The Policy of Rice Import Substitution: the Case of the Senegal River Valley and Delta

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I. Introduction

The basin of the Senegal river stretches from Guinea (30 800 km²), through Mali (155 000 km²) Mauritania (75 600 km²), to Senegal (72 400 km²) and covers a total of 333 800 km², or 12.3 per cent of the total surface area of the four countries combined (2713 million km²). It is generally divided into an 'Upper Basin' (233 000 km²) and a 'Valley' (148 000 km²) and the dividing line crosses Bakel (Senegal), 820 km from the river mouth. The 'Upper Basin' covers more than one third of the area of the Fouta Djalon as well as the entire administrative region of Kayes in Mali. The 'Valley' stretches through the River administrative region in Senegal (the departments of Dagana, Podor and Matam), through some administrative districts of the departments of Bakel and Kédougou (the Eastern Senegal administrative region) and through some districts of the administrative regions of Rosso, Aleg, Kaedi and Kiffa in Mauritania.

The French colonial administration displayed an early interest in the development of the Senegal river basin and, in October 1938, established the MAS (Mission d'Aménagement du Sénégal), whose task it was to undertake studies on development possibilities, formulate projects, supervise future works and develop cotton growing for export.

Until the eve of World War II, the MAS concentrated its activities mainly on the Valley to the almost total exclusion of the Upper Basin which specialized in groundnut production. During World War II, the failure of cotton growing and the deteriorating food situation in the colony led the MAS to abandon cotton production and concentrate on rice farming instead.[1] That is the reason why, in 1945, two engineers employed by MAS, Peltier and Delisle, drew up a vast rice development project for the Senegal river which was to cover 50 000 hectares. The first rice scheme to be developed by the MAS at Richard Toll was seen as the implementation of stage one of the Peltier/Delisle Plan for integrated development of the whole Delta area.[2] The work on developing a rice scheme covering 6000 ha at Richard Toll started in 1949 and was completed in 1957 as follows:

1944	experimental rice scheme covering	120 ha
1946/49	experimental rice scheme covering	600 ha
1949/53	first crop centre covering	1500 ha
1953/57	completion of the rice scheme covering	6000 ha

This experiment in mechanized rice farming, which continued until 1971, ended in failure. The experts put this failure down to technical, economic as well as financial reasons and generally blame the following factors:

(a) insufficient, or neglect of, levelling of the land
(b) lack of maintenance of agricultural machinery
(c) incompetence among certain groups of staff and insufficient supervision of staff; unsuitability of some equipment
(d) delays in sowing and other crucial cropping operations
(e) the appearance of wild rice

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(f) wear and tear of the canals and draining ditches
(g) damage to crops by birds and livestock
(h) poor management of the rice scheme
(i) a too abrupt Senegalization of company officials in 1960/61; a too frequent turnover of members of the Managing Board of the company, particularly of Managing Directors
(j) the artificial support enjoyed by the rice scheme (subsidies, cash advances, etc.).[3]

In 1959/1960, on the eve of independence, the only rice scheme to have been implemented in the Delta was that of Richard Toll; in other words, only 6000 ha out of the 50 000 ha planned for the region under the MAS project. This failure can be explained partly by the very strict profit-earning criteria to which the project was subjected and partly by the fact that the colonial administration concentrated almost exclusively on the groundnut producing region (in the colony) which benefited from gigantic infrastructural investments and also achieved impressive rates of economic return.[4]

Since independence, rice consumption has been growing steadily in Senegal for the following reasons:

(a) an increase in the population and a high rate of urbanization
(b) changes in people's food habits—a tendency to prefer rice to millet
(c) expansion of single cash crop (groundnut) farming, with the result that peasants who specialize in groundnuts are obliged to buy their rice.

Since rice production in Senegal is insignificant in relation to demand, it is obliged to import ever-larger quantities of rice from abroad.[5]

TABLE I

TOTAL AVAILABILITY AND IMPORTS OF WHITE RICE BETWEEN 1960 AND 1974 (in 1000 metric tons)

	1960	1962	1964	1966	1968	1970	1972	1974
Imports	102	135	168	183	188	119	170	207
Total availability	158	190	255	249	226	220	240	250

Confronted with such a catastrophic dependence on overseas countries for foodstuffs, the river states opted for a policy of rice import substitution by adopting and implementing modern rice farming projects. In Senegal, a number of such projects are now in the process of implementation: three in the Casamance region, financed by the European Development Fund (FED) and the French Central Economic Cooperation Fund (CCCE); one project for growing rain-fed rice in eastern Senegal financed by the FED and the CFDT (Compagnie Francaise pour le Développement des Fibres Texiles); as well as the rice farming projects on the left bank of the Senegal river, both in the Delta and Valley areas. In this article I shall confine myself to rice farming experiments carried out in the Valley and Delta of the Senegal river.

II. Experiments in Developing Rice Farming in the Delta and Valley of the River Senegal

A. The S.A.E.D. rice scheme (left bank)

The development of the Delta, which began during the colonial period with the practice of controlled submersion, was continued by the OAD (the Autonomous Delta Organization), set up in 1960. The OAD developed more than 3000 ha and, in 1964, commissioned the MAS to build an 85 km long dike with walls bordering on the left bank of the river in that part of the Delta lying between St. Louis and Rosso. This laterite earth dike controls the inflow of flood water into the Senegalese part of the Delta and was intended to enable the OAD to develop 30 000 ha of rice fields under controlled submersion.

