|
| 1 agronomist or Rural Equipment engineer to replace the counterpart of the head of division |
| 1 topographic engineer |
| 1 Rural Equipment engineer specialised in construction |

Source: RED

Financing of stage 1 of this project is sought in the amount of approximately 625 million CFA francs.

4.42. Assigning regional development master plans official status

Two outline development master plans have recently been studied by multidisciplinary teams financed by the World Bank master plans.

- 1 - A SAED short and medium term action programme for 1976 which was brought up to date in 1978.
- 2 - A Rural Development scheme for the Casamance (September 1978).

These documents, which are very complete, are not widely available to the Senegalese technical departments and are referred to only when drafting plans and programmes formally. Their recommendations are not always in line with other master plans established by regional organisations.

The main conclusions of these master plans should be ratified at national level, bringing the corresponding options to the surface and taking care to maintain their overall consistency.

The following points in particular should be brought into an official basis:

(a) Development hypotheses

- agricultural output potential,
- needs for basic foodstuffs,
- options as regards land development,
- rhythm of equipment,
- availability of national and foreign funds,
- characteristics and dates of entry into operation of joint OMVS and OMVG projects, etc..

(b) Geographic location of development projects

- conditions for water control and protection against floods,
- quality of soils (topography, suitability for cultivation, present use, etc.),
- nearby availability of agricultural labour-force,
- transport infrastructures and services,
- economies of scale, etc..

(c) Long-term development scheme (1990-2000), involving in particular:

- a 1/500,000th or 1/1,000,000th general map,
- recapitulative table for each four year plan of the amount of credits and areas developed and cultivated,
- series of 1/200,000th or 1/50,000th maps for project identification.

(d) Short-term studies and medium-term work programme

- 3 year programme of study and basic investigation,
- development activities to be performed by firms,
- public corporations' development activities,
- needs for engineers, technical assistance and training programmes,
- yearly financial requirements.

(e) Complementary missions

- harmonised research programmes in the fields of agronomy, hydrology, forestry, fishing and health, etc.,
- processing of agricultural products,
- participation of regional organisations, etc..

A few short expert missions could help national departments in the preparation of concrete proposals based on existing information.

The extension of official status to regional guidelines, the wide circulation of explicitly stated national options and objectives and the organisation of exchanges between the various national and regional development organisations, would certainly be useful to the country.

4.43. Implementation of multidisciplinary programmes

A programme of associated research dealing with certain aspects of sluice-gate dams on the Lower Casamance has been presented by the Rural Equipment Directorate in liaison with the Ministry for Rural Development, the SOMIVAC, the General Delegation for Scientific and Technical Research and the Ministry for Public Health (see the development of the Guidel valley above).

It would be worthwhile appraising the extent to which such a step, associating research workers and development executives could be taken in other regions, especially in:

- the Middle and Higher Casamance whose development appears to be a priority,
- the River region in relation to agronomic and socio-economic research projects of the OMVS.

4.45. Experiments with wheat (see annex F)

A mission consisting of two international experts in agronomy research and two Sahelian officials from research centers has been suggested to prepare a draft regional policy for wheat. This project would include a regional component and a set of national research projects including one for Senegal. The length of the mission has been estimated at approximately 1 month and its cost at 12 million CFA francs.

4.51. Second generation irrigated farming programme

RECAPITULATION OF PROJECTS

Project ref. n°	PROJECT TITLE	Estimate Million CFA francs
	<u>River area</u>	
17	Rehabilitation of RONQ, THIAGAR and DIAWAR pumping stations (preliminary formulation mission to be sent)	1,250
18	Completion of the BOUNDOUM hydro-agricultural perimeter (615 ha; invitations to tender of the implementation of this project will be issued shortly)	290
19	Completion of the THIAGAR hydro-agricultural project (485 ha; invitations to tender of the implementation of this project will be issued shortly)	270
21	Development of the N'DER basin (150 ha; a preliminary mission for pedological studies is scheduled)	228
22	Rehabilitation of the BOUNDOUM, DAGANA and NIANGA perimeters (preliminary mission scheduled for formulation and appraisal)	p.m.
23	Construction of SAED headquarters in Saint-Louis (preliminary mission of identification projected)	450
24	SAED short-term programme (1980-85) (mission to update programme scheduled feasibility studies of projects are financed by IBRD). Commitments required for 3,000 hectares a year over 5 years, i.e., 15,000 hectares	25,000
	<u>Casamance region</u>	
20	Integrated rural development of the KALOUNAYES region (reformulation to be drafted by a special mission)	2,450
25	Programme of associated research for the development of GUIDEL (RED estimate)	1,676
26	Survey of reservoirs and irrigable land, Middle and Upper Casamance. (Preliminary mission to establish the terms of reference for the programme of study)	p.m.

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Project ref. n°	PROJECT TITLE	Estimate Million CFA francs
	<u>Other projects</u>	
27	Strengthening the capacity of the Rural Equipment Directorate (RED) - technical assistance over 3 years - construction of an office building for the RED	150 109
28	Technical assistance to strengthen the SOMIVAC	150
GENERAL TOTAL i.e. approximately \$ US 150 million		32,023

4.52. Short-term actions: Estimate of cost of missions

Mission ref. n°	MISSION TITLE	Cost Million CFA francs
1.1	Update the SAED short and medium-term programme	14
1.2	Identification of reservoirs and irrigable land in Middle and Upper Casamance	12
2.1	Rehabilitation of the DAGANA, NIANGA and BOUNDUM perimeters: project formulation and evaluation	15
2.2	Renovation of the RONQ, DIAWAR and THIAGAR pumping stations: project formulation and evaluation	8
	<u>Other expert missions</u>	
3.1	Integrated rural development of the KALOUNAYES region (SOMIVAC)	10
3.2	Socio-economic expertise on the potential development of salt lands in the BIGNONA region (SOMIVAC)	15
3.3	Pedological survey of the N'DER basin (River region)	0.6
3.4	Pilot salt land irrigation project in the Fiméla-Fatick region	0.25
3.5	Use of solar energy for pumping irrigation water	3

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Mission ref. n°	MISSION TITLE	Cost Million CFA francs
3.6	Survey of actual water consumption on SAED perimeters	5
3.7	Building of SAED headquarters in Saint- Louis	5
3.8	Specifications for a future technical library for the RED	3
3.9	Preparation of an agro-industrial pro- gramme for the SAED	4
4.0	Definition of a Sahelian experimental wheat programme	12
TOTAL COST OF MISSIONS		106.8
i.e. approximately \$ US 497 thousand		

ANNEXES

S E N E G A L

- . Some general data
- . Its agriculture
- . Its economy

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	1.3	Population
	1.4	Industry, mining, infrastructure
Chapter II	2.1	Agriculture
	2.2	Agricultural share of national production
Chapter III	3.1	Public finance The Senegalese budget
	3.2	Foreign trade

SENEGAL

CHAPTER I - GENERAL DATA

1.1 GEOGRAPHY

Senegal is located in West Africa between longitudes 11 and 17° West, and between latitudes 12 and 17° North. The western coast, which is approximately 500 km. long, is on the Atlantic and, with the Cape Verde Peninsula, marks the most westerly point of the African continent.

Neighbouring countries are: to the North, MAURITANIA (borderline set by the Senegal river); to the East, MALI and to the South, GUINEA (Conakry) and GUINEA-BISSAU. GAMBIA is an enclave within Senegal extending some 40 km. on either side of the Gambia River and some 370 km. to the East, thus isolating the Casamance region from the rest of the country.

The surface area of SENEGAL is 196,722 km² and its maximum dimensions are almost 500 km. from North to South and some 680 km. from East to West.

1.2 MAIN CLIMATIC CHARACTERISTICS

(a) A Sahelian or sub-Sahelian climate prevails in most of the country (North of Gambia), with

- . a dry season (October-November to May-June) alternating with a rainy season whose length declines as one moves further North;
- . irregular rainfalls (droughts) which are very sparse, given the thermal region (an average 880 mm. at Nioro du Rip to 300 mm. at Podor);
- . average temperatures between 25 to 35° with annual amplitude (approximately 7°) lower than daily amplitude.

(b) Eastern Senegal, and especially the Casamance region has a Sudano-Sahelian climate again with the alternation of two seasons - one dry, one wet - but rainfall is greater (approximately 1,200 mm. on average) and the rainy season lasts longer.

(c) On the coast, North-West trade winds in alternance with the monsoon change the Sahelian climate slightly, bringing lower temperatures during the dry season, and higher temperatures during the wet season.

1.3 POPULATION

In 1976, the population was 5.1 million including 350,000 foreigners. Some 200,000 Senegalese live in other countries.

70% of the population is rural in spite of rapid urbanisation (800,000 people in greater Dakar) and have a high rate of increase (2.87% per year); the West of the country is very densely populated (80 inhabitants per sq. km in the DIOURBEL region).

The largest towns are: the capital, DAKAR, population 798,800; THIES, population 117,300; KAOLACK, population 106,900; SAINT-LOUIS, population 88,400 and ZIGUINCHOR, population 72,700.

Most Senegalese are Muslims and may be divided into two sects: the Mourides and the Tidjânes. Animism is still existent in the Casamance region and south of eastern Senegal. Christians are very few in number and are chiefly found in towns, on the "petite côte" and in the lower Casamance region.

The 1976 figure for population of working age is 2.8 million, of which 800,000 are urban dwellers. Almost 72% of the population lives in the country and is mainly employed in traditional farming.

There are 140,000 wage earners in the modern sector of the economy; more than 63% of these workers are located in the Cape Verde peninsula. It is estimated that 3,300 new wage-paid jobs are created each year.

313,000 children, i.e., only 30% of all children, go to primary school; 56,000 students attend primary school. There is little occupational training: less than 500 certificates of qualification are issued annually. Dakar university has 8,800 students, of whom more than 50% are taking literary and legal courses.

As regards health, needs are only partly covered: there are 0.6 doctors and 11.7 hospital or maternity beds per 10,000 inhabitants.

1.4 INDUSTRY, MINING, INFRASTRUCTURES

Industry is developing slowly, at a pace of 5% a year; it consists mainly of processing imported semi-processed goods, which therefore entails low added value.

2,800 people only are employed in industry, 80% of them concentrated in Cape Verde; this is far from enough to absorb the growth in the number of urban dwellers.

