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THE DEVELOPMENT OF IRRIGATED AGRICULTURE IN THE SAHEL

REVIEW AND PERSPECTIVES

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INTRODUCTION

In May 1977, the plenary meeting of the Club du Sahel at Ottawa adopted a drought control and development strategy in the Sahel as well as a "first generation programme".

Both the strategy and the programme had an irrigated farming development component with a double purpose :

- to assure that part of cereals production would be protected from climatic vagaries;
- to contribute towards food self-sufficiency by producing part of the crops which require irrigation in the Sahel (rice, wheat, sugar).

Three years later, it seems desirable to organize a meeting in Dakar of Sahelian officials and members of the international community to review the status of irrigated farming, to examine to what extent the first generation programme has been implemented and what the impediments were, and also to examine the status of the second generation programme.

In order to gather the necessary data, expert missions visited different Sahelian countries during 1979. This paper is an attempt to present a synthesis of the collected information and thereby provide a basis for discussion at the Dakar meeting.

I. THE STATUS OF IRRIGATED AGRICULTURE IN THE SAHEL

It is not easy to provide a precise picture of the development of irrigated agriculture in the Sahel and its development during the past years. In this sector, as in many others, there is a lack of reliable data and even contradictions in information provided by different sources. It is obviously difficult to count the weight of millet produced by the traditional farmer or the heads of cattle owned by the nomad shepherd. But similar difficulties apply to counting irrigated hectares and tons of rice produced. Therefore the following data should be used with caution even though an effort was made to confirm them with cross references.

1.1 Area cultivated

FAO yearbooks provide full statistical series for irrigated areas in the 8 Sahel countries between 1961 and 1978. It is the only source to provide such detailed information. Even if, as we shall see, these data should not be taken without question, it can be hoped that being published by a single agency they are homogeneous in time and space and can thus at least indicate trends.

Table 1 provides a summary of FAO data.

It appears that since 1960, irrigated areas have increased by 4.5% on the average and, to the extent that the published series are reliable, growth was slightly slower before 1970 (3.5%) and more rapid thereafter (5.3%).

TABLE I

TREND IN AREA IRRIGATED
ACCORDING TO FAO

(in thousands of hectares)

	1961 1965	1966	1970	1974	1975	1976	1977
CAPE VERDE	2	2	2	2	2	2	2
CHAD	-	1	1	1	1	1	1
GAMBIA	12	15	20	20	25	25	27
MALI	43	50	61	70	75	90	90
MAURITANIA	3	3	3	3	3	3	8
NIGER	4	5	5	6	6	6	8
SENEGAL	77	90	92	125	125	127	127
UPPER VOLTA	-	-	-	2	2	2	2
T O T A L	141	166	184	229	239	256	265

But these figures should not be taken unquestioningly. The survey which was carried out by the Club du Sahel irrigated agriculture team in 1976 indicated quite different figures (see Table 2).

TABLE 2

AREA IRRIGATED IN 1976
ACCORDING TO THE IRRIGATED AGRICULTURE TEAM

(in thousands of hectares)

	Total or good water control	Partial water control	TOTAL
CAPE VERDE	0.6	1.3	1.9
CHAD	0.7	1.6	2.3
GAMBIA	1.5	-	1.5
MALI	50	67	117
MAURITANIA	2	-	2
NIGER	4.6	0.7	5.3
SENEGAL	19.1	76.5	95.6
UPPER VOLTA	4.3	2.7	7.9
T O T A L	82.8	149.8	232.6

A comparison between Tables 1 and 2 requires some comments :

- FAO statistics apparently do not distinguish between areas under total water control and those under only partial control; the latter do not offer the same production security;
- even if overall statistics for the 8 States vary little, a country by country comparison shows serious discrepancies.

Surveys made by WARDA(1) indicate only 135,000 irrigated hectares in 1976. Even if surfaces devoted to products other than rice (particularly sugar) were added to this figure, it is obvious that they would not amount to 100,000 hectares. These divergencies increase our uncertainty.

(1) WARDA = West African Rice Development Association (Monrovia, Liberia).

The results of surveys made in 1979 are summarized in Table 3.

TABLE 3

AREA IRRIGATED ACCORDING TO A SURVEY MADE IN 1979 (area farmed in 1978-79)

(in thousands of hectares)

	Water control		TOTAL
	TOTAL	PARTIAL	
CAPE VERDE	1.9	-	1.9
CHAD	0.5	4	4.5
GAMBIA	2.2	-	2.2
MALI	42	69	111
MAURITANIA	1.9	-	1.9
NIGER	4.8	1	5.8
SENEGAL	14	77 (?)	91
UPPER VOLTA	5.8	3.2	9
T O T A L	73.1	154	227

These areas represent surfaces effectively under cultivation in 1978-79 with rice, wheat, sugar, fruits and vegetables, etc...

The data indicated in Table 3 are probably not fully homogeneous with those of Table 2 (the 1976 survey apparently slightly overestimated the area farmed under total water control). Nevertheless, a comparison of both tables shows that :

- irrigated areas under total water control barely increased between 1976 and 1979. Although several countries slightly increased their developed and farmed areas, those of the Office du Niger decreased (53,200 hectares developed, 39,500 farmed in 1976-77; 35,500 in 1978-79);

- irrigated areas with partial water control, although less well known, did not seem to increase.

The 1979 survey also indicates that not all developed areas are farmed and not all areas farmed are harvested (due to various reasons). A large portion of older developments are out of service and require rehabilitation (see part 1.2 below).

All the data above point to the following conclusions with the caveat that they represent only orders of magnitude :

> In 1979, areas farmed in the Sahel under modern irrigation were on the order of 75,000 hectares under total water control and 155,000 under partial water control. They have almost doubled in size since 1960. But, generally speaking, during the past few years, the development of new areas has barely surpassed the surface of older ones which had to be abandoned.