The OAD, however, was never invested with the status of a body corporate and, because it had no financial autonomy, it failed in the task. It was dissolved and replaced, on 20 January 1965, by the SAED (Corporation for the Development and Exploitation of the Delta Lands), an industrial commercial company administered by a board made up of the representatives from various ministries and operating under the auspices of the Ministry of Rural Development.

The SAED intervenes on several levels.

On behalf of the state, it is responsible for:
pre-development studies
execution of the work (dikes, roads, miscellaneous maintenance)
supervision and training of peasants and cooperatives
settlement of immigrant families in the perimeter
community facilities (schools, dispensaries)

On behalf of the peasants, it is responsible for:
the water situation (irrigation and drainage)
supplying fertilizers and seeds
carrying out mechanized cropping techniques
threshing of the harvest
collection of paddy

On its own behalf, the SAED:
purchases and transports the paddy
processes paddy into white rice
would be responsible for possible future operations under state control.

The task, then, of the SAED is to train and organize the peasants for the production of paddy with a view to reducing Senegal's dependence on abroad for foodstuffs.

(i) *Infrastructure and organization of production* The SAED has experimented with four water-control systems in rice plots on a mounting scale of complexity, from 'primary' to 'gravitational secondary' to 'secondary with water pumping' to the 'tertiary' system.

Before the completion, in 1964, of the peripheral dike which follows the river bank for 85 km, it was impossible for people to settle on the *oualo* (land which is inundated yearly when the river floods). At that time, there were only 25 villages with 13 895 inhabitants in the whole Delta area (including the Upper Delta). The SAED development programme, however, required more manpower than was readily available on the spot and that is why, after having completed the dike, the Corporation built five new villages (between 1965 and 1967) in which 5543 persons from neighbouring regions were settled. In 1968/69, the total population of the Delta (including the Upper Delta) had risen to 19 438 persons in 3340 families, i.e. slightly less than six persons/family.

The Senegalese state, which owns all the land in the country since the adoption of the Legal Instrument of 17 June 1964, has granted land to the SAED in the Delta area. The SAED, in turn, grants land to the farming cooperatives it has established; these cooperatives do not own their holdings, they merely enjoy a simple right of user.

(ii) *Agricultural production* The increase in acreage tilled by SAED cooperatives has been as follows:

year	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71
hectares	6 300	9 300	10 250	9 750	10 700	10 012

Not all the acreages tilled were actually sown either for pedological or other reasons (salinity in certain basins, certain members of the cooperatives refusing to sow on high-lying parts). Acreages sown or cropped represented between 80 and 100 per cent of land under cultivation. Because of a lack of water control in the plots during the drought period 1965–70, a high proportion of fields were lost during those five seasons. Harvested acreages represented 94 per cent of those sown in 1965/66; 90 per cent in 1966/67; 84 per cent in 1967/68; 80 per cent in 1968/69; and 73 per cent in 1969/70.

From 1963 to 1972, paddy production and yields evolved as follows:[6]

TABLE 2

SAED: FARMED ACREAGES, PADDY PRODUCTION, YIELDS AND MARKETING OF PADDY, FROM 1963 TO 1972

year	area (ha) ploughed	sown	harvested	production (in m tons)	yield m tons/ha	marketing (in m tons)
1963/64	2 000	2 000	2 000	—	—	990
1964/65	3 100	3 100	2 800	—	—	1 100
1965/66	6 300	6 300	5 900	11 800	18.6	5 000
1966/67	9 300	9 300	8 300	22 000	18.0	8 450
1967/68	10 250	9 650	8 450	15 000	16.0–17.7	6 100
1968/69 [a]	9 750	8 800	800	1 000	1.1–12.5	516
1969/70	10 700	9 096	9 096	17 000	18.7	10 927
1970/71 [a]	10 012	10 012	6 337	10 200	10.0–16.0	3 000
1971/72 [a]	10 500	9 500	7 400	16 800	10.0–22.7	8 000

Note: (a)=years of insufficient rainfall (150 mm, 148 mm and 50 mm respectively).

The figures on yields are approximate and sometimes calculated in relation to acreages sown and at other times to acreages harvested. The production in 1966/67, 1967/68 and 1969/70 was average, but that of 1968/69 was very low, as was production in 1970/71 and 1971/72. In 1970/71, 4000 ha were lost (150mm of rain in three months) and in 1971/72 2100 ha were lost (50mm of rain in three months). However the use of pumping made it possible to save 63 per cent of acreages in 1970/71 and 80 per cent in 1971/72.

(iii) *The SAED's prospects between now and 1980* The original objective of the SAED, i.e. to develop 30 000 ha of the Delta into fields under controlled submersion at the rate of 3000 ha per annum, has not been achieved. By 1971 only 10 000 ha had been developed and a further 16 300 ha are expected to be developed before 1980 which is the final year of the Delta development operation. Moreover, paddy production has not exceeded an annual 17 000 metric tons (except in 1966/67) as shown by the tables below, and the SAED's contribution to reducing the food deficit in Senegal is negligible.