Mining production is basically of phosphates: 1.5 million of lime phosphates and 200,000 tons of alumina phosphates. Development projects for the iron mines of Falémé are under study, with an extraction capacity of ten million tons a year. Cement production, at 400,000 tons a year, covers only part of the needs and capacity is scheduled to be doubled in the near term.

Energy needs are met exclusively by hydrocarbon fuels. Annual imports are 700,000 tons and the cost exceeds 15 billion CFA francs(1). 183 MW of rated power installed as of 1977 should rise to over 250 MW, and energy output, 500 GWH in 1977, is increasingly 8% a year. 94% of consumption is located in Cape Verde and Thiès, the only areas with an interconnected network.

The tarred road network (see map) is being extended. It links Dakar to the regional capitals with branches to MATAM, M'BACKE and KOLDA. The railway system links DAKAR to SAINT-LOUIS and DAKAR to BAMAKO via THIES, DIOURBEL and TAMBACOUNDA.

112,000 tourists visited Senegal in 1976, staying mainly in Dakar, on the Petite Côte and in the Casamance region. Growth of the tourist trade has been slack for the past two years.

(1) 100 FCFA = 2 French Francs.

CHAPTER II

2.1 AGRICULTURE

Farming occupies 70% of the economically active population but accounts for only a small percentage of gross domestic product. (approximately 18 to 20%) as it does not meet national food requirements. Irregular rainfalls result in low and randomly variable yields.

Groundnuts are almost the only exported agricultural product, and represent close to 60% of agricultural production (at producer prices); they account for more than 80% of the income derived from marketing food crops. The annual harvest can vary from 600,000 tons to 1,450,000 tons of shelled groundnuts. It was estimated at 963,000 t. in 1976-77.

Millet (small millet and sorghum) is grown on 1,100,000 to 1,200,000 hectares with a yield of 600 to 700 kg per hectare and an average crop of 600,000 tons. The 1976-77 crop was estimated at 554,000 tons. Millet is the basic food in the deep countryside.

Corn is produced mainly for self-consumption in the Casamance region and in Eastern Senegal. The amount of corn grown is insufficient (52,000 tons), as an additional 40,000 tons have to be imported.

Rice is grown in the Casamance and Senegal river region over approximately 80,000 hectares with an average annual production of 110,000 t. of paddy rice, i.e. 73,000 tons of rice, which covers less than 30% of national needs. The remainder is made up by 200,000 tons of broken rice imported each year. This costs over 18 billion CFA francs in 1974.

Wheat has undergone promising trials, but production remains at an experimental stage, in spite of fast-growing demand which is presently above 100,000 tons per year.

Efforts have been made to introduce new crops:

- 90,000 tons of truck farming crops per year are produced in Cape Verde, of which 8,000 tons are exported (forecast to reach 25,000 tons in 1980);
- sugar cane, planted on 5,000 hectares at Richard Toll, produces approximately 30,000 tons of sugar per year; however, annual national needs are 90,000 tons;
- cotton is grown on 40,000 hectares in the Casamance region and Eastern Senegal yields 45,000 t. of cotton seeds which are marketed. However, production has been stagnant for the last few years.

- There are 2,500,000 head of beef, and 2,700,000 sheep and goats; 50,000 tons of meat are produced yearly, which is lower than consumption and necessitates imports of 12,000 t. of livestock on the hoof, mainly from Mauritania;
- Fishing is an important activity. The annual catch is 570,000 tons (of which 20,000 t. in the Senegal river) with an overall value of 24 billion CFA francs; processing and marketing of fish is largely performed using artisanal methods (dried smoked fish). The industrial fishing catch was 50,000 tons in 1976.

Senegalese food production is not enough in aggregate to feed the nation; more than 300,000 t. of cereals must be imported, which costs close to 25 billion CFA francs. This deficit will increase with the years, by reason of population growth. It should be stressed that in spite of great potential, the percentage of food production from irrigated land is low with only 110,000 t. of paddy rice.

To meet demand in the year 2000, the CILSS/Club du Sahel estimates the required increase in production to be:

- . 408,000 t. of rice, compared with present production of 75,000 t. (total anticipated demand: 483,000 t.)
- . 237,000 t. of wheat. Present output practically nil.
- . 207,000 t. of sugar. Present production 30,000 t. (total anticipated demand: 237,000 t.).

2.2 SHARE OF AGRICULTURE IN GROSS DOMESTIC PRODUCT (GDP)

The table below shows the value of GDP, and the value added by agriculture and the main products.

Year	Crop Year	Value of franc as compared w. value in 1971	Value added in billion current CFA francs				Agriculture's percentage share of GDP
			G.D.P.	Agriculture	Cereals	Ground nuts	
1973	72/73	0.89	243	28	10.5	10.1	11.4
1974	73/74	0.77	299	38	14.1	16	12.6
1975	74/75	0.69	359	73	28.2	35	20.4
1976	75/76	0.65	405	84	23.6	50.3	20.6
1977	76/77	0.62	420	73	21.6	40.5	17.4
1978	77/78	0.57	390	49	17.1	21.5	12.6

Source: Revised Fifth Plan.

The data in the table confirm:

- the leading position of groundnuts in the agricultural sector;
- the limited safety margin in Senegalese agriculture vis-à-vis climatic conditions, in particular in 1972/73 and 1977/78;
- a fragile foodcrop/cashcrop balance, through the incentive effect of producer prices.

Agricultural production in the rural sector, with 70% of the country's population, covers a small percentage of GDP (approximately 20% in good years, 12% only during bad years), but it supports the living standards of urban dwellers and the economy in general.

Year	Value added in million CFA francs		Value added in million CFA francs		Value added in million CFA francs	
	1971	1972	1973	1974	1975	1976
Total	10.0	10.0	10.0	10.0	10.0	10.0
Food crops	4.5	4.5	4.5	4.5	4.5	4.5
Cash crops	5.5	5.5	5.5	5.5	5.5	5.5
Other	0.0	0.0	0.0	0.0	0.0	0.0
Food crops	4.5	4.5	4.5	4.5	4.5	4.5
Cash crops	5.5	5.5	5.5	5.5	5.5	5.5
Other	0.0	0.0	0.0	0.0	0.0	0.0

CHAPTER III

3.1 PUBLIC FINANCE

GDP has been stagnant for two years in current francs and has declined markedly in constant francs; the 1978 figure was 390 billion CFA francs, i.e. \$ 350 per capita.

<u>Year</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
GDP in billion CFA francs (current francs)	243	299	359	405	420	390
GDP in billion CFA francs (constant 1971 francs)	217	229	247	264	260	224

The total budget rises on average by 8% a year; credits allocated for investment represented only 20% of operating credits up to 1973, later increasing to 30%. The capital outlay budget is always in deficit.

BUDGET OF SENEGAL

BREAKDOWN OF ANTICIPATED REVENUE (in millions of francs CFA)				ANTICIPATED BREAKDOWN OF CAPITAL EXPENDITURE (in millions of francs CFA)			
	<u>75-76</u>	<u>76-77</u>	<u>77-78</u>		<u>75-76</u>	<u>76-77</u>	<u>77-78</u>
Ordinary income	84	79	89	Total	25	40	18
of which:				General stu-			
Direct taxes	23.62	17.64	18.4	dies and	0.9	1.27	1.11
Customs				scientific			
duties and	31.62	36.5	44	research			
similar				Hydraulics	0.71	3.52	1.6
Internal in-				Crop produc-	2.59	2.95	0.8
direct taxa-	13.5	14.5	18.65	tion			
tion				Non agricul.	0.19	0.7	0.3
Registration				production			
& stamp	2	2.29	2.9	Transport &	1.4	3.57	2.4
duties				communications			
Income from				Social and	4.07	7.7	2.6
portfolio &	11.69	6.44	0.37	communal			
real assets				equipment	5.03	7.98	4.1
Payments for	1.36	1.37		Administrative			
services				equipment	6.97	7.23	5
Contributions				financial			
& participa-	0.13	0.18	4.68	investments	0.04	0.08	0.73
tion				Multipurpose			
Loan repay-	0.08	0.08		operations			
ments				Other	3.1	5.0	0.04
Extraordinary	12	40	18				
receipts							
Borrowings	12	40	18				

Officially-recognised State debt was 84.2 billion CFA francs in 1976, i.e. 18% of GDP with debt/service payments of 9.7 billion.

Official development assistance amounts to approximately 9% of GDP, but the share of loans is increasing (25% in 1975). The distribution in 1975 was as follows:

FRANCE :	47%	OPEC :	7.5%
EEC :	18%	USA :	4.5%
UNITED NATIONS :	4.2%	CANADA :	4.7%
IBRD/IDA :	9%	WEST GERMANY :	3.0%
EASTERN EUROPEAN COUNTRIES :	1%	OTHER :	2.1%

Commitments undertaken for the 1973-77 Fourth Plan were evaluated at 276 billion of which 55% financed out of foreign aid, and were divided as follows:

Credit	%	Interest (%)	Maturity (years)	Grace Period (years)
Subsidies (grants)	28	-	-	-
Soft loans	22	2	25	10
Subsidised loans	16	4 - 6	10 - 25	5
Loans at average terms	17	8 - 9	10 - 25	3 - 5
Eurodollar loan	17	libor + 2.5	3 - 5	almost nil

The initial forecasts of the Fifth Plan (1977-1981) were for 410 billion of investments (276 for the Fourth Plan). The accent is placed on the productive sector: agriculture, livestock farming, fishing and industry. 260 billion are expected to be defrayed from abroad, leaving national financing to cover 150 billion, of which 70 billion out of the national budget.

3.2 FOREIGN TRADE

Exports cover 75% to 80% of imports, which increased from 38 billion CFA francs in 1961 to 126 billion in 1975.

Close to 75% of Senegal's foreign trade is derived from groundnuts (40 billion in 1975), phosphates (24 billion) and fishing (7 billion).

Import of foodstuffs amounted to close to 40 billion CFA francs in 1974, the year of soaring prices of cereals on world markets. Petroleum products can also be mentioned (15 billion), as well as machinery (11.9 billion), chemicals (12 billion), etc...