Another 200,000 hectares under traditional irrigation (lowlands, recession agriculture, etc..) should be added to the above.

Compared to the 13 million hectares of rainfed farming, irrigated agriculture is only marginal in the Sahel.

There is another interesting comparison : in East Africa, Sudan has a climate similar to that of the Sahel, and it has apparently made a different development choice as shown in the following table.

	Population	Irrigated farming	Rainfed farming
SAHEL	30 million	230,000 hectares	13,000,000 ha.
SUDAN	20 million	1,560,000 hectares	5,500,000 ha.

1.2 Areas to be rehabilitated

The survey carried out in 1979 shows the importance of developed areas but which are no longer farmed because they need rehabilitation :

Gambia	1,750 hectares
Mali	17,000 ha. (Office du Niger)
Mauritania	300 ha.
Niger	1,000 ha.
Senegal	5,150 ha. (SAED)
Upper Volta	660 ha.
	25,800 ha.

The amount of area needing rehabilitation is alarming and deserves an explanation (see Chapter 2).

1.3 Production

1.3.1. Rice

Rice is the main crop farmed on irrigated land. FAO statistics indicate its production trend as follows :

TABLE 4

TREND OF PADDY RICE PRODUCTION

(in thousands of tons)

	1961-1965	1974	1975	1976	1977	1978
CHAD	29	35	37	40	20	40
GAMBIA	33	55	60	50	11	29
MALI	172	90	218	237	182	270
MAURITANIA	1	4	4	5	5	12
NIGER	11	30	35	29	30	34
SENEGAL	103	116	136	112	62	127
UPPER VOLTA	33	39	33	40	23	32
T O T A L	382	369	523	513	333	544

In 1979, the harvest will be less than 400,000 tons.

However, it should be noted that rice is produced not only with modern irrigation methods, but also under traditional farming (recession agriculture) and rainfed farming in the Casamance and in the Gambia.

For 1976, WARDA has broken down production according to these different categories (for countries of West Africa; Chad was added because most of the rice is farmed under flooding). It should be noted that there is no substantial difference between WARDA and FAO figures (see Table 5).

TABLE 5

BREAKDOWN OF PADDY RICE PRODUCTION IN 1976

(in thousands of tons)

	TOTAL	Modern irrigation		Uncontrolled flooding	Rainfed farming
		Total water control	partial water control		
CHAD	40	2	3	35	-
GAMBIA	44	6	7	17	14
MALI	257	107	85	67	-
MAURITANIA	4	4	-	-	-
NIGER	29	10	2	17	-
SENEGAL	110	16	15	53	26
UPPER VOLTA	40	10	2	28	-
T O T A L	524	155	114	207	40

It can be seen that about half of rice production comes from modern irrigated areas, but that only 30% are completely protected from climatic vagaries thanks to total water control. Farming under partial water control and particularly traditional crops are very dependent on rainfall.

Moreover, Table 4 and the graph on p. 10 show that rice production is far from being sheltered from climatic vagaries. It shows, also, that in normal years, between the beginning of the sixties and 1975-79, rice production increased roughly by a third while demand increased by two-thirds at least, due to rapid population growth and urbanization. In the recent past, in normal years, production was stagnant while consumption rose at a yearly rate of over 8% which was substantially more than had been expected.

The growth of rice production is not keeping up with the increase in demand.

As a consequence, rice imports have increased regularly. They amounted to :

- 130,000 tons per year between 1960 and 1964 (mostly Senegal : 120,000 tons)
- 190,000 tons per year between 1965 and 1969;
- 260,000 tons per year between 1970 and 1974.

Since 1976 they have amounted to over 300,000 tons with a high in 1978 following a bad harvest in 1977.

In 1980, they will no doubt be much higher than 300,000 tons due to a bad harvest in 1979.

All the Sahelian countries are now more or less importers of rice, including Mali in some years. In the early sixties, Mali was a rice exporter.

1.3.2. Wheat

Wheat production in the Sahel amounts to approximately 12,000 tons which represents4% of overall food consumption. Wheat is produced mostly through traditional farming and in small quantities with modern irrigation. During the past years, production has barely increased.

However, the demand for wheat or wheat flour is growing very rapidly in the Sahel. Since 1976, the annual increase in wheat consumption has been 11%. Therefore, imports are increasing considerably:

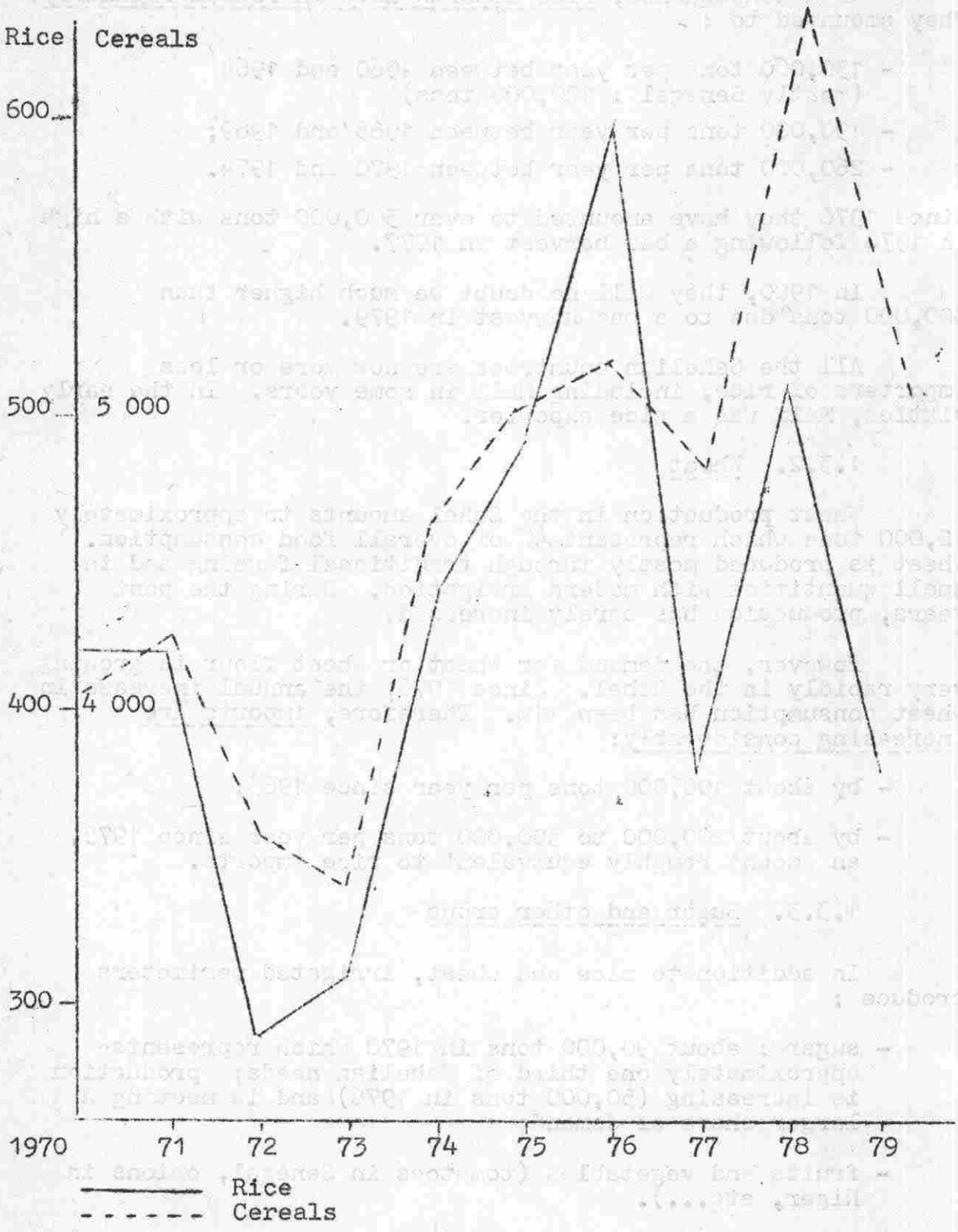
- by about 100,000 tons per year since 1965;
- by about 200,000 to 300,000 tons per year since 1975, an amount roughly equivalent to rice imports.

1.3.3. Sugar and other crops

In addition to rice and wheat, irrigated perimeters produce :

- sugar : about 90,000 tons in 1978 which represents approximately one third of Sahelian needs; production is increasing (50,000 tons in 1976) and is meeting a larger share of demand;
- fruits and vegetables (tomatoes in Senegal, onions in Niger, etc...).

The areas devoted to these crops are marginal.



Rice production is affected by climatic conditions to a greater extent than overall cereals production.

In summary, if irrigated agriculture production is to be placed in the context of overall cereals production in the Sahelian countries, which amounts to slightly more than 5.5 million tons in a normal year, the conclusion is that :

> Modern irrigated farming provides less than 5% of total cereals production of which less than 3% is totally protected from climatic hazards.

On average, during the past 3 years, the Sahel has produced only :

> Half of the rice
> A third of the sugar
> 4% of the wheat

which it consumes

For rice and wheat, production is far from keeping pace with the increase in demand.

1.4. Yields

The 1979 survey shows a very large variation in yields for rice which is the main crop farmed under irrigation. One finds very intensive farming with double annual cropping in Niger river valley developments of the Republic of Niger where, in 1978, the average yield seems to have been over 8.1 tons per hectare with records of 9.9 tons (1).

In Mali, by contrast, irrigated farming is much less intensive. There is no double annual cropping. Yields at the Office du Niger have varied in recent years between 1.7 and 2.6 tons per hectare, though, according to experts, they should reach 5 to 6 tons. They are lower in projects under partial water control : between 1 and 1.8 tons per hectare. As a general rule, productivity seems to be increasing, but very slowly and with a tendency towards reaching a ceiling, particularly at the Office du Niger.

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(1) Query whether these brilliant results are not obtained to the prejudice of soil fertility. The TOULA development activity report notes in January 1978 that soils are being depleted even though the first crop was farmed only in the winter of 1975.

Because of the variety of local situations in the Sahel it is difficult to make an overall evaluation. Nevertheless, it is quite clear that double cropping is not prevalent and that yields, with a few exceptions, even if they have slightly increased in recent years, remain very low.

1.5 Development Costs

The term "irrigated agriculture" includes many different operations which range from developing acreage under total water control to much lighter work designed to partially control land submersion by water. Moreover, since the conditions for implementation vary from one region to another, it is not surprising to find wide differences in development costs :

- the cost of controlled flooding operations may vary from 100,000 to 250,000 FCFA per hectare (Riz Ségou, Mopti Rice in Mali); the improvement of lowlands in Upper Volta require investments of the same order of magnitude : 250,000 FCFA per hectare;

- the cost of small irrigation dams in Upper Volta is higher : 1 million FCFA per hectare plus the cost of dykes;

- operations designed to obtain total water control are considerably more expensive : 1 to 2 million FCFA per hectare at the SAED; 1.4 million for the Banfora sugar perimeter in Upper Volta (1974 prices); 2.5 million in Mauritania; 3 to 4 million in the Niger Valley (Republic of Niger), and in certain specific cases, up to 6 million FCFA.