TABLE 3

THE SHARE OF SAED'S PADDY PRODUCTION IN REGIONAL AND NATIONAL TOTAL 1965–1970 (in metric tons)

	1965/66	1966/67	1967/68	1968/69	1969/70
National production	122 265	125 324	134 549	58 232	139 900
River region production	27 478	38 101	38 064	11 947	30 094
SAED production	11 812	22 065	15 453	1 000	16 650
SAED/National production (%)	9	17	11	1.7	11
SAED/River region production (%)	42	57	55	8.3	55

TABLE 4

THE SAED's CONTRIBUTION TO THE AVAILABILITY OF WHITE RICE, 1965–1970 (in metric tons)[7]

	1965/66	1966/67	1967/68	1968/69	1969/70
Production	79 000	81 000	88 000	38 000	91 000
Imports	203 000	170 000	154 000	188 000	159 000
Availability	282 000	251 000	242 000	226 000	250 000
SAED	7 700	14 300	10 000	630	11 000
SAED/Availability (%)	2.7	5.6	4.1	0.2	4.4

The SAED's failure to achieve its production target can be explained chiefly by climatological factors (lack of rain) and the inability to control water (irregular river floods), which in turn explain the disenchantment of the cooperative peasants, discouraged by an unpredictable and costly rice single-crop agriculture. In order to overcome the problems of controlled submersion, the SAED adopted, from 1969, a system of secondary and tertiary schemes which ensured complete control of water in the plots (although control of the river flood was not achieved since the regimen of the Senegal river had not been regulated and cropping in the rice basins always depends on floods). In practice, the adoption of secondary and tertiary systems raised new problems intrinsic to rice cropping, the appearance of casual weeds, red rice and parasites, that can only be eliminated by regular crop rotation which presupposes intensive rice farming. Confronted with these problems, the SAED adopted, in 1971, a complete programme of intensified rice farming, aimed at improving the existing tertiary system, and agronomic research (experimentation with short-cycle, high-yield varieties, crop diversification, weed control, the use of fertilizers, agricultural machinery and modern cropping techniques, a seeding programme). The programme is designed to produce 63 800 metric tons of paddy by 1980 on 16 300 ha (of which 3400 will have two annual crops) and a yield of 35 quintals/ha on the improved acreage.

The success of the rice intensification programme will depend on the internal water control on the plots and, especially, on external control, i.e. of the flood of the river Senegal. The latter can be achieved with the construction of the Maka-Diama dam (near St. Louis) which will regulate the flow of the river into the Delta and allow for two crops a year since fresh water would be available all year round.

The success of the programme will also depend on which peasant organization formula is chosen. That of peasant cooperatives used between 1965 and 1970, has proved to be a failure for the following technical reasons: non-control of water in the plots, four successive years of rain shortage, problems of access to certain plots, problems of weeding in large sheets of water, invasion of wild rice, too small an acreage per worker. The result was stagnation or a drop in yields and the cooperatives fell into debt. However, the failure of the cooperatives formula cannot be entirely explained by these technical problems; it is the underlying philosophy which is at the root of the failure.

The cooperatives were allowed almost no initiative; the members were underemployed (40 working days/ha) and their tasks consisted solely of sowing, weeding and harvesting, the actual tilling being carried out by the SAED's caterpillar tractors and other machinery. The basic problem, therefore, is the introduction of rice monoculture without water control. Unless water can be controlled, the peasants cannot make a living from the extremely unpredictable rice farming. Their disenchantment is logical—it is irrational to be underemployed and in debt when working in a modern form of farming that is as unpredictable as traditional after-flood agriculture.

That is why the SAED, in 1971, adopted its programme for intensified rice farming and gradual control of water in the plots and also replaced the cooperative system by one of producer groups, which gave more initiative to the peasants in the farming work.[8] Thanks to the gradual control of water, brought about by an improvement in the tertiary system, by a rigorous selection of the members of the producer groups, by far-reaching supervision and by the high degree of initiative the producers were allowed in carrying out the farming work and handling the irrigation equipment, these groups are

achieving positive economic and financial results, are able to pay off their debts and obtain credit for new equipment. This new policy made it possible to increase working time from 45 days/ha (under the cooperative system) to 90 days/ha, to increase yields from 18 to 32 quintals/ha and to raise the net income of the producer group in the Boundoum dam from 16 140 CFA francs/ha under the old co-operative system to 38 425 CFA francs/ha (in 1971).

Irrespective, however, of the higher income earned under this new farming system, a peasant who works no more than 90 days/ha is still underemployed for the rest of the year. In order substantially to increase their incomes and discourage them from resorting to 'traditional' activities during the off season, it is necessary to introduce crop diversification in the Delta area. The SAED has made provision for this development in its programme. But such diversification will not be possible without the introduction of two annual crops, which, in turn is not feasible without access to fresh water all the year round. Hence the need to construct the Maka-Diama dam. The higher productivity of the peasants, who would be working for most of the year, would perhaps allow the SAED to achieve its production target for 1980.