ANNEX B

- B1 - Irrigated potential, irrigated area and rice, wheat and sugar production by broad zones in 1976, 1983, 1990 and 2000
- B2 - Debt of SAED farmers
Indebtedness and rate of repayment
Cost of SAED developments
- B3 - Finance secured by the SAED from 1964 up to 31st December, 1978.
SAED programme after revision of the Fifth Plan
- B4 - Short bibliography
- B5 - Glossary of abbreviations

SENEGAL

IRRIGABLE POTENTIAL, IRRIGATED AREA AND RICE, WHEAT AND SUGAR PRODUCTION
BY BROAD ZONES IN 1976, 1983, 1990 AND 2000

Source: Club du Sahel, Working Group on Irrigated Farming

R E G I O N	R I V E R					C E N T R E					C A S A M A N C E				GENERAL			
	BAKEL	MATAM	AERE	PODOR	DAGANA R-TOLL	DELTA	TOTAL	NIAYES CAPE VERDE	GROUND-NUT BASIN	LOWER SALOM	SYLVO-PAS-TOTAL ZONE	TOTAL	LOWER	MIDDLE	UPPER	TOTAL	TOTAL	
Area in thousands sq. km.	4,000	10,000	5,000	6,000	2,500	2,500	30,000	3,000	60,000	5,000	40,000	108,000	7,000	17,000	35,000	59,000	197,000	
Population (000)	60	100	50	45	25	120	400	1,000	2,000	200	50	3,250	275	300	175	850	4,500	
Irrigable potential in thousand ha.	14	95	42	65	21	30	267	6	-	4	-	10	100	15	65	180	457	
Irrigated surface 1976 Nat. Sub.	2.2	17.6	11.1	25.4	1.3	7.4	69.9	1	-	-	-	1	10	5	3	1	88.9	
Cont. Sub.	-	-	-	-	-	8	8	3	-	-	-	3	52	8	7	67	78	
Total control	0.1	0.2	0.1	0.7	8	13.1	13.1	1	-	-	-	1	10	-	-	-	14.1	
1983 Nat. Sub.	2	15	9	20	1	5	50	1	-	-	-	3	54	5	3	18	69	
Cont. Sub.	-	-	1	1	-	2	4	1.5	3	-	-	3	11	11	10	75	62	
Total control	2	11	6	7	10	10	46	1	-	0.5	-	2	-	-	-	-	48	
1990 Nat. Sub.	1	8	5	10	-	-	24	1	-	-	-	1	-	5	3	8	33	
Cont. Sub.	-	-	-	-	-	-	-	3	-	-	-	3	70	11	10	91	94	
Total control	4	22	12	13	13	15	79	3	1	2	-	6	-	-	8	8	93	
2000 Nat. Sub.	-	-	-	-	-	-	-	1	-	-	-	1	-	5	3	8	9	
Cont. Sub.	-	-	-	-	-	-	-	3	-	-	-	3	92	11	10	113	116	
Total control	9	56	33	26	16	15	155	3	2	3	-	7	-	2	14	16	178	
NOTE: Nat. Sub. = Natural submersion; Cont. Sub. = Controlled submersion; Total control = Total water control																		
RICE, WHEAT and SUGAR PRODUCTION (in thousand tons)																		
1976	Paddy	11	25	25	114	25	87	87	87	87	87	87	87	87	87	87	112	
	Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	
	Sugar	48	48	48	89	48	89	89	89	89	89	89	89	89	89	89	194	
1983	Paddy	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
	Wheat	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	
	Sugar	169	169	169	260	169	260	260	260	260	260	260	260	260	260	260	417	
1990	Paddy	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
	Wheat	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	125	
	Sugar	373	373	373	462	373	462	462	462	462	462	462	462	462	462	462	704	
2000	Paddy	52	52	52	74	52	74	74	74	74	74	74	74	74	74	74	74	
	Wheat	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	205	

COST OF SAED DEVELOPMENTS

SAED : DEVELOPMENT COSTS

MAJOR DEVELOPMENTS

- STUDIES

Topography	10 to 15,000 F/hectare
Pedology	8 to 10,000 F/hectare
Studies	20 to 30,000 F/hectare
Feasibility	5 to 8,000 F/hectare

Sub-total 43 to 63,000 F/hectare

- DEVELOPMENTS

Machinery	40 to 50,000 F/hectare
Earthworks/Civil engineering	700 to 1,000,000 F/hectare

Sub-total 740 to 1,050,000 F/hectare

TOTAL 783 to 1,113,000 F/hectare

VILLAGE PERIMETERS

- STUDIES

Topography, pedology, sociology	15 to 25,000 F/hectare
---------------------------------	------------------------

- DEVELOPMENTS

Pumping	150,000 F/hectare
Work	50,000 F/hectare

Sub-total 200,000 F/hectare

TOTAL 215 to 225,000 F/hectare

ANNEX B2

DEBT OF SAED FARMERS

Indebtedness and rate of repayment
in 1977/78

	Aggretate debt	Repayment	%
<u>PADDY</u>			
DELTA	294,494,319	80,076,736	27.2
DAGANA	51,344,212	35,186,360	68.5
NIANGA	47,760,681	40,130,196	84.0
GUEDE	42,881,800	15,099,690	35.2
AERE-LAO	12,510,270	2,721,924	21.7
MATAM	4,944,282	4,060,441	82.1
BAKEL	4,460,396	3,962,010	88.8
TOTAL SAED PADDY	482,782,253	181,237,357	37.5
<u>TOMATOES</u>			
DELTA	81,838,125	12,283,817	15.0
DAGANA	50,458,317	49,345,433	99.9
NIANGA	10,839,432	10,839,432	100.0
TOTAL SAED TOMATOES	143,135,874	72,468,732	50.6

Source: SAED

FINANCE SECURED BY THE SAED FROM 1964 UP TO 31.12.1978

Credits secured by the SAED since the beginning of development in 1964 amount to 33 billion CFA francs, which is broken down as follows :

Credits secured by the SAED as of the 31.12.1978

in current CFA francs

Description	Amounts	Financial sources
Delta perimeter	16,454,000.000 *	FAC, CCCE, BNE
Dagana perimeter	3,100,000,000	BIRD, BNE
Nianga perimeter	1,671,000,000	FED
Guede perimeter	942,000,000*	BNE, China
Matampodor perimeter	6,995,000,000*	FAC, BOAD, CCCE
Bakel perimeter	1,400,000,000*	USAID
Training project	2,809,813,000**	USAID, FAC, CCCE, UNDP
Bakel solar pump project	311,000,000**	FAC, USAID
* Underway		
*** Being started		

Source : SAED

SAED PROGRAMME AFTER REVISION OF THE 5TH PLAN (JUNE 1979)

Cost in thousand CFA francs

PROJECT	REVISED COST	DONORS	Objective (1981) in hectares		Disbursed 1,000F CFA	Observations
			Revised	Executed		
Major Tellel Dyke Debi Lampsar	2,257 1,223 4,891	CCCE Kuwait IBRD	1,800 1,100 2,200	1,500 - -	1,075 - -	(Second divided project. Debi and Lampsar con- tract being signed
Ndombo-Thiago Matam-Aere-Lao	1,000 140	CCCE CCCE	800 1,300	- 800	- 122	Agreement in principle Being signed Underway 79/81 operation
Matam Phase II Dagana (c)	1,629	CCCE Senegal	1,520 500	- -	- -	
Bakel Amorphil Island Nianga (c) North Kassack Thiagar Saldewala Ngalenka Demet Bakel (solar pump)	700 441 1,430 250 270 2,012 302 3,220 150	USAID Nether, KFW FAC CILSS KFW IBRD BOAD USAID/ FAC China IFAD USAID	1,800 600 1,300 200 405 1,087 300 3,220 130 820	130 250 - - - - - - -	147 - - - - - - - -	Underway secured Financing secured Underway Underway
Guede (basin) Faleme Ronq Jeune	842 100					

Source : Revised Fifth Plan

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GLOSSARY FOR ABBREVIATIONS

ACDI/CIDA	Canadian International Development Agency
BAD/ADB	African Development Bank
BCEOM	Bureau Central d'Etudes Outre Mer (France)
BDPA	Bureau pour le Développement de la Production Agricole (France)
BIRD/IBRD	International Bank for Reconstruction and Development
BNE	Budget National d'Equipement (Senegal)
CCCE	Central Fund for Economic Cooperation (France)
CEE/EEC	European Economic Community
CILSS	Permanent Interstate Committee for Drought Control in the Sahel (Upper Volta)
CIMMYT	International Center for the Improvement of Maize and wheat (Mexico)
CSS	Senegalese Sugar Company
DER/RED	Rural Equipment Directorate
FAC	Assistance and Cooperation Fund (France)
FED/EDF	European Development Fund
IDA	International Development Association
IRAT	Institut de Recherche en Agronomie Tropicale (France)
NAS	National Academy of Sciences (USA)
OCDE/OECD	Organisation for Economic Cooperation and Development
OMVG	Gambia River Basin Development Authority
OMVS	Senegal River Basin Development Authority
OPEP/OPEC	Organisation of Petroleum Exporting Countries
ORSTOM	Office for Scientific and Technical Research Overseas (France)
PIDAC	Projet Intérimaire de Développement de la Casamance
PRS I	Projet Riz Sedhiou I
PRS II	Projet Rural Sedhiou II
SAED	Société d'Aménagement et d'Exploitation des terres du Delta
SOCAS	Société de Construction Alimentaire du Sénégal
SODAGRI	Société pour le Développement Agricole et Industriel
SODEFITEX	Société pour le Développement des Fibres Textiles

SOGREAH	Société Grenobloise d'Etudes et d'Aménagements Hydrauliques (France)
SOMIVAC	Société de Mise en Valeur de la Casamance
UPR	Unité de Planification Régionale de la SOMIVAC
USAID	United States Agency for International Development