1.6 Irrigation potential

Three factors are necessary for the creation of new irrigated perimeters :

- irrigable land

- water for irrigation

- developments which can be implemented technically and economically.

Therefore the notion of an irrigated agriculture potential is not a purely technical matter, it also requires the consideration of economic factors. For the Sahel as a whole, water is the prime factor limiting the expansion of irrigated areas.

Then, economic considerations compel the elimination of underground water because development is too costly in most cases as well as those surface developments which are excessively expensive. This leads to the following orders of magnitude as regards the potential for irrigated agriculture :

TABLE 6

IRRIGATED AGRICULTURE POTENTIAL

(in thousands of hectares)

- Cape Verde	5
- Chad	280
- Gambia	70
- Mali	1,000
- Mauritania	205
- Niger	145
- Senegal	460
- Upper Volta	130
TOTAL	2,300

The surface area indicated in Table 6 represents the area which could be developed over the next 20 to 25 years on the condition that the necessary regulating dams are built.

It can be seen that with the exception of Cape Verde the availability of water severely limits the development of irrigated agriculture, all other countries have a much higher development potential than is presently being exploited.

With cereals yields of around 8 tons per hectare (experience has shown that these yields can be reached) 600,000 hectares of irrigated farming should be enough to cover the needs estimated in the Ottawa strategy in the year 2000 (1,371,000 tons of rice, 500,000 tons of wheat, 680,000 tons of sugar).

1.7 The Ottawa Strategy and its implementation during the recent years

The objective of the Ottawa strategy is to create, between now and the year 2000, a new 500,000 hectares of irrigated areas with water control to which would be added 100,000 hectares of rice under controlled flooding.

Moreover, documents submitted at the Ottawa Conference indicated that the Sahel State Plans had even more ambitious targets : 718,000 hectares to be developed before the turn of the century of which 140,000 between 1978 and 1982. The document stressed that the development of these 140,000 hectares in 5 years entailed a drastic change in the planning and the implementation of irrigation projects and training of irrigation farmers.

Considering that these 5 year objectives were too ambitious for a first phase, the Ottawa document proposed the following guidelines which were generally accepted :

- to rehabilitate existing perimeters and to draw lessons from past experience;
- to undertake the studies required for the development of major river basins;
- to implement projects which seem possible taking into account the various constraints (studies, training, financing, etc...).

The drastic change in the implementation of new projects has not happened yet. Focusing on the two main countries where 90% of Sahelian irrigated agriculture can presently be found, one notes that :

- in Senegal, the Vth Plan had anticipated that areas to be developed by the SAED would increase from 9,000 to 33,000 hectares and that, in the Casamance, 5,000 hectares would be developed. In 1979 - halfway through the Plan - only 4,000 hectares had been developed by the SAED. The objectives of the Plan have been reconsidered and, for the second half, it is anticipated that 3,000 hectares per year will be developed.
- in Mali, the 1974-1978 Plan had anticipated :

  37,000 hectares of complete developments - 17% was carried out;

  106,000 semi-developed hectares - 38% was carried out;

  45,000 hectares of improvements in existing perimeters - 2% was carried out.

The same situation applies to almost all other countries. In Mauritania, 2,700 hectares were developed out of 9,600 planned.

To present a short summary of trends during the past few years, it can be stated that :

(a) For the Sahel as a whole, the yearly level of 5,000 hectares of new modern developments reached previously has not been surpassed. Although a yearly level of 25 to 30 thousand hectares to be reached as soon as 1978 was undoubtedly too optimistic, it would have been desirable to develop between 7 to 8 thousand hectares per year in 1978 and 1979, thus starting a progression which could later have been accelerated.

(b) The rehabilitation of existing perimeters, which had been considered as the top priority of the Ottawa Strategy, is falling behind. However, it should be stressed that the most important rehabilitation programme - that of the Office du Niger - is now underway. The technical dossiers of the first programme, which have been prepared by the World Bank, will be ready at the end of 1980.

(c) The preparation of major development projects in the Senegal river valley has progressed. Some of the financing has been secured. However, the implementation of the dams has not yet entered an active phase.

(d) The development studies for Niger river are actively underway in the Republic of Mali and Niger. However, the overall studies of the river which would be necessary to insure consistency among national projects have been set aside for several years already.

1.8 Conclusions

It may be useful to recall the principal points which can be derived from the preceding analysis of the present status of irrigated agriculture in the Sahel :

- the demand for food products which can be produced under irrigation only (or mainly produced under irrigated production) : rice, wheat, sugar, is increasing as anticipated and in some cases even faster (rice and particularly wheat);

- the supply, particularly that of rice, is not following the increase in demand and imports (commercial imports + food aid) have increased considerably;

- wheat production remains insignificant : 4% of demand;

- the share of cereals production which is totally protected from climatic hazards thanks to full water control represents only a very small share of total production (less than 3%). A bad crop year, like 1977, results in a considerable increase in imports;

- the pace of new developments has not changed yet; new irrigated developments represent a maximum of 5,000 hectares per year under total water control (of which 4,000 are for rice farming);
- the existing irrigated perimeters continue to deteriorate; consequently, despite new developments, the surface area under water control barely increases. There are presently a total of 26,000 hectares to be rehabilitated and their rehabilitation is falling behind schedule.

II. PROBLEMS CREATED BY THE DEVELOPMENT OF IRRIGATED AGRICULTURE

The conclusions to be drawn from the analysis of the present state of irrigated agriculture in the Sahel and its recent development are that despite the real efforts undertaken during these past years to develop irrigation, the Sahel has not yet embarked on the road towards food self-sufficiency which was set in the Ottawa strategy.