B. The O.A.V. rice scheme (left bank)

The task of developing the Senegal river Valley was assigned to the OAV (Autonomous Valley Organization), established by Public Decree of 22 May 1961. The goals of this corporation, whose head office is in St. Louis, were:

to develop waste land or abandoned land in the Valley
to work in liaison with specialized technical services to build the structures indispensable to the development of the rice basins
to provide technical assistance to the population in the Valley
to contribute to the rural development of the Valley.

The original objective of the OAV was to promote semi-mechanized small-scale rice farming in the Valley. The first Development Plan of Senegal (1961–1964) instituted a change in the OAV's initial working formula and proposed that the basins be converted for producing and increasing seeds, and large funds were to be earmarked to the OAV for this purpose. However, financing was not obtained for the programme and, from the 1962/63 season, the OAV went in for extensive rice cropping by adopting a formula of village farming and controlled submersion. The OAV development system comprised:

a large surrounding dike
one or two structures to control the flow of the flood into the basins and to limit its entry below a certain threshold
small floodbanks to distribute water at different levels and to protect the basins against excessive water.

The work carried out included: (a) an initial stage of building or improving existing dikes and small floodbanks, constructing bridges, tilling rice basins, ploughing, dividing the land into plots and distributing fertilizers and seeds; (b) a crop season proper, from sowing (seeds were broadcast at the rate of 120 kilos/ha) to harvest, as well as checking dikes and small floodbanks. The peasant producers were organized in cooperatives in the entire area covered by the OAV. In 1967/68, there were 4519 peasants organized into 23 cooperatives.[9]

(i) *Technical results obtained by the OAV* From 1962 to 1969, the trends in acreages under rice cultivation were as shown on table 5.

This table clearly shows that the actual acreage farmed never exceeded 1253 ha, although 3300 ha are arable for rice. Only during the 1968/69 crop season did the acreages cropped represent 55 per cent of arable acreages, the percentages during other crop seasons varying between 19 per cent to 38 per cent annually.

TABLE 5

TRENDS IN ACREAGES UNDER RICE CULTIVATION BY RICE BASIN, 1962–1969 (in ha)[a]

Locality	1962/63	1963/64	1964/65	1965/66	1966/67 by tractor	1966/67 by hand	1967/68 by tractor	1968/69 by hand	1968/69 by tractor	1968/69 by hand
Saldé	185.8	185.8	184	65	105	20	—	137	(c)	—
Pété-Galoya	91.35	91.35	174	200	182	—	—	194	(c)	—
Méry Mboumba[a]	38	38	173	212	55	—	59	15.5	(c)	36.5
Madina	111	111	160	160	160	—	160	—	—	160
Guédé	150	150	245	273	273	177	173	227	273	250
Niangab			20	65	38.25	40	38	150	—	188.25
Total tilled by tractor	576.15	576.15	956	975	813.25		530		273	
Total tilled by hoe						237		723.5		634.75
Total tilled	576.15	576.15	956	975	1 050.25		1 233.5		907.45	
Total arable	3 000	3 000	3 300	3 300	3 300		3 300		1 650	
Total tilled/ total arable (%)	19	19	29	29.5		32	38		55	

Notes: (a) dike extended towards Méry in 1964.
(b) dike built in 1964.
(c) the dikes at Saldé, Pété-Galoya and Méry were breached during the 1967 flood and had not been repaired in 1968.

The main obstacle to improving the economic activity in the OAV rice basins was inadequate water control which was the result of the practice of controlled submersion. When using this technique, the rain is responsible for germination, whereas the plant grows with flood water from the river, the flow of which into the fields is regulated by a system of dikes and small floodbanks.

But the Senegal river Valley is situated in a Sahelian climatic belt with insufficient and highly irregular rainfall, and it is the volume, regularity and periodicity of rain which condition the volume of acreages tilled and the germination of the seed. In fact, if the rains come too early the result might well be a reduction in acreages tilled; if they come too late, the rice has to be sown late; if they come at intervals interspersed with short drought periods, the rice may have to be sown again; if the rains are too heavy the low-lying parts of the basins may be flooded too soon. The crucial factor for the growth of the plant is the height of the flood. If it is too low, the fields ploughed and sown will not be flooded, the plant will not grow sufficiently and the harvest will be low. If, on the other hand, the flood is too high, the dikes and small floodbanks will be submerged, the plants drowned and there will be no harvest at all.

Certain errors were also committed in the design of the technical structures themselves; the surrounding dikes (78 km) were too long in relation to the acreages dammed (6883 ha) and the acreages suitable for rice farming (3300 ha) were too small in relation to the acreages dammed. Moreover, the structures were designed to hold back floodwaters up to a level supposedly only reached one year in ten, but this level was in fact attained both in 1961 and 1964 and even surpassed in 1965.

The technicians, then, designed and built the OAV structures on the basis of incorrect flood predictions. The practice of controlled submersion and the poor design of technical structures could not fail to lead to mediocre production results.