A N N E X C

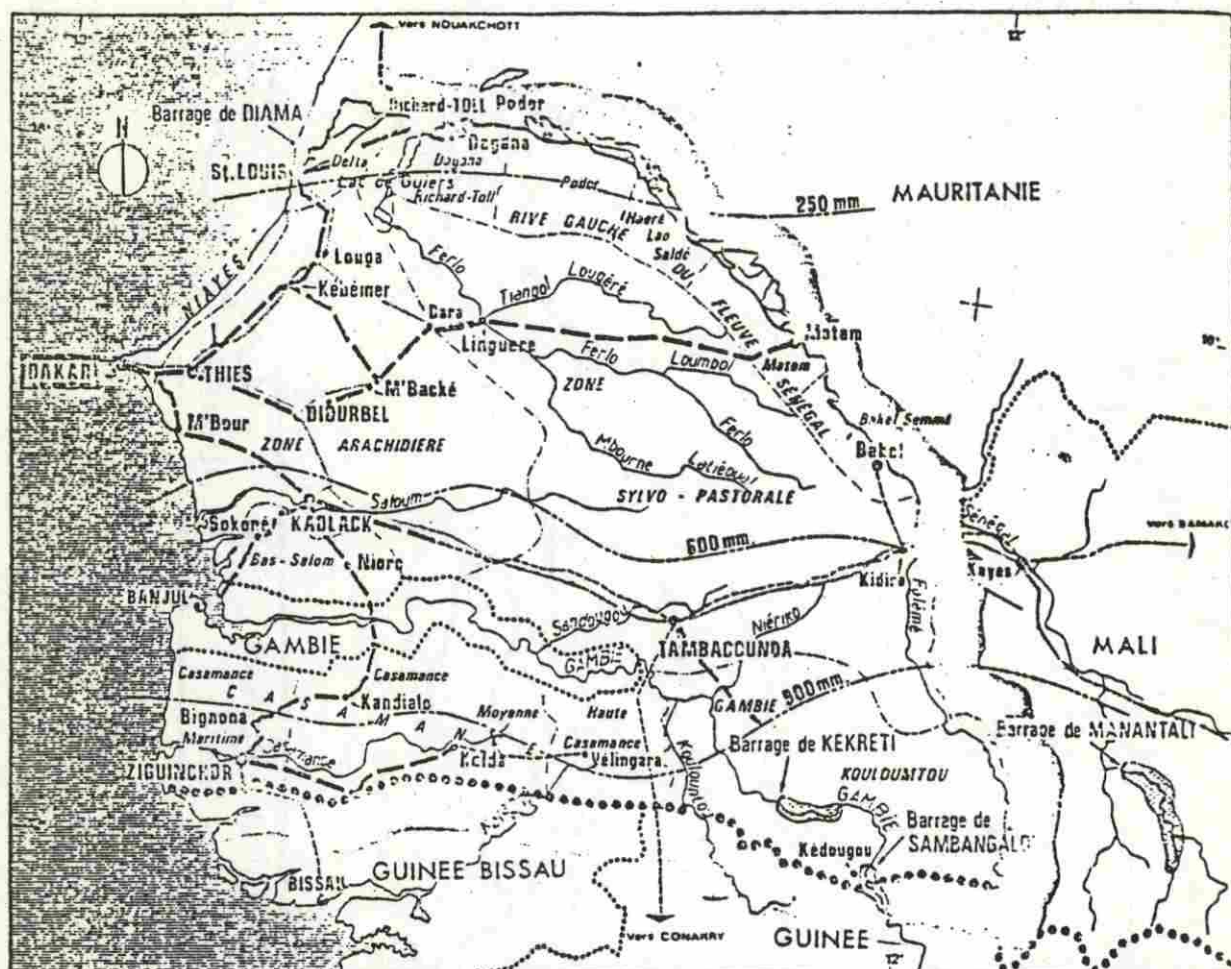
MAPS OF SENEGAL

1. Main existing or projected irrigation perimeters
2. Administrative map
3. Senegal river valley : hydroagricultural developments
4. Senegal delta and lower valley
5. Hydroagricultural dams and development envisaged in Casamance
6. Kalounayes region

SENEGAL

Main existing or projected irrigation perimeters

Source: Club du Sahel
Working Group on Irrigated Farming

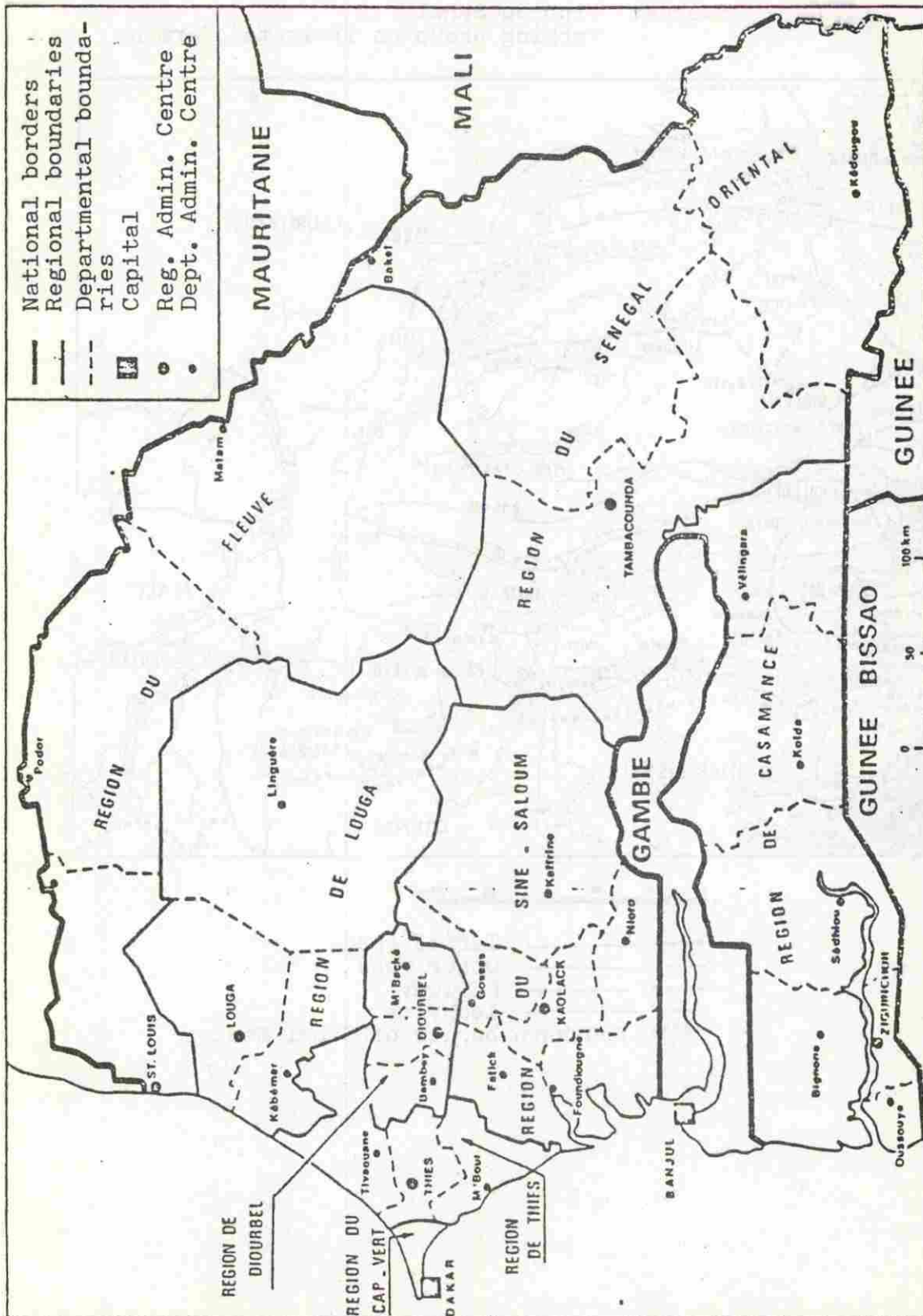


- | | |
|-----------|---------------------------------|
| — — — — — | Tarred road |
| — — — — — | Other road |
| — — — — — | Railway |
| — — — — — | Isohyets |
| | Southern border of Sahel States |