In fact, the data which has been collected shows that the development of irrigated farming runs against a basic problem of rate of return :

- the modern developments which are designed to protect crops from climatic hazards are expensive and require high investments. Investment costs per hectare are always more than one million FCFA (US $ 5,000) and can reach 3 and even 4 million FCFA (US $ 15 to 20,000). They also require continuous and expensive maintenance. Without maintenance, they deteriorate rapidly and their rehabilitation is even more costly than their maintenance;

- such investments can only be justified economically if their yields are much higher than those of rainfed or traditional river flood farming. These yields can be obtained through intensive farming and double cropping;

- however, in the Sahel today, these conditions are rarely met. In fact, there are many reasons for the delay in developing irrigated farming or why Sahelian developments do not provide the results expected. These reasons can be grouped under 4 major categories :

  . technical problems
  . management and training problems
  . agricultural policy problems
  . financing problems.

2.1 Technical Problems

The first problem encountered in all Sahelian States without exception is that of maintenance of existing developments. Lack of maintenance is the reason projects need rehabilitation. The need for rehabilitation concerns not only relatively older developments such as the Office du Niger but also some which are only a few years old, such as DAGANA, NIANGA, BOUNDOUM in Senegal.

In other cases, the lack of maintenance results in important losses - short life of pumping stations on certain Gambian perimeters, damage to infrastructure in Mali, etc...

Although Sahelian authorities are well aware of these problems, they must nevertheless be stressed. Their solution probably involves the participation of farmers in maintenance activities, which, in most cases, today are assumed by centralized agencies. They go beyond technical considerations; attacking present problems squarely would require training and information activities, the establishment of sufficiently motivating marketing conditions for the farmer and the observance of strict management regulations (for example : the creation of a fund for maintenance expenses).

Standardizing equipment (regulating valves, pumps, etc...) will not solve maintenance problems, but it would at least help to facilitate their solution.

A second problem originates from the design of projects and particularly the gathering of data prior to project design. The lack of preliminary studies (pedological, topographical, geotechnical) has in several cases led to cost overruns or in lower yields than had been expected. Perhaps the preparation of a data-gathering format including the technical and sociological information which is required for a project could provide useful guidelines and avoid the repetition of previous mistakes.

Lastly, a third problem which must be stressed is that irrigation activities are designed to assure safety for crops from climate hazards and also, if not more, to intensify farming. The profitability of irrigated projects can only be secured through intensification. Therefore, for a development to be successful, agronomy is as important as hydraulics. Surveys carried out in 1979 show that there are gaps in this field and that despite efforts already made additional agronomic research needs to be undertaken: development of wheat varieties which are adapted to local conditions and also development of rice varieties adapted to specific local conditions. An even greater effort needs to be done for disseminating more intensive farming methods and maintaining soil fertility.

These technical aspects are important but alone they do not account for disappointing yields or difficulties in achieving double cropping. Major factors such as carrying out timely farming practices, replanting, etc... and the level of producer prices go far beyond the technical sector.

2.2 Management and training problems

Management problems start when projects are built and when investments reach high levels (see part 1.4). A survey to seek ways of reducing costs would no doubt be useful. With data available today, it appears that the high prices are due to a certain disinterest on the part of local companies to engage in this type of activity. There is little competition among such companies, an absence of systematic research for solutions capable of reducing unit price, few projects built on force account, etc...

Preparing large work programmes over several years, together with a stricter control of firms would certainly lead to lower costs.

Other problems appear at different operating stages :

- inputs are not supplied on time;

- the implementation of farming practices is not satisfactory: farmers usually reproach national organisations entrusted with these studies for not carrying them out in time;

- water management is often not strict enough - lax management together with lack of maintenance can lead to disastrous consequences. As an example: on certain large perimeters, 40% of their surface areas were damaged for the above reasons during the 1977-78 harvest.

All of these management difficulties are of course related to training problems:

- training of management staff. Most participating firms lack sufficiently well-trained staff and the establishment of efficient maintenance structures is always much longer than anticipated;

- training of extension workers. Not only a lack of extension workers is noted but also their inadaptability due to the fact that their theoretical training is sometimes barely credible to farmers whom they are supposed to guide.

2.3 Agricultural policy problems

It is not an easy matter to transform a traditional farmer into a high-performing irrigated farmer. To get him to make efficient use of the expensive developments put at his disposal so as to make them profitable is not easy. Thus, besides the training required, there is a problem of motivation.

Intensified farming and double cropping are possible only if they are financially appealing to the farmer i.e. if the purchase price of production is considered sufficiently high after taking into account expenses.

However, almost everywhere in the Sahel, official marketing prices are not considered to be incentive enough while production costs are said to be high and increasing faster than income. For example Mali, where the producer price for rice has increased 46% between 1974 and 1978, while agricultural equipment has gone up 200% and fertilizers 62 to 75%. Operating expenses which can reach the equivalent value of 4 tons of rice per hectare farmed, are often considered as unbearable under present economic conditions.

Furthermore, marketing is often unsatisfactory (5% of small Senegalese perimeters' production is marketed).

The Nouakchott Colloquy held in July 1979 under the auspices of the Club du Sahel and CILSS discussed these problems extensively and recommended that Sahelian governments study and implement coherent cereals policies - such policies are just as necessary for the development of irrigated farming as for rainfed agriculture.

2.4 Financing problems

High development costs have already been discussed above. Even if, as we shall see in the next chapter, efforts undertaken by the international community to finance irrigation projects have considerably increased, the high investment costs are a serious constraint to the development of irrigated farming.

The same applies to operating costs. Irrigated development projects often entail very high recurring costs. The amount of these costs compared to the resources of Sahelian States and farmers is certainly not alien to maintenance failures or the little interest shown by farmers for irrigated farming.