(ii) *The failure of the OAV production programme* To all intents and purposes, the OAV management never drew up any medium-term plan and often failed even to plan ahead for one year at a time. During the 1967/68 crop season, for instance, there were problems about ploughing the fields. The organization which usually carried out the ploughing work for the OAV had let them down at the last moment and the management was obliged to call upon the office of Agricultural Services to find a solution. In the end and after many discussions with private firms in Dakar, with the SAED and with the Centre for Reproducing Seeds of the Subdivision for Mechanical Tools of the Ministry of Public Works, the SAED was finally commissioned to do the ploughing. All this naturally led to a delay in executing

the work, which only started on 1 August instead of being completed by the end of June or at the latest mid-July.

The seeding projections were generally not achieved by the OAV management, for it depended on outside suppliers; the seeds were delivered late by the Centre for Reproducing Seeds at Richard Toll and by ONCAD (Office National de Coopération et d'Assistance pour le développement). The seeds were often of a poor quality (containing a high proportion of red rice) and were distributed late to the peasants.

Since the OAV management had no financial prerogatives and depended entirely on the financing body in Dakar it was unable to solve the immediate and urgent financial problems because administrative red tape involved far too much delay. The OAV management limited itself to carrying out administrative and financial tasks. There was practically no technical supervision of the peasants (the only technician was the company director, an agricultural engineer, who lived in St. Louis, far from the OAV plantations). The supervision was provided by regional services (the Centres for Rural Expansion), whose work covered many areas and which could therefore not provide regular supervision of the cooperative rice farmers.[10]

(iii) *Failure of the OAV cooperative system* The cooperative system imposed on the OAV peasants, as in other regions of Senegal, was unsatisfactory from their point of view and, hence, did not provide an incentive to work. The first problem arose from the distribution of plots to the peasants. This was done haphazardly and was not conducive to efficient work. The peasant, well knowing that he would no longer be working the same plot the following year and not knowing which plot he would be working next, could see no advantage in the proper upkeep of either this or any other plot. If a peasant was unlucky enough to be allocated a badly situated plot, he had no one to complain to if he had too much water (low-lying parts of the basin) or no water (high-lying parts).

This method of distributing plots, then, meant that the peasants had no incentive to provide proper care of the crops, nor to supervise or maintain the dikes, which were often damaged during the dry season by livestock passing through on their way to the river for water.

All these factors combined—the long drought from 1966 to 1972, the highly irregular river floods during the same period (the hazards of controlled submersion), poor administrative and financial organization of the OAV, the absence of a medium-term programme, the lack of supervision of the peasants, the poor technical design of structures, the inefficiency of the cooperative system, the irrational distribution of plots to the peasants—to ring the death knell for the OAV, whose plantations are now being farmed by the SAED. The latter has, in the past few years, drawn up a programme of tertiary systems in certain fields.

III. The Conditions and Consequences of the Rice Import Substitution Policy

In order to reduce the food shortage and dependence on foreign countries for foodstuffs, the river states have adopted a policy of rice import substitution, which has resulted in total dependence on foreign capital and multinational corporations. This fact emerges clearly from an analysis of the various operations required for the production of white rice.

A. Technical studies and special surveys of the Valley and the Delta

The various preparatory technical studies and surveys were carried out entirely by foreign public or private firms with foreign public or private capital:

Hydrological surveys were undertaken by the BCEOM (Bureau de Coopération et d'Etudes d'Outre-

Mer), the Société Grenobloise d'Etudes et d'Application Hydrauliques (SOGREAH) and ORSTOM (the French office for scientific and technical research overseas),

Climatological and rainfall studies were carried out by ORSTOM,

Land and mapping surveys were carried out by the French National Geographic Institute, the SEGECOT company, the SAET, the Muller Office and the United Nations (Project for the Hydro-Agricultural Study of the River Basin),

Pedological surveys were undertaken by the Société Centrale pour l'Equipement du Territoire (SCET); by the Institute for Tropical Agronomic Research and Food Crops (IRAT) and by the Agricultural Studies and Development Company (SEDAGRI) under subcontract of the FAO,

Studies on hydro-agricultural schemes were carried out by SCET and the United Nations (Hydro-agricultural Study of the River Basin) under subcontract,

Agronomic studies were carried out by IRAT,

Studies on human settlements in the Delta were made by the CROS mission, those on fishing by the Centre technique Forestier et Tropical (CTFT) and those on animal husbandry by the IEMVT (Institut d'Elevage et de Medecine Vétérinaire des Pays Tropicaux).

B. Hydro-agricultural schemes

The rice scheme at Guédé, the first experiment in modern rice farming in the Valley, was initiated by the colonial administration between 1939 and 1943. The MAS built the surrounding dike and canals and installed the pumping station.

The rice scheme at Richard Toll was also started by the colonial administration, with funding by FIDES (Fonds d'Investissement pour le Developpement Economique et Social) mainly relying on money supplied under the French budget. With a view to capitalist industrialization in the agricultural sector (total mechanization and introduction of the wage-earning system), the colonial administration imported all the technology required to set up the rice scheme in Senegal. It was also necessary to import the technology for the scheme structures and general equipment (earthwork equipment, protection dikes, pumping and draining-off station, floating equipment, transport) as well as for infrastructural work (roads, land improvement, housing for foreign cadres, etc.). Total investments for the 6000 ha scheme at Richard Toll by FIDES came to 3000 million CFA francs in 1956, or around 500 000 CFA francs/ha developed.