SENEGAL

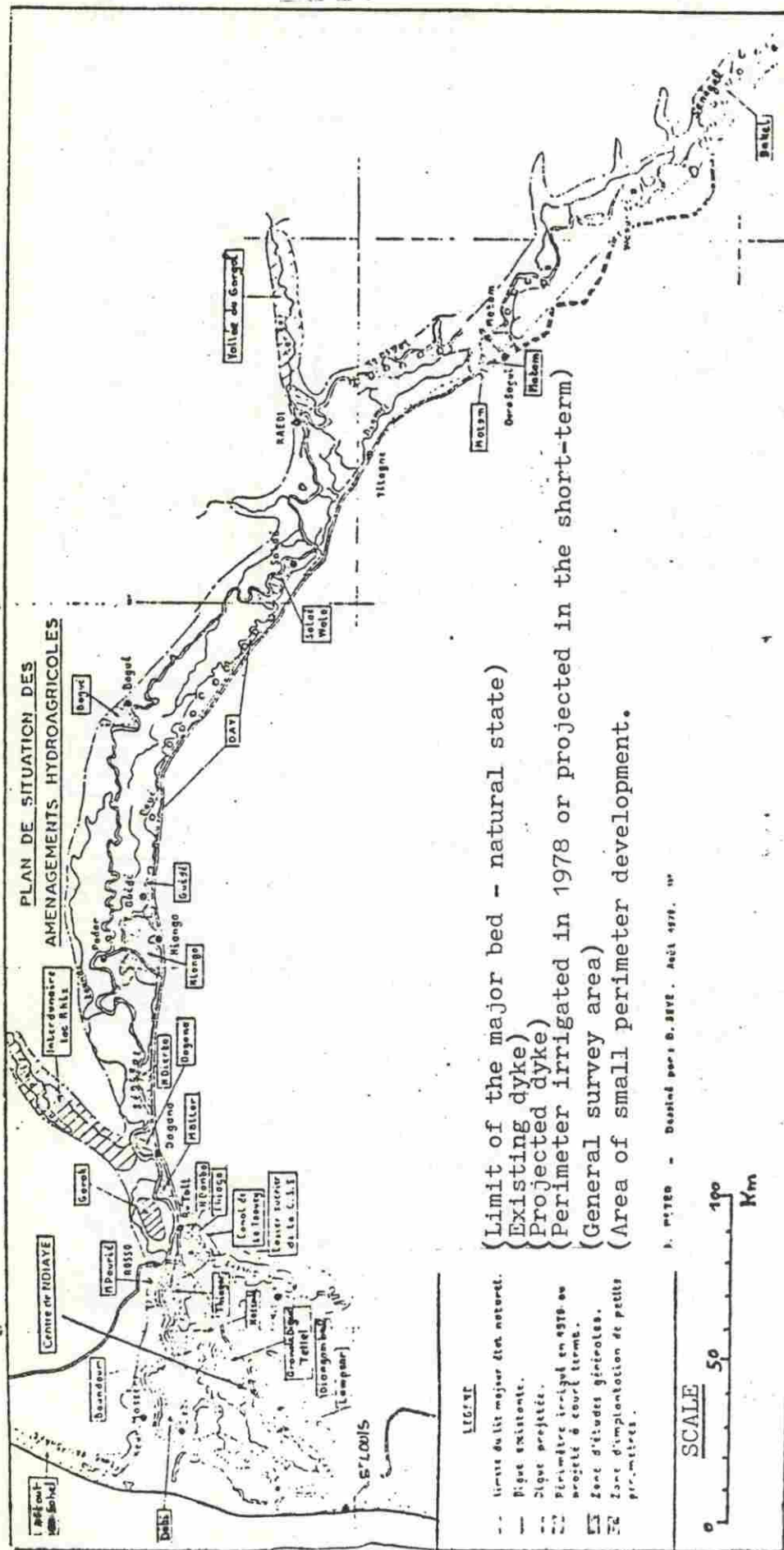
Administrative Map

1977



SENEGAL RIVER VALLEY : HYDROAGRICULTURAL DEVELOPMENTS

- 87 -









(Limit of the major bed - natural state)
 (Existing dyke)
 (Projected dyke)
 (Perimeter irrigated in 1978 or projected in the short-term)
 (General survey area)
 (Area of small perimeter development).

3


1.3



Station	PX Km	Débits m ³ /s	PNE m ON
Dagana B	107	2,0	4,20
Dagana A	169	2,8	3,26
Richard-Toll	145	16,0	—
M'Foulé	100	5,4	—
Thiagar	127	4,7	2,35
Rong	113	17,5	2,20
Dikwar	102	7,0	2,50

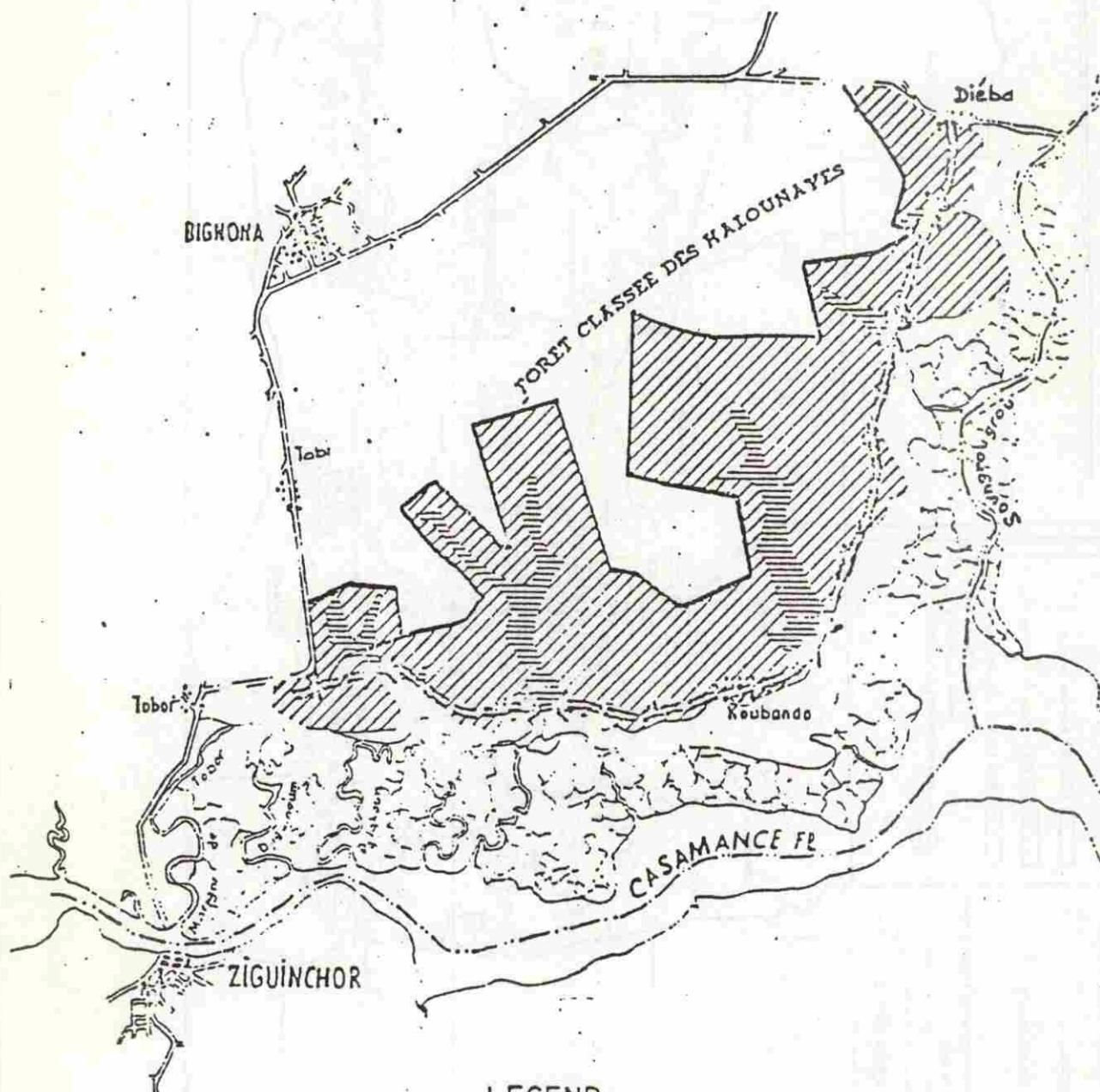
 Digues projetées
 Digues existantes
 Routes existantes
 Routes projetées
 Routes projetées sur digue
 limite du lit mineur

Campagne	7/7/78	8/0/81	8/4/85
Boundoum	3200	3200	3200
Thlaga	1000	1500	1500
Kassak	600	1200	1200
Grande Digue Tellel	4000	2100	2100
Débi	—	1500	1500
Lompsoir - Cuvelles	870	3070	3070
Diagambol	—	1000	1000
Ndongo - Thlaga	—	800	600
Dogond	3200	3200	3200
MBlor	—	2500	2500
Ndlorbo	—	2000	2000
Total	9870	22070	22070

 Zone Inondée
Périmètre Trigué ou projeté
Ouvrage sur digue ou mortier (existe et est en projet)

KALOUNAYES REGION

Scale: 1/200.000th



LEGEND

2.160 ha gross
= 1.500 ha net



Rice plantations protected by an anti-salt dam

16.880 ha gross
= 10 000 ha net



Rainfed farming



Loop road

ANNEX D

- N O T E -

PERSONNEL AND TRAINING REQUIREMENTS
FOR THE OPERATION OF IRRIGATED PERIMETERS

Contents

1. General information on the "SAED training" project.
 2. Present organisation of hydro-agricultural developments
 - (a) large developments
 - (b) village perimeters.
 3. Type of staff to be trained for:
 - (a) producer groups
 - (b) the project proper
 - (c) environment of the project.
 4. Schedule of training for a specific project.
 5. Short-term Senegalese requirements.
- Conclusion.

1. GENERAL INFORMATION ON THE SAED TRAINING PROJECT(1)

A training project financed by FAC-CCCE-USAID is being executed by the SAED to meet medium-term requirements for qualified staff given the pace of development which should reach 3,000 to 5,000 hectares annually during the next few years.

This project has four objectives:

- training and further training of SAED staff in charge of perimeter management and provision of advisory services to producers;
- training of farmers' leaders and producers in the management of their groups and exploitation as well as the rational use of irrigation;
- training of irrigation experts for the Senegal river and other regions of the country or neighbouring countries and the development of suitable irrigation methods;

(1) Reference may be made to the document "Problems of training at the SAED (BDPA, FAC/CCCE financing, 1977).

- maintenance of the stock of machinery.

The project, which uses existing structures, also involves:

- building and operation of the "N'diaye National Centre for Application and Improvement of Irrigation Methods", divided in two units: a training unit and a unit for technical advice on irrigation;
- three years of technical assistance by an agronomics instructor, a rural engineer and an agronomics engineer;
- training sessions for heads of perimeters;
- equipment of machinery maintenance centres, provision of spare parts and implementation of a technician training programme with the participation of four technical assistants.

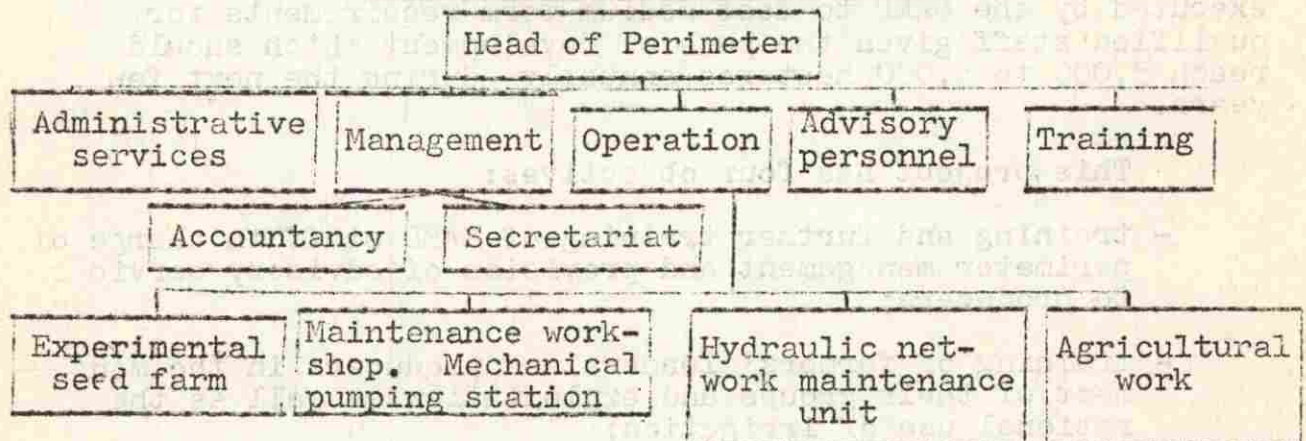
2. PRESENT ORGANISATION OF HYDRO-AGRICULTURAL DEVELOPMENTS

The organisation described is that of the SAED in 1978, but the main lines can be found elsewhere. Apart from central departments, it concerns "large developments" and "village perimeters".