2.5 Conclusions

For description purposes, problems encountered by the development of irrigated farming were broken down into several categories. However, these difficulties form a whole - for example, lack of funds by farmers leads perimeter management agencies to collect costs only partially and an increase would probably not be possible. This necessarily reflects on maintenance. On the other hand, lack of maintenance equipment is not without impact on perimeter productivity, etc...

Thus the whole system of irrigated farming must be improved and not by individual measures, but through a coherent policy to be defined in each specific case.

It should be added that if from the macro-economic viewpoint the purpose of irrigated farming is to increase cereals production by protecting it from climatic hazards, this can only be achieved if, on the micro-economic level, the farmer finds an improvement in his lifestyle. In seeking ways to improve the system, we should be encouraged to take better note of the needs of the population concerned. In designing new developments we should adopt a less technocratic approach by having the population participate and by considering sociological constraints and the need to intensify farming, etc... on an equal footing with technical conditions of the site (1).

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(1) The case of Nigerien farmers who organized both their participation in perimeter maintenance and their training shows that this is feasible.

III. STATUS OF THE FIRST GENERATION PROGRAMME

Financing for the implementation of the first generation programme (1978-1982) presented at the Ottawa meeting is summarized in Table 7.

TABLE 7

FIRST GENERATION PROGRAMME FOR IRRIGATED FARMING

(in US $ millions)

. CHAD	30.2
. GAMBIA	27
. MALI	125
. MAURITANIA	159
. NIGER	64.8
. SENEGAL	130
. UPPER VOLTA	27.5
T O T A L	563.5

These costs do not take account of studies and the construction of the major regulating dams on the Senegal, Gambia, Niger, Voltas and the Logone-Chad basin because, on the one hand, all costs cannot be charged to irrigation only, and on the other, all costs have not yet been established.

They do not include projects already financed at the time of the Ottawa meeting.

Before reviewing the implementation of this programme, it is useful to stress that :

(a) The first generation programme was prepared hastily. It was never perfectly consistent, exhaustive, or defined with total precision.

(b) The first generation programme never coincided with the list of projects in the State development plans.

(c) Certain projects entered in the first generation list in 1977 were only project ideas then and their cost estimate was only for guidance purposes. Since then some were defined, others modified and costs have risen. World inflation has also added its share.

The above leads to a certain vagueness in the contents of the first generation programme and mostly in the amount of financing required for its implementation. Therefore, a basic comparison between financing secured and that indicated in Table 7 would not be very significant.

For information, according to the "Status of the Club du Sahel/CILSS First Generation Programme" donor commitments to 1979 covered 43% of the overall programme.

A qualitative comparison among the following is more interesting :

- trends of the first generation programme;
- share of the programme implemented or underway;
- what remains to be implemented.

TABLE 8 STATUS OF THE FIRST GENERATION PROGRAMME

	Programmed	Implemented or underway	To be implemented
GAMBIA	- Programme directed towards small developments and preparing the development of the Gambia river basin	- Basically studies (including the Gambia basin) - And rehabilitation and expansion of small perimeters	- Developments of valleys studied - Equipment (rice mill, road)
UPPER VOLTA	- Development studies - Pursuing small hydraulics programmes - Establishing a training centre for extension agents	- Sizeable effort undertaken for studies - Small developments which do not require substantial financing	- Study effort to be pursued - Training centre remains at a very preliminary stage
MALI	- 14 development projects including • rehabilitation and expansion of the Office du Niger • Segou Rice • Mopti Rice - 4 training projects	- The main projects: Office du Niger, Segou Rice, Mopti Rice were started but there is an important lag in studies - 2 training projects are underway	- For the Office du Niger, only a single pilot project is underway. The main project remains to be financed & implemented - Lake Horo projects, and ponds in the lake zone
MAURITANIA	- Very large programme of 16 development projects	- Several feasibility studies were carried out or are underway - Several projects underway (BOGHE)	- Several projects remained at the project idea stage: Nouakchott suburb, GARAK, GALI... - Financing to be secured for projects studied

TABLE 8 (cont'd)

	Programmed	Implemented or underway	To be implemented
NIGER	- Development of the Niger river basin - Small reservoirs in the Adar Doutchi Maggia - Tillabery sugar perimeter	- Underway - Underway - Feasibility study carried out	Slow implementation pace - many construction sites are abandoned due to cost overruns
SENEGAL	- Improvement and expansion of delta and river valley reservoirs - Establishing & improving developments in other areas - Training centres	Most projects received at least partial financing and were started	Important development delays
CHAD	- Various project studies, training of extension agents, establishment of a programming unit - Lake Chad polders		
CAPE VERDE	- Programme of various developments defined in 1978	As of October 1st, 1979 55% of financing is secured	

The following two conclusions can be made based on the preceding table :

- the first being that an important effort is underway to carry out studies and prepare future project identification documents. This provides hope for increasing irrigated farming development in the future;

- the second being the slowness in implementing development projects, noted in almost all countries. Most projects have a considerable lag. Some are due to lack of financing, but most are due to a lack of staff in development agencies - their capability to programme and implement new projects is very limited at present.

  Similar delays were noted and stressed in the implementation of rehabilitation projects.

Concerning financing secured, if it is difficult to determine the exact share of the first generation programme which has really been financed, it is interesting to compare the amounts in Table 7 with the trend of commitments for irrigated agriculture development as they appear in "Official Development Assistance to CILSS Member Countries from 1975 to 1978".