Technology also had to be imported by SAED to introduce into its basins first primary, then secondary and finally tertiary systems. For these:

(a) the cost of the primary system (peripheral dike and water intake and outlet structure) totalled 850 million CFA francs

(b) the cost of the secondary gravitational system 59 700 CFA francs/ha over 8460 ha, i.e. more than 407 million CFA francs

(c) the total average cost of a perimeter operating on the secondary gravitational system (to which must be added the cost of the primary system) in 1969/70 was 137 300 CFA francs/ha

(d) the total cost of building the three pumping stations at Diawar, Ronq and Thiagar was higher than 260 million CFA francs (in 1969), the average cost, when broken down per station, being 24 100 CFA francs ha on a total of 10 735 ha of developed land

(e) the cost of secondary systems with pumping totalled 161 400 CFA francs/ha

(f) the cost of the tertiary system reached 151 000 CFA francs/ha in 1970 on the 185 ha developed in the North Boundoum rice scheme.

Total investments in the SAED perimeter had reached more than 3175 million CFA francs by January 1971, mainly financed by the FAC (The French Aid and Cooperation fund), or the equivalent of 350 000 CFA francs per developed hectare (on a total of 9096 developed hectares).

Total investments planned by the SAED (hydro-agricultural infrastructure, supervision and tech-

nical assistance, research and miscellaneous, agricultural machinery, subsidies to cover deficits) for the period 1971–78 will reach 3251 million CFA francs, of which 1874.8 million would be provided by the FAC and the balance by the Senegalese government (1646.15 million) in the form of subsidies.

C. Soil preparation in the rice fields

In order to carry out tilling or puddling work, mechanical traction equipment had to be imported. In the old rice fields in Richard Toll, which were wholly mechanized, all ploughing equipment was imported. In the SAED scheme, where tilling and puddling was totally mechanized before 1971, tractors were imported (continental caterpillar tractors and tractors with Ferguson wheels) as well as MacCormick ploughs.

In the SAED plantations, it was only after the failure and termination of the cooperative system (which allowed very little initiative to the settlers) and the adoption of the system of peasant producer groups in 1971, that the peasants started to use draught animals for ploughing. However, this practice is not widespread and imported machines are still generally used for ploughing.

D. Levelling and construction of small floodbanks

In its plan to improve the tertiary system and water control, the SAED has modified the contours of the plots and regulated them so as to avoid shifting of soil and to achieve water planes of the desired depth. Thus, one and the same plot may, according to acreage, contain several contour levels spaced 10 cm apart.

Basic levelling and rough grading work is carried out with machinery borrowed from the Public Works Ministry (graders, compactors and vibratory rollers, etc.) and with equipment belonging to the SAED (Cormick offsets); the final details and finishing (after ploughing and puddling or spraying) are done with levelling drags (floats) and a landlever. All this equipment has to be imported into Senegal.

E. Direct sowing and transplanting

In the mechanized scheme at Richard Toll, sowing is done in lines with imported tractor-drawn seed drills. In the SAED plantation, seeds are broadcast, but this is often followed by mechanical turning under. In its rice farming intensification programme, the SAED introduced transplanting techniques in some plots; this is generally considered superior to direct sowing and consists of raising young plants in nurseries and then transplanting them into the rice fields. In carrying out its policy of rice import substitution, the Senegalese government depends on foreign suppliers for seeds, although this dependence is gradually being reduced with the production by the SAED of Savoigne seeds.

F. Care of the plants and manuring

Between sowing (or transplanting) and harvesting, the plants are nursed and developed by (a) irrigation and draining, (b) plant pest and disease control, (c) control of casual weeds, and (d) manuring.

Control of casual weeds (grasses and sedge) can be either preventive (using seeds free from weeds, careful soil preparation in the basins, weeding and maintaining the canals and the edges of the rice fields) or remedial (sowing pre-germinated seeds under water, continued submersion of the plants under a layer of water which prevents the growth of casual weeds, or pulling up weeds by hand after sowing). Remedial control may also consist of the use of chemicals, such as chemical herbicides (soda, potassium and amine salts, esters).

In the SAED basin, because there is a shortage of manpower, weeding is done chemically, using manual spraying machines strapped to the back, carried over the arm or by power-driven spraying machines. Senegal depends on foreign countries also for the supply of chemical herbicides and spraying machines.

Plant pest and disease control is carried out through disinfection of the soils and seeds, by spraying

and powdering the rice fields, by the use of antibiotics and by sufficiently high doses of fertilizer. These, again, are chemical products which are usually imported into Senegal.

Manuring is used to make up for soil deficiencies and to increase fertility, to compensate for the loss of mineral elements during harvesting and to modify the chemical composition and nutritive value of the grain. Use is made either of natural organic manure or mineral fertilizers (nitrogen, phosphorus, potassium, lime, etc.). Mineral fertilizers used in the rice fields in the Valley and the Delta are manufactured at M'Bao (sulphuric acid, phosphoric acid, superphosphates and compound fertilizers) and by the SIES (Senegalese Industrial Fertilizer Co.) which was established mainly with foreign capital (special loan from the FAC, loans from the European Investment Bank, the International Finance Corporation, the Central Economic Cooperation Fund, etc.).