- The surface area of large developments is 3,000 ha. divided into a hydraulic mesh with unit cells of over 50 hectares which are operated in common by a 15 to 20 member producer group, i.e. an average tract of 3 ha. per person.

Structural organigram of the advisory personnel

on a large perimeter: DAGANA

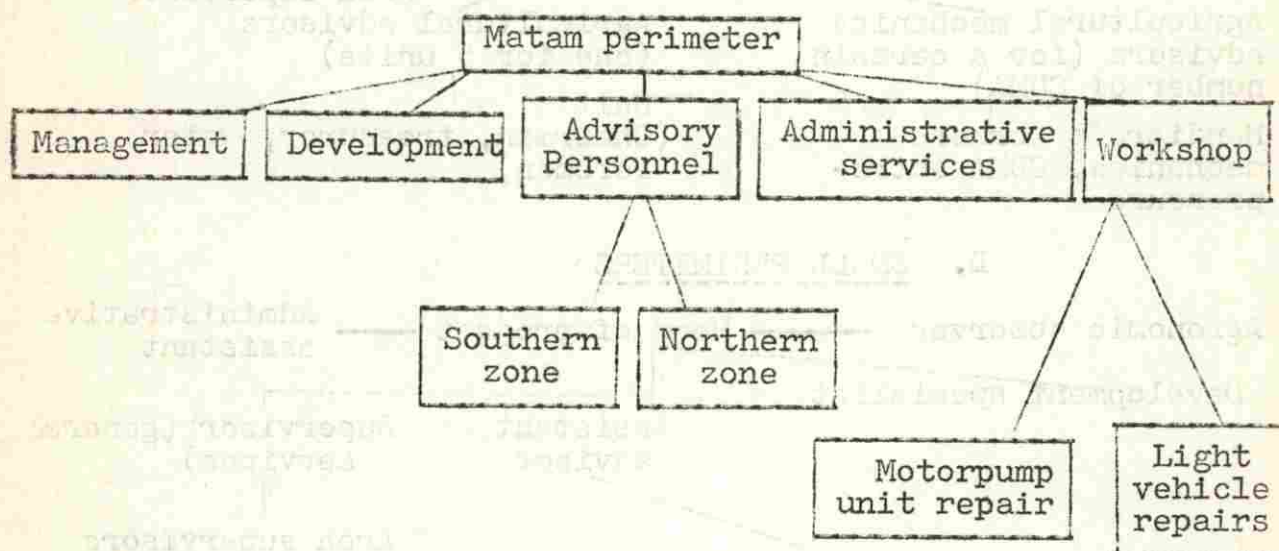


Advisory personnel on-site includes a head of project and two assistants, a zonal chief for each 500 hectare area and a basic advisor for 100 ha. tracts.

In addition to this advisory personnel structure, the head of project has at his disposal:

- administrative services and supervisory staff (general services)
- a head of exploitation in charge of mechanical work
- a repair and maintenance unit for machinery and hydraulic projects
- a training centre
- a seed farm.

(b) Village perimeters are prepared by the participants centred on pumping stations feeding 20 to 50 hectares, the surface awarded to each averages 0.432 acre. The diagram below is that of the small village perimeters in the Matam area:



Note: The organisation charts for Aéré Lao and Bakel are similar to that of Matam.

On an aggregate surface of 700 ha. with approximately 40 perimeters, the advisory personnel includes:

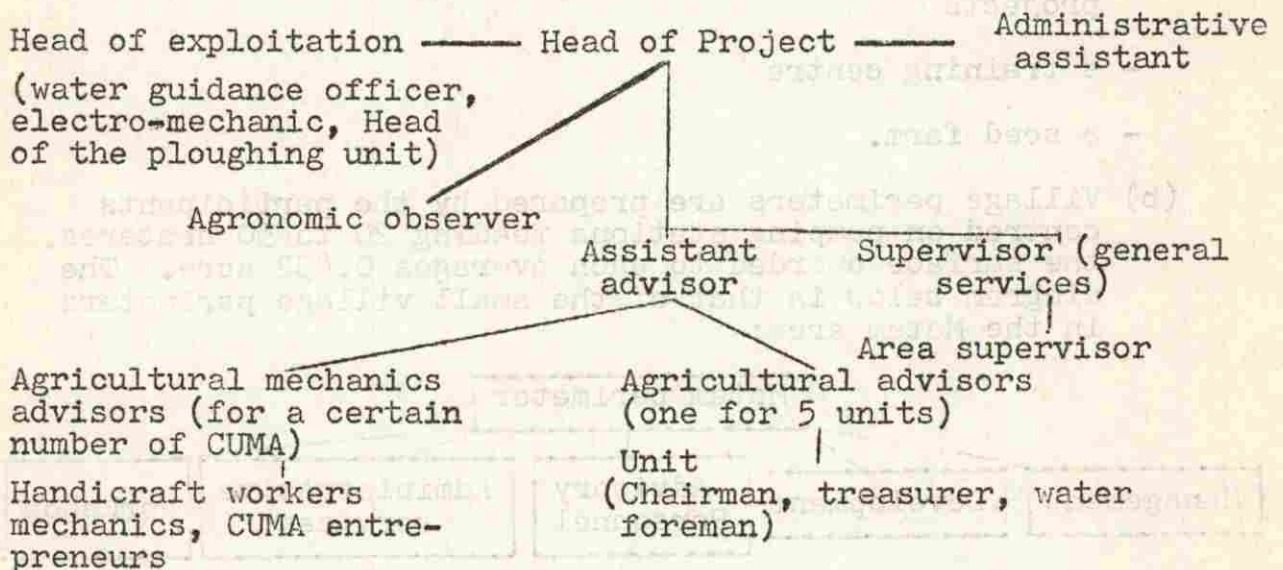
- a chief of perimeter, helped by an assistant advisor and an administrative assistant, a supervisor (general services), a development specialist and a training/extension assistant;

- eight basic advisors;
- an expert mechanic.

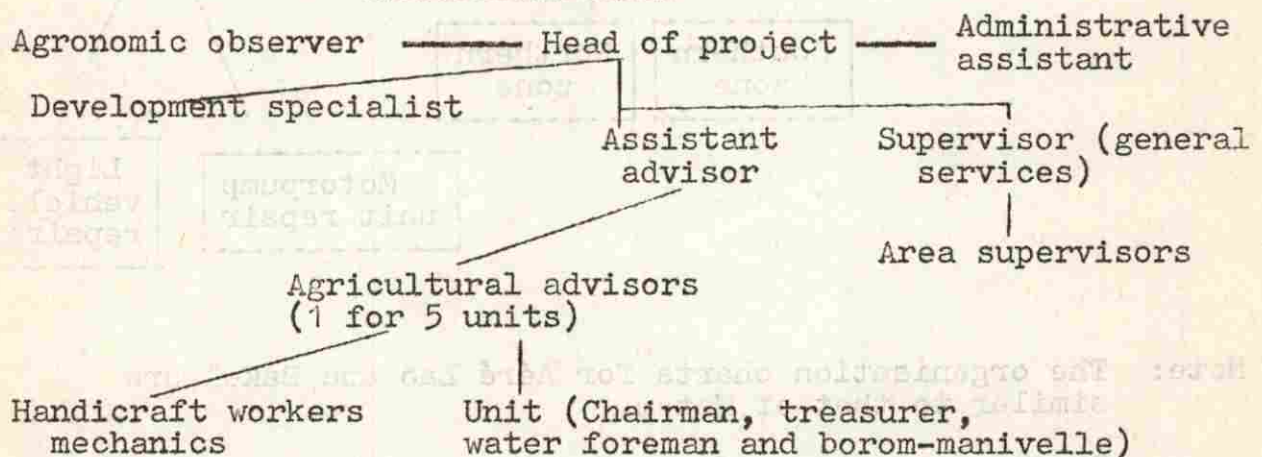
3. TYPE OF STAFF TO BE TRAINED

The advisory personnel structures for the two kinds of perimeters may be divided as follows. They yield a very precise definition of the allocation of tasks, as well as the specialities and the methods for training, ranging from the producer groups to the project head.

A. LARGE PERIMETERS



B. SMALL PERIMETERS



(a) Training of producer units

With a hydraulic cell of approximately 50 hectares, training is aimed at:

- the producers on site, on the technical aspect (farming methods, water supply operation, etc.) and the managerial aspect within the hydraulic cell;
- unit leaders;
- water foreman in charge of water distribution;
- pump attendants in charge of everyday maintenance and operation of motorpumps.

(b) Training in relation to the project proper

The personnel can be divided into 5 units, as follows:

- basic advisors who can become agricultural advisors, agricultural machinery advisors and even assistant advisors after complementary training;
- supervisors in charge of supplying inputs and marketing of goods for the area (500 hectares) or the project;
- an operations and maintenance team with an exploitation and development assistant (ITA level); an electrical mechanic, a mechanic, a water attendant, a chief of the maintenance unit, a chief of the ploughing team and a head of contracting services;
- chief of pre-extension staff or an agronomic observer (ITA level) in charge of adapting techniques, verifying and interpreting tests carried out on several plots and introducing new techniques;
- head of project taking orders from an executive engineer, and assisted by a financial agent.

(c) Training for project related activities

Specialised training will also be provided in agricultural mechanisation as well as agriculture-related trades: handicraft workers (blacksmiths, brick-layers, mechanics...) and provision of agricultural services (farming methods, ramming...).

TRAINING SCHEDULE FOR A 3,000 HECTARE IRRIGATION PROJECT

The following table shows the timing of training and staff requirements for a large development project of approximately 3,000 hectares.