TABLE 9

COMMITMENTS FOR THE DEVELOPMENT
OF IRRIGATED AGRICULTURE

(in US $ millions)

1975	1976	1977	1978
23	63.9	74.7	105.5

Several commitments from the category "integrated rural development" should be added to the above figures since they concern irrigated farming activities (related to other actions) as development of lowlands.

Table 9 shows that :

- commitments for irrigated farming have substantially increased since 1976;

- the amount of 1978 assistance should be around US $ 110-120 million close to the US $ 130 million mark which would correspond to the implementation of the first generation programme over a period of 5 years as described in Table 7 (and taking into account inflation).

Lastly, if all assistance devoted to the development of both irrigated farming and major river basins between 1975 and 1978 is added together, it amounts to US $ 400 million, i.e. a little more than 10% of total external assistance (project and non-project assistance).

IV. INVENTORY OF SECOND GENERATION PROJECTS

Missions to the field in 1979 permitted the gathering of a certain number of proposals to form a second generation programme (1980-1985)(1). To provide an overview of this programme outline, projects were broken down into 4 categories:

- rehabilitation of existing developments;
- studies for new developments;
- projects constructed;
- accompanying activities (research, training, pilot projects, etc...).

TABLE 10

PROPOSALS FOR A SECOND GENERATION PROGRAMME

(in US $ millions)

	Rehabilitation	Studies	Projects	Accompanying activities	TOTAL
CAPE VERDE		0.2	2	1.2	3.4
GAMBIA	3.5	14.1	161.5	6.9	186
UPPER VOLTA		4.1	247.6	3	255
MAURITANIA		9.5	320.9	16.6	347
MALI		7.7	397.1	19.5	424
NIGER		0.8(2)	11.2		112
SENEGAL	6	0.5	134.4	12	153
T O T A L	9.5	37.2	1374.7	59.2	1480

Several comments should accompany this table :

(a) Senegal river developments programmed within the OMVS framework are not included. The cost of the Diama and Manantali dams is presently estimated at US $ 535 to 560 million.

Niger river developments studied by Mali and Niger are not included either.

On the other hand, the Yelitenda salt intrusion bridge-dam on the Gambia river is included.

(1) 1981-1985 would be more appropriate.
(2) Plus several studies for which no estimate is available yet.

(b) No programmes for the Republic of Chad are included.

(c) Rehabilitation activities are considered as being almost totally financed within the framework of the first generation programme. Only some remaining programmes are listed in the second generation programme. It would be advisable to check that all activities are covered in either the first or second generation programmes.

(d) The cost of studies is probably underestimated in the table, some studies being included in the implementation itself. Moreover, the cost of several studies has not been estimated yet (particularly for Niger).

(e) It is possible also that accompanying activities are included under "projects", but the total amount to be devoted to these activities is low.

Financing for training activities amounts to only :

US $ 17 million

which is barely 1% of the overall programme.

It is possible but not certain that other training activities are implicitly included in the programme (specific technical assistance, extension agents, etc...). But, due to the quantity of training, management and maintenance problems described above, it can be questioned whether this component is not underestimated and whether the implementation of the second generation programme such as it is presently outlined might not be severely hindered by the serious lack of accompanying activities.

The implementation of this programme should permit the carrying out of :

- total water control developments :

. GAMBIA	5 500	hectares
. UPPER VOLTA	10 000	"
. MAURITANIA	15 000	"
. MALI	15 000	"
. NIGER	11 000	"
. SENEGAL	16 000	"
TOTAL :	72 500	hectares

i.e. an average of 14,500 hectares per year

- partial water control developments :

. MALI and SENEGAL ..... 70 000 hectares

i.e. an average of 14,000 hectares per year

This programme may not be overly ambitious after taking into account the effort made during the past few years to study and prepare projects.

It does suppose a change in the pace of implementation which, to date, has not exceeded 5,000 hectares per year.

Certain projections included in this second generation programme will be difficult to implement in some countries, particularly those which have carried out new developments at a relatively modest rate. These projections may not be realistic. Therefore, on the whole the outlined programme may seem a bit optimistic.

It also supposes a change in the rate of outside financing To provide comparisons, by excluding major basin developments (Senegal, Niger and also Gambia - see Table 10), aid commitments to the development of irrigated agriculture should reach on the average :

US $ 270 million per year

This implies an increase of 2.3 times compared with the 1978 level.

Lastly, it should be stressed again that the projected change in the implementation pace, makes it even more necessary that special attention be paid to accompanying activities, particularly training.

If all developments are implemented by 1985 and are in a good production cycle, paddy rice production could be increased by 400,000 tons per year on top of the 500,000 tons grown in a normal year. Then rice farming would be much less vulnerable to climatic vagaries.

Also, if rice demand increases at a more moderate rate and does not exceed 900,000 tons per year in 1985, the implementation of the projected programme could stabilize the rice deficit at around 300,000 tons per year in processed rice.

V. PROPOSALS FOR THE MEDIUM TERM

Several action proposals for the medium term can be suggested after examining the present situation, the status of the first generation programme and the status of preparation of the second generation programme :

(a) - The first generation programme has suffered from ambiguity from the beginning : it was not clear whether this programme, also called CILSS programme, included State programmes fully or partially, or was just a supplement to them. Its exact status is difficult to monitor due to the poor definition and vagueness of the programme.

There may be another ambiguity in the second generation programme. Theoretically, it covers the period 1980-1985, more realistically 1981-1985, and overlaps with the first generation programme (1978-1982) of which some priority projects are not yet financed - particularly rehabilitation activities and developments studied within the programme's framework.

This may lead to confusion among the programmes. The Sahelian countries as well as the international community are certainly interested in avoiding this. Therefore, the following is suggested :

- rearrange first generation projects not yet financed but considered as "priority", particularly both rehabilitation and new activities, together with the most interesting activities of the second generation programme analyzed above;

- prepare a single new programme which would include both :

  . an increase in the pace of new developments from the current 5,000 hectares/year; and

  . progress in attracting external financing.