G. Harvesting and threshing of the paddy

In the old Richard Toll rice scheme, combine harvesters were used for harvesting and threshing. These are large, expensive machines capable of carrying out several operations simultaneously such as cutting the stalks, gathering together the harvest, transporting and supplying the 'threshing' part of the machine, threshing, separating paddy from husks, cleaning the paddy as well as temporary storing and sacking of clean paddy.

In the SAED plantations, harvesting is done either by peasants using sickles or by combine harvesters; threshing is also done by hand on the spot or mechanically by combine harvesters. These extremely costly machines are imported into Senegal (especially from Italy).

H. Milling the rice

The rice is husked and whitened in fully equipped rice mills in the Delta of the Senegal river. The two rice mills at Richard Toll were built in 1956 and 1967 respectively. The SAED built one rice mill at Ross-Béthio in 1969. All three mills are equipped with silos for storing both paddy and white rice.

TABLE 6

THE PROCESSING AND STORAGE CAPACITY OF THE DELTA RICE MILLS

Location and type of installation	*year of construction*	*processing capacity -paddy (in m tons)* per hour	per year [a]	*storing capacity (in m tons)* of paddy	of rice
Richard Toll					
Guineti type	1956 [b]	7.0	22 000	8 000	1 200
Schule type	1967	2.5	8 000		
Ross-Béthio					
Schule type	1969	6.0	19 200	5 000	800
Total		15.5	49 200	13 000[c]	2 000[d]

Notes: (a) the mills are in operation 16 hours/day, 20 days/month, 10 months/year.
(b) totally renovated in 1971.
(c) total storing capacity for paddy, with three lots a year, is 40 000 metric tons/annum.
(d) total storing capacity for white rice, with six lots a year, is 12 000 metric tons/annum.

The industrial centre at Richard Toll (rice mill built in 1956) cost 286 785 million CFA francs in 1956, whereas the mill and the silo at Rosso-Béthio cost 147 115 million CFA francs in 1969. All the technology for building and operating these rice mills was, and continues to be, imported into Senegal.

I. The difficulties of implementing the import substitution policy

The fact of having adopted a rice import substitution policy, which implies dependence on foreign capital and multinational corporations, imposes economic, financial and technological conditions

on the river states which they are entirely powerless to influence in any way:

the cost per developed hectare in the rice plantations is too high
the need to import technology which is generally costly, poorly adapted to local conditions and which tends to deteriorate rapidly
the need to import certain indispensable inputs and spare parts for the machinery and equipment
use of expensive foreign technical assistance.

The rice producing companies have not succeeded in controlling these external factors, which combine to raise costs significantly. Because of these constraints and the lack of water control in the plots (which cannot be achieved without the construction of a storage dam on the river), and because of underemployment of the peasants, rice production in the Valley and the Delta is, in fact, of minor importance.

TABLE 7

PADDY RICE PRODUCTION IN SENEGAL AND IN THE RIVER REGION, 1969–1974
(in 1 000 metric tons)

	1969	1970	1971	1972	1973	1974
Senegal as a whole	58.3	155.9	90.5	108.2	36.7	64.3
The River region	12.0	14.2	20.0	27.9	6.5	9.8

Source: Statistics supplied by the Senegalese Statistical Office.

TABLE 8

PRODUCTION OF WHITE RICE IN SENEGAL AND IN THE RIVER REGION, 1969–1974
(in 1 000 metric tons)

	1969	1970	1971	1972	1973	1974
Senegal as a whole	37.9	101.3	58.8	70.3	23.8	41.8
The River region	7.8	9.2	13.0	13.1	4.2	6.3

Note: Calculations made on the basis of 1 metric ton of paddy rice corresponding to 650 kilos of white rice.

Management problems for these rice-producing companies are such that the cost of producing white rice in the Delta and Valley is generally higher than the purchasing price of imported rice (especially from Asia). Table 9 gives a rough estimate of the cost of producing paddy in the Valley and Delta, an estimate that must be highly approximate because no documents are available and the rice producing companies do not apply very strict accounting systems.

TABLE 9

APPROXIMATE COSTS PER METRIC TON OF PADDY PRODUCED IN THE VALLEY AND DELTA OF THE RIVER SENEGAL (in 1970 CFA francs)

Scheme	Farming costs per ha[a]	Yield (in tons/ha) real[b]	potential	Cost of producing real	potential
SDRS (Richard Toll)	60 000–75 000	2.4	3.0–4.5	25 000–31 000	13 000–25 000
SAED	30 000–32 000[c]	1.6	2.0–2.5	19 800–20 000	12 000–16 000
COLONAT (Richard Toll)	25 000–30 000	2.0	2.5–3.5	15 000–17 000	8 500–14 000
GUEDE	25 000–30 000	2.0	2.0–3.0	12 500–15 000	10 000–12 000

Source: R.D. Hirsch, 'La riziculture dans les Etats de l'OERS', p. 40.
Notes: (a) financial costs only.
(b) average 1965–70; official yields for Guédé are very optimistic.
(c) the financial outlay for peasant members of the co-operative is only between 10 000 and 12 000 CFA francs, but if costs borne by the SAED as well as subsidies are included, the total is very high.