TIMETABLE FOR THE IMPLEMENTATION AND PERSONNEL TRAINING FOR A 3,000 HECTARE PROJECT

-3	-2	-1	0	1	2	3	4	Installation of CUMA
Primary development	Primary development	Creation of producer units. Detail of clearing. Ploughing and watering	Surface considered 600 ha. Input supply. Start up of the 1st pumping station	Surface considered 1200 ha. 2nd pumping station	Surface considered 1800 ha.	Surface considered 2400 ha. 3rd pumping station	Surface considered 3000 ha.	3000 ha.
		1 head of project 1 chief of area 1 chief of ploughing team 1 pro. supervisor 1 op. assistant 1 workshop mech. 1 admin. assis. 1 assis. mech.	1 head of project 2 chiefs of area 1 chief of ploughing team 1 pro. supervisor 1 op. assistant 1 workshop mech. 1 electro-mech. 6 basic advisors 1 admin. assis. 1 water warden 1 mechanic	1 head of project 3 chiefs of area 2 chiefs of ploughing teams 1 pro. supervisor 1 op. assistant 1 workshop mech. 2 electro-mechs. 18 basic advisors 1 admin. assis. 2 water wardens 2 assis. advisors 3 area supervisors 2 mechanics	1 head of project 4 chiefs of area 2 chiefs of ploughing teams 1 pro. supervisor 1 op. assistant 1 workshop mech. 2 electro-mechs. 18 basic advisors 1 admin. assis. 2 water wardens 2 assis. advisors 4 area supervisors 3 mechanics	1 head of project 6 chiefs of area 3 chiefs of ploughing teams 1 pro. supervisor 1 op. assistant 1 workshop mech. 3 electro-mechs. 24 basic advisors 1 admin. assis. 3 water wardens 2 assis. advisors 6 area supervisors 4 mechanics	1 head of project 6 chiefs of area 3 chiefs of ploughing teams 1 pro. supervisor 1 op. assistant 1 workshop mech. 3 electro-mechs. 30 basic advisors 1 admin. assis. 3 water wardens 2 assis. advisors 6 area supervisors 5 mechanics	1 head of project 1 project supervisor 1 op. assistant 1 workshop mech. 3 electro-mechs. 1 admin. assistant 3 water wardens 2 assis. advisors 6 area supervisors 10 rural advisors 10 machinery advisors 10 mechanics
	1 head of project 1 chief area 1 pro. supervisor 1 op. assis. 1 workshop mechanic 1 chief ploughing team 1 admin. assis.	6 basic supervisors 1 electro-mech. 1 admin. assis. 1 water warden 1 chief of area 1 workshop mech.	6 basic supervisors 1 chief of ploughing team 1 assis. advisor 3 area supervisors (general services) 1 chief of area 1 electro-mech.	1 chief of area 6 basic advisors 1 area supervisor 1 assis. advisor 1 mechanic	1 chief of area 6 basic advisors 1 area supervisor 5 CUMA art. 1 electro-mech. 1 water warden 1 mechanic	6 basic advisors 1 mechanic		

TE: The additional staff necessary during the implementation of the CUMA will be trained the year before, i.e. 10 administrative advisors
10 operators of agricultural machinery
5 mechanics

Source: SAED

5. SHORT-TERM NEEDS IN SENEGAL FOR QUALIFIED PERSONNEL TO MONITOR IRRIGATION PROJECTS

These figures, although indicative, show the magnitude of the effort to be made by Senegal for training and recruitment(1) to secure the production of irrigated food crops which it can expect from the hydro-agricultural developments undertaken in the Casamance and the river region.

• Heads of project, agronomic engineer's degree	10
• Assistant advisors and operators and chief of area, ITR and ITA level	65
• Administrative assistant, project and area supervisors	65
• Development specialists and water foremen	35
• Basic advisors, rural machinery advisors	184
• Chiefs of ploughing teams, mechanics, electro-mechanics, pump attendants	96

These figures are established on the basis of an average pace of development of 5,000 hectares per year (2).

In conclusion, it may be stressed that the best approach is on-the-job training or specialisation of cadres and agents, within the core of the production unit formed by an irrigation project. It is irreplaceable but cannot be improvised. It requires the prior organisation, qualified training personnel and funds.

- (1) An effort should be made in the field of wages: qualified staff working for Development Corporations on the site should earn the same as they would in the private sector. Their motivation should be fostered by a system of bonuses and advantages as compared with personnel and technicians with similar qualifications in the capital. See the Janet report (FAC - IBRD - CCCE, November 1978) pages 20 and 21, on the SAED.
- (2) Reference may be made to the CILSS/USAID/ILO mission report of April 1978: "Need for training of higher and medium level executives in the field of agriculture during the 1978-1982 period for CILSS member countries". Senegal report, 56 pages, plus an overall report.

ANNEX E

- N O T E -

THOUGHTS AND PROPOSALS AS REGARDS THE EXAMINATION
OF PROPOSALS AND THE IMPLEMENTATION OF PROJECTS

CONTENTS

1. Genesis of development projects.
 - (a) reconnaissance and identification
 - (b) project feasibility and pre-implementation studies
 - (c) development work
 - (d) operation and maintenance of perimeters
2. Specification of the feasibility and implementation dossiers.
3. Coordination in evaluation missions.
4. Taking regional developments into consideration.
5. Completion of projects, maintenance and management.
 - (a) organisation and operation
 - (b) rural hydraulics
 - (c) agricultural production.

In the way they have been consulted, the basic proposals which are shown to donors are of several forms. Many evaluation missions go to the location, using criteria corresponding to each financing body. As a result, projects are sometimes only partially executed because certain basic components have not been financed.

Harmonisation is the only way to simplify the preparation of the basic records which limit the number of evaluation missions, make the various financing procedures compatible and accelerate the effective allocation of credits.

1. GENESIS OF DEVELOPMENT PROJECTS

The initial phase can be divided schematically into the following broad headings: identification, feasibility and execution studies, development work, operation and maintenance.

(a) Reconnaissance and identification of projects

These studies are generally carried out by international organisations, but sometimes through bilateral aid. This is the case for:

- | | |
|--|-------|
| - the OMVS hydro-agricultural project | FAO |
| - the OMVS socio-economic project | UNDP |
| - the SAED short and medium-term programme | IBRD |
| - the Casamance development scheme | IBRD |
| - the lower Casamance development scheme | USAID |

Although national counterparts assist the foreign experts and the head of the project is usually a national executive, the "digestion" of these studies is not always easy and the results are not always fully used in the definition and implementation of the subsequent activities.

The reinforcement of highly qualified national staff with proven on-site experience should be envisaged at national level by the Planning Department, the Rural Equipment Directorate, and the Survey Department (see para. 4.41).

(b) Project feasibility and pre-implementation studies of projects

National Corporations often contract these studies out to engineering offices employing mainly foreigners. The tasks performed by national executives essentially concern basic investigations (topography, geotechnology, pedology), which are not always done in enough depth because of lack of resources; this entails difficulties in the later execution of the project (see Chapter II).

An effort should be made to have more national executives associated with these studies, in particular for:

- analyses : CERED, ISRA laboratories etc..;
- development of basic designs for structures;
- design and publication of records.

(c) The execution of development work

In general, this is carried out by:

- firms, for large basic infrastructures;
- public corporations for some repetitive activities such as smoothing, tertiary development and sometimes building.

In all cases, a large expert staff with several years of experience in the field is needed. This is the typical profile: a head of site who is able to position a structure, calculate and draw metallic structure and shuttering diagrams), make an inventory of supplies and define geotechnical tests, etc..

Very few qualified nationals are available for these tasks; adequate training should therefore be carried out in parallel with the upgrading of these functions.

This aspect is shown in the FAC-CCCE- World Bank mission report (November 1978). The inspection of the work associated with the development of 3 to 5,000 ha. perimeters requires the creation of a team, whose members should include:

- 1 rural engineer
- 1 technical assistant
- 1 civil engineering assistant
- 1 technical assistant
- 1 earth-works assistant
- 1 topographic brigade.

In our view the SAED does not have the necessary qualified personnel with long experience of projects. Foreign personnel should therefore be called in with the necessary operating resources (technical assistance or a mission by independent consulting engineers).

(d) Operation and maintenance of perimeters

It is estimated that the development of a 2 to 3,000 hectares perimeter for irrigated farming (with full water control) calls for the following staff:

<u>Personnel</u>	<u>Start-up period</u>	<u>In normal operation</u>
High-level executives	3	2
Medium-level executives	12	8
Technicians	30	20
Advisors	30	5
Qualified manpower	25	25
TOTAL	100	60

If the credits available are to allow an overall rate of development of 4 to 5,000 hectares, more than 500 qualified agents must be trained in the next five years in the operation and maintenance of perimeters.

The aspect is analysed more thoroughly in para 5.4 below.

2. SPECIFICATION OF THE FEASIBILITY AND IMPLEMENTATION DOSSIERS

The proposals presented to donors are often put forward as projects for execution with a degree of formal accuracy such that invitations to tender can be prepared directly. Nevertheless, the basic investigations to obtain full information on the environment (hydrology, pedology, geotechnology, agronomics, socio-economics, etc.) are often too superficial, and several projects have thus had to be remodelled for various reasons: excess salinity, insufficient water supply, lack of motivation of population, etc.

A few basic principles should be respected when drafting these feasibility records, including:

- an identification document placing the project in the framework of a development master plan should have been compiled;
- financing of the feasibility study is a precondition for proceeding to pre-implementation studies;
- the method of paying for services should be adequately defined. Although engineering study missions can be paid for on a lump sum basis, on-site investigations must be carried as far as necessary for them to be deemed satisfactory, and therefore form part of an independent programme in which payment is based on the amount of work actually done;
- the norms taken into consideration should be the national ones;
- variants may be presented;
- the degree of specificity does not have to correspond to that of an implementation schedule;
- the main lines of the complementary programmes (research, training, etc.) should be defined.

Feasibility records drawn up in this way would be integrated in a coherent whole, less burdensome, more easily examined and adaptable if necessary.

The pre-implementation dossier should only be compiled once the principle of financing has been accepted and just before the issue of invitations to tender.

3. COORDINATION IN EVALUATION MISSIONS

Considerable time is devoted by national authorities in receiving experts who are there to compile data or make evaluations. Given that many projects are similar, it could be worthwhile to have them evaluated jointly by several potential donors, leading to time savings and better coordination.

This approach appears to be particularly appropriate for the Senegal river, where the same general principles of development apply to all perimeters.

4. TAKING REGIONAL DEVELOPMENTS INTO CONSIDERATION

Projects for the irrigation of perimeters are often presented independently of other large structuring developments such as the structures common to the OMVS, communication and electricity systems, and the basic services which should be explicitly mentioned in the main development schemes reviewed in para. 5.22. It appears that the corresponding financing programmes could be drawn up in parallel, which would, in some cases, avoid substantial outlays.