  This programme would have two components : a "first generation component" and a "second generation" one.

- lastly, it would be desirable that this programme appear not as an additional CILSS programme, but an overall programme of Sahelian States prepared under CILSS auspices.

(b) - To prepare this programme, choices must be made. Criteria for project selection are not always clear in preparatory activities for the second generation programme. The following approach is suggested.

To compare irrigated agriculture projects with others, it is certainly mandatory to consider not only the project's rate of return but the security it contributes to cereals production. One should therefore take into account the "security value" of the project.

However, to compare projects within the irrigated agriculture sector, the rate of return should count first and, as an initial estimate, the expected production per investment unit, together should permit a classification project to be made.

It is very probable that :

- intensification projects on existing developments should be top priority;
- rehabilitations, which cover only part of initial investments, might be second priority; and
- new developments with the highest production/ investment ratios should come next.

A second selective criteria, no doubt as important as the first one, is the project's chance of success. Given past failures and partial successes, new undertakings must be successful and be incentive to farmers (and not discouraging bad examples) if major irrigation programmes are to be implemented one day. The quality of studies, the taking into account of the population's needs and their receptivity, a good preparation of future management, the quality of projected extension services, etc... are important factors to be considered.

To minimize the failure rate, moderately sized developments should be preferred during the coming years as opposed to major developments carrying greater risks. They will be implemented when it has been proven that development projects can be totally successful with full cooperation from the population.

(c) - In the outline of the second generation programme, two points seem only partially defined :

- regional activities. They have not been programmed yet. It would no doubt be useful to anticipate a certain number of activities at this stage : data dissemination, standardization of equipment, research and experiments (in intensifying rice farming, wheat farming), training at medium and higher levels, etc...

  Studies of the major river basins and coordination of major river development projects should not be forgotten either.

- accompanying activities, which as we stressed above, appear underestimated in view of difficulties encountered to date. Rather than having many separate training activities, it would no doubt be efficient to include special funds for training in each intensification, rehabilitation and new development project (training for farmers, management personnel).

(d) - the implementation of new projects should be inseparable from the implementation of a coherent cereals policy, particularly cereals prices, the price of inputs and the marketing system. More details can be found in the documents of the Nouakchott Colloquy mentioned earlier.

Included in this programme should be an effort to increase the efficiency of organizations which design, implement, maintain and manage irrigated developments, and a structuring of these organizations to decentralize them. Also, the needs and constraints of the population concerned with irrigation and their real participation in the management of developments should be taken into account. A solution to problems which are theirs first of all, is part of a coherent cereals policy.

(e) - efforts to develop irrigated agriculture have increased in recent years and the international community has significantly increased financing for this sector. Nonetheless, the Sahel's deficit in rice and wheat is increasing.

We have already seen that if there are no major set-backs, operations projected as of 1981 would at best stabilize the deficit.

This implies that efforts undertaken for the development of irrigated agriculture should not be relaxed. Otherwise we may witness a major increase in the rice and wheat deficits with a corresponding increase in the need for food assistance.

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THE SAHEL STATES

Major projected irrigated zones and hydraulic network

ESTIMATION DU POTENTIEL HYDROAGRICOLE DES PRINCIPAUX BASSINS HYDROGRAPHIQUES DU SAHEL

Bassins	Ecoulement Moyen annuel Milliards m³		Débits d'étiage m³/sec	Surface irrigable en ha en maîtrise totale garantie à 80% sans régularisation	Superficie irrigable en ha en maîtrise totale après barrage de régularisation 1ère GENERATION	Potentiel après régularisation totale
SENEGAL	à Bakel	23	8 – 10 à 20 m³/s	30 000	Diama 75 000 Manantali 250 000	1 000 000
NIGER	Koulikoro Niamey	46 30	– 50 – 10 à 20 m³/s	Au Mali 50 à 60 000 Au Niger 15 à 20 000	Selingue 100 000 Tossaye 30 000 Kandadji 80 000	1 500 000
Logone Chari Lac Tchad	Logone à Lai Chari à N'Djamena	15 40	– 40 [illegible]	Logone au Tchad 5 000 Chari 80 000 Lac Tchad 100 000	Koundam et Goré 50 000 Chari 70 000	300 000 [illegible]
Voltas	Volta Noire Volta Blanche Volta Rouge	1 [illegible] [illegible]		Sourou et divers 20 à 30 000	Bagré 30 000	130 000 [illegible]
GAMBIE	Goulombo	[illegible]		7 000	Sambangalou 50 000 Kekreti 50 000	800 000
TOTAL				200 à 275 000	900 000	2 à 3 000 000

PRINCIPAUX OUVRAGES _ REGULARISATION PREVUS

Ouvrages	Ecoulement annuel Milliards m³	Volume régularisation Milliards m³	Hauteur barrage en Mètres	Surface irrigable Milliers hectares	Production d'Energie Gwh*
SENEGAL					
Manantali	12	10	76	300	800
Diama	20	1,4	2,50	75	
[illegible]	0,4	0,8	20	20	
NIGER					
Selingue	12	3	25	80	180
Tossaye	32	2	20	20	70
Kandadji	30	20	45	150	1000
Tchad Chari Logone					
Goré	3	3	25	10	85
Koundam	3,5	3	55	12	140
Voltas					
Sourou et Volta Noire	1,6			80	
Bagré et Volta Blanche	1,2	0,8	30	30	30
GAMBIE					
Sambangalou	2,8	6,7	104	50	010
Kekreti	3	6,3	70	60	320

* 1 Gwh = 1 Million de Kwh