The cost of producing milled white rice in the rice schemes at Richard Toll has always been higher than the purchasing price for imported rice. Whereas the price (CIF Dakar) for which the OCAS

has been buying imported broken rice has varied from 22.78 CFA francs/kilo in 1965 to 34.14 in 1968 and 28.01 in 1970, the average cost of producing white rice by the company out of the mill has varied between 35.9 and 66.8 CFA francs/kilo. The average producing price between 1967/68 and 1970/71 was 45.7 CFA francs/kilo. In order to save the company from competition that would be fatal, the Rice Stability Fund subsidized it as long as the price of imported rice was low by setting a comparatively high price to the consumer (the retail price of broken rice was set at 45 CFA francs/kilo).[11]

However, the rise in world prices for rice cut down the resources of the Stabilization Fund and the government was no longer prepared to give artificial financial support to the rice producing company at Richard Toll, which was finally dissolved on the 31 December 1971. The cost of milled white rice from the SAED mill in Ross-Béthio was as high as 40 CFA francs/kilo in 1971 and thus also higher than the purchasing price of imported rice. This meant that the SAED also needed financial support from the State.

IV. Conclusion

The rice import substitution policy opted for by Senegal has not only not reduced its dependence on food from abroad but, what is worse, has increased its structural, economic, financial and technological dependence on the dominant capitalist countries and the multinational corporations, who have a world-wide monopoly of the granting of loans and of the production and marketing of the technology required by the rice growing enterprises in the Delta and Valley of the river Senegal.

The present crisis in the world capitalist system has increased the dependence of the river States which, because of world inflation, have been obliged to buy foreign technology at constantly rising prices while at the same time being confronted with increasing operational costs for their rice companies (more expensive fertilizers, fuel, spare parts, maintenance work in the schemes, equipment, etc.), as well as an increase in the world price of imported rice. They are obliged to continue importing rice since national production is both unpredictable and inadequate.

It is not technically impossible for these countries to succeed, between now and the year 2000, in becoming self-sufficient in food—by intensifying rice farming, introducing short-cycle high-yield varieties and other food crops (wheat, sorghum, maize, black-eyed peas, etc.), by nationalization, intensive supervision of groups of peasant producers, and by constructing a dam in the Delta capable of supplying freshwater all the year round to the rice schemes on both banks of the river. But unless they then break away from a substitution policy financed by foreign capital and multinational corporations, the problems now facing our countries, i.e. the development of 'underdevelopment' and growing marginalization of the overwhelming majority of the people can only be accentuated. And these are problems which cannot be understood in the context of conventional academic analysis but which require a new approach.

Notes

1 It was this very policy of 'developing' the colonies and the almost total concentration on industrial export crops that caused, and worsened, the food shortage in some African countries. In the case of Senegal, for example, the population grew from 1.45 million in 1920 to 3.05 million in 1959, whereas available foodstuffs *per capita* in the country fell from 240 kilos to 145 kilos during the same period. Food imports to Senegal represented less than 7 per cent of available foodstuffs (cereals) in 1920 and almost one-third in 1960. The food shortage has been growing steadily and the situation has been aggravated by the fact that the population doubled in the space of forty years (1920–1960) while cereal imports only rose sixfold during the same period.

2 Nesterenko, 'amenagement de la Vallée du Sénégal et casier rizicole de Richard Toll', MAS, Saint-Louis, 1954. J.C. Giacottino, 'Richard Toll, bilan économique et humaine d'une expérience rizicole', M.A.S., Saint-Louis, June 1961.

3 R.D. Hirsch, 'étude économique du casier rizicole de Richard Toll 1953–1971', Saint-Louis, January 1972.

4 It is well known that the high economic return of the groundnut trading economy throughout the colonial period was achieved by the introduction of economic and non-economic measures aimed at maintaining the renumeration of labour at close to, or even below, subsistence level.

5 R.D. Hirsch, 'la riziculture dans les Etats de l'O.E.R.S. (Organisation des Etats Riverains du Sénégal), Saint-Louis, 1971 (Direction de la Statistique de la République du Sénégal).

6 *Project d'intensification de la riziculture dans le Delta du Fleuve Sénégal*, SAED, 1972, p. 4.
7 Rodts, 'étude économique de la SEAD', Saint-Louis, June 1971. R.D. Hirsch, 'la riziculture dans les Etats de L'O.E.R.S.', op. cit.
8 A.K. Cissokho and G. Raffard, 'les groupements de producteurs dans le Delta du Sénégal', SAED, Saint-Louis.
9 Seyral, 'rapport de fin de mission agronomique', Saint-Louis, March 1970.
10 *Rapport sur la campagne agricole 1967/68*, O.A.V., Saint-Louis.
11 R.D. Hirsch, 'la riziculture dans les Etats de l'O.E.R.S.', op. cit.