Several misunderstandings have been generated by misinformation or no information as regards regional projects.

5. COMPLETION OF PROJECTS, MAINTENANCE

These aspects are chiefly of concern to the SAED, which has already undertaken several programmes and has experienced difficulties in the completion and operation of projects.

The joint mission to the SAED (FAC-IBRD-CCCE) carried out in November 1978 has produced a report containing a set of recommendations which are recalled below:

(a) Organisation and operation

- . reinforcement of the autonomy of operating centres and the discontinuation of some activities carried out by the central level of the SAED.
- . reorganisation of the central level as well as of accounting procedures and budget management.
- . reinforcement of executive staff and personnel policy.
- . improvement of development monitoring.

(b) Rural hydraulics

- . Pursuit of a programme of studies aimed at increasing the present rate of development of 2,000 hectares a year. This programme should begin quite soon with commitments earmarked to this end by the World Bank. It is nevertheless necessary to ensure good coordination with regional developments.
- . Rehabilitation of hydraulic projects and structures; this is of particular concern for:
 - the renovation of the Ronq, Diawar and Thiagar pumping stations;
 - the rehabilitation and completion of the Boundoum, Thiagar and Dagana networks.

(c) Agricultural production

- . Contractual definition of required services as between farmers, producer units, cooperatives and ONCAD.
- . Improvement of agro-industrial activities.

ANNEX F

WHEAT FARMING IN SAHEL COUNTRIES

Status and prospects(1)

I. PRESENT DEMAND AND CILSS/CLUB DU SAHEL FORECASTS

There has been a veritable infatuation with wheat and its derived products (bread) over the last ten years in the Sahel countries, especially in towns.

In 1976, the eight Sahel countries imported between 205,000 and 230,000 tons of wheat, of which 102,000 tons for Senegal alone. Demand is increasing every year, and is fostered by food aid supplied to Sahel countries during the last few years.

On the basis of FAO projections, which have been used by the Working Group on irrigated farming, the demand for wheat in the CILSS countries will be 268,000 tons in 1980, 314,000 tons in 1985 and 500,000 tons in 2000.

The 1979 wheat crop was very poor: approximately 10,000 tons, grown essentially using traditional methods(2) with low yields (1 to 1.5 tons per hectare). Irrigated wheat production is still at the experimental stage.

II. CURRENT EXPERIMENTS IN THE SAHEL

To our knowledge, three Sahel countries are undertaking research into wheat farming (3):

- Senegal: in Guédé, in the framework of the OMVS/FAO agronomic research project;
- Chad: in Bol, on the shores of lake Chad;
- Mali: in Diré, on the bank of the Niger river.

The results for Diré are unknown.

In Bol, 11.3 hectares were sown in the 1976/77 crop year and produced 23 tons of wheat, i.e., a yield of 2 tons per hectare. Results for the 1977/78 crop year are unknown. The 1978/79 harvest covered less than 20 hectares and the yield is unknown. The wheat-cotton rotation system is proving difficult to implement.

- (1) By Jean Lebloas, Club du Sahel, Rural engineering consultant and Dominique Peter, engineer at the GREF.
- (2) In Mauritania, Senegal, Mali, Niger and Chad.
- (3) Upper Volta is also to undertake research soon in the framework of the development of the Sourou valley (20,000 ha. of irrigated rice, sugar cane and wheat.

The results of the OMVS/FAO project for Guédé in Senegal are reviewed in more detail below.

III. RESEARCH ON WHEAT IN GUEDE (Senegal)(1)

Although it has been known for a long time in Mali, Mauritania and Senegal, wheat has only been a subject for research in the Senegal valley since 1966, at the IRAT station of Richard-Toll, and (mainly) at Guédé, in 1969, in the framework of the OMVS/FAO project.

(a) varieties:

More than 50 different varieties of wheat have been tested in actual cultivation and close to 500 varieties on an indicative basis.

During the 1975/76 crop year, the 105-day cycle "Mexipak" variety yielded 2.5 to 6 tons per hectare, with a density of 79 to 85 (Average yield: 3 tons/ha.).

Other Mexican varieties produced better yields, but are more vulnerable to depredation by birds.

Tests were also made on wheat/rye cross-breeds, which are fairly disease-resistant (blight, mildew, septoriosis) and adapt well to acid and alumina soils. They provide better yields than wheat on light soils, but lower ones on heavy soils; the flour produced leaves something to be desired for baking purposes.

(b) farming techniques

"Fondé" soils (light unflooded land) gave the best results. Yields are over 40% higher than those obtained on "Hollaldé" soils (heavy and generally flooded).

Wheat reacts well to the layer formed by a weeded winter crop (corn), a vegetable (niébé) or a fodder crop; however, 30 to 40 days are nevertheless necessary for the decomposition of the vegetable substance.

The most appropriate cultivation methods seem to be ripping followed by two passes with the rotovator and one with the levelling blade to obtain perfect smoothing. This is the basic condition for success, as wheat is very sensitive to excess water during germination and suckering.

Sowing should be carried out between the 15th November and 10th December, in order to take advantage of the cold spells in December and January. A seed density of 160 kg. per hectare should yield 600 ears per square meter after suckering.

Wheat crops can be damaged by rats and, in particular, by birds.

(1) According to an OMVS report (1978).

(c) fertilizers

A mix of 80 kg. phosphorus, 60 kg. potassium ground fertilizer and 140 kg. nitrogen contents provides the most suitable type of manure (ground fertilizer and coverage for the suckering and growth phases and the formation of the ears).

(d) irrigation

Irrigation should be performed so as to build up permanent water but not excessive reserves in the soil. Application of doses of 500 m³ of water per hectare every 8 days is enough.

However, the method of applying the dose is not automatically apparent. Submersion with such small dosages (a height of 5 cm.) necessitates perfect levelling and small plots; but small plots are incompatible with mechanised ploughing and harvesting.

Average yields, which were 3 tons per hectare in 1976 have since been declining regularly.

IV. WHEAT IN AFRICA

Ethiopia, Kenya, Sudan and Tanzania are at present the main wheat producing countries in Africa. On the basis of FAO estimates, these countries' production in 1969 was respectively: 760,000, 162,000, 88,000 and 40,000 tons. Wheat needs cool temperature at time of suckering and first stages of growth and these conditions are met in the highlands of Eastern Africa.

Wheat production in the Sudan is concentrated in the irrigated perimeters of Gezira and Khashm el Girba.

In Africa, black mildew of the stem is wheat's worst enemy. East African countries have carried out permanent research aimed at discovering varieties which can resist mildew (blight) while remaining profitable.

More recently, Nigeria has begun a major irrigated wheat programme in the North of the country. In the single state of Kano, development is scheduled for 70,000 ha., irrigated by a dam (completed in 1972). Mexican varieties of wheat will be used.

V. THE NEED TO DEVELOP RESEARCH INTO WHEAT IN SAHEL COUNTRIES(1)

Only through research were the East African countries able to increase their wheat growing - as well as their crops' resistance to mildew. The Sahel countries must therefore now design a common policy for research into wheat, and especially:

(1) "Agronomic Research Prospects in Africa" (National Academy of Sciences, Washington, D.C., 1976).

- research on high-yielding varieties adapted to the various conditions found in the Sahel and resistant to diseases (mildew, septoriosiis);
- research on irrigation and crop rotation in Sahel areas with noteworthy irrigation potential;
- research into wheat irrigation, methods of growing, the size of tracts, harvesting techniques;
- research on the baking quality of grains associated with millet.

This policy should be implemented in collaboration with the African research centers: Nioro (Kenya), Zeit and Alemaya (Ethiopia), Khartoum and Wad Medani (Sudan); and closer to Sahel countries, in Nigeria, the Kano research centre and Ibadan university.

The Research to be undertaken in the Sahel could be linked with that performed with these various centres by international research bodies such as the CIMMYT(1) in Mexico.

Sahel countries would in particular benefit greatly from exchanging with Nigeria vegetable materials, tested in several sites belonging to similar ecological zones, but subject, however, to different constraints as regards pests and diseases.

A high-level scientific mission(2), with two international experts specialised in agronomic research, and two Sahelian experts working for existing research centres, could lay the ground for a regional policy of research on wheat.

This project would include:

- (a) at national level: a set of national projects for reinforcing existing centres or projects for the creation of such centres covering equipment, operation and technical assistance.
- (b) at regional level: a system organised for the exchange of information and vegetable materials, and continued coordination with other centres throughout the world.

Phase I of this project would last a minimum of 4 to 5 years.

(1) CIMMYT: International Centre for the Improvement of Maize and Wheat, Mexico.

(2) The "Committee on the potential of agronomic research in Africa" chaired by the Rockefeller Foundation (New York, USA) and sponsored by the National Academy of Sciences, (Washington, D.C.).

ANNEX G

SAED TRAINING PROJECT

Status as of October 1979

I. THE RECORD

The first report defining the project was drafted in 1977 by the BDPA office, financed by the FAC-CCCE: training of irrigated farming instructors. The project specifications were finalised in March 1978 (BDPA) after the Senegalese Government had made changes and additions.

Training centre scheduled at N'DIAYE, 40 km. from St. Louis.

Cost : 278 million CFA francs.

II. FINANCING

FAC: 140 million CFA francs: Infrastructures, buildings, teachers' living accommodation.

CCCE: 138 million CFA francs: Building, equipment, technical assistance.

The financing agreement by the FAC is dated as of June 1978. A request for additional funds was presented to the FAC by Senegal for the construction of buildings (prices need to be brought up to date).

III. STATUS OF THE PROJECT

- (a) Training in the SAED Saint-Louis headquarters began in 1978 within the framework of this project. Mainly for SAED agents, it is going well.

FAC technical assistance: agronomics instructor and one deputy.

- (b) The invitation to tender for building the N'Diaye centre has been issued. Work should begin quite soon.

- (c) An irrigated farming teacher and an instructor in perimeter management techniques are expected (CCCE).

IV. USAID PROJECT

USAID has taken responsibility for training technicians and employees responsible for maintenance of SAED machinery. After the issue of the invitation to tender, USAID appointed a Swiss consultancy firm to perform this training. The activity should therefore begin very shortly.