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ON  
MALI

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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE



Department of State, IO/UCS

WASHINGTON, D. C. 20521

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (A.I.D.), Office of Science and Technology (DS/ST) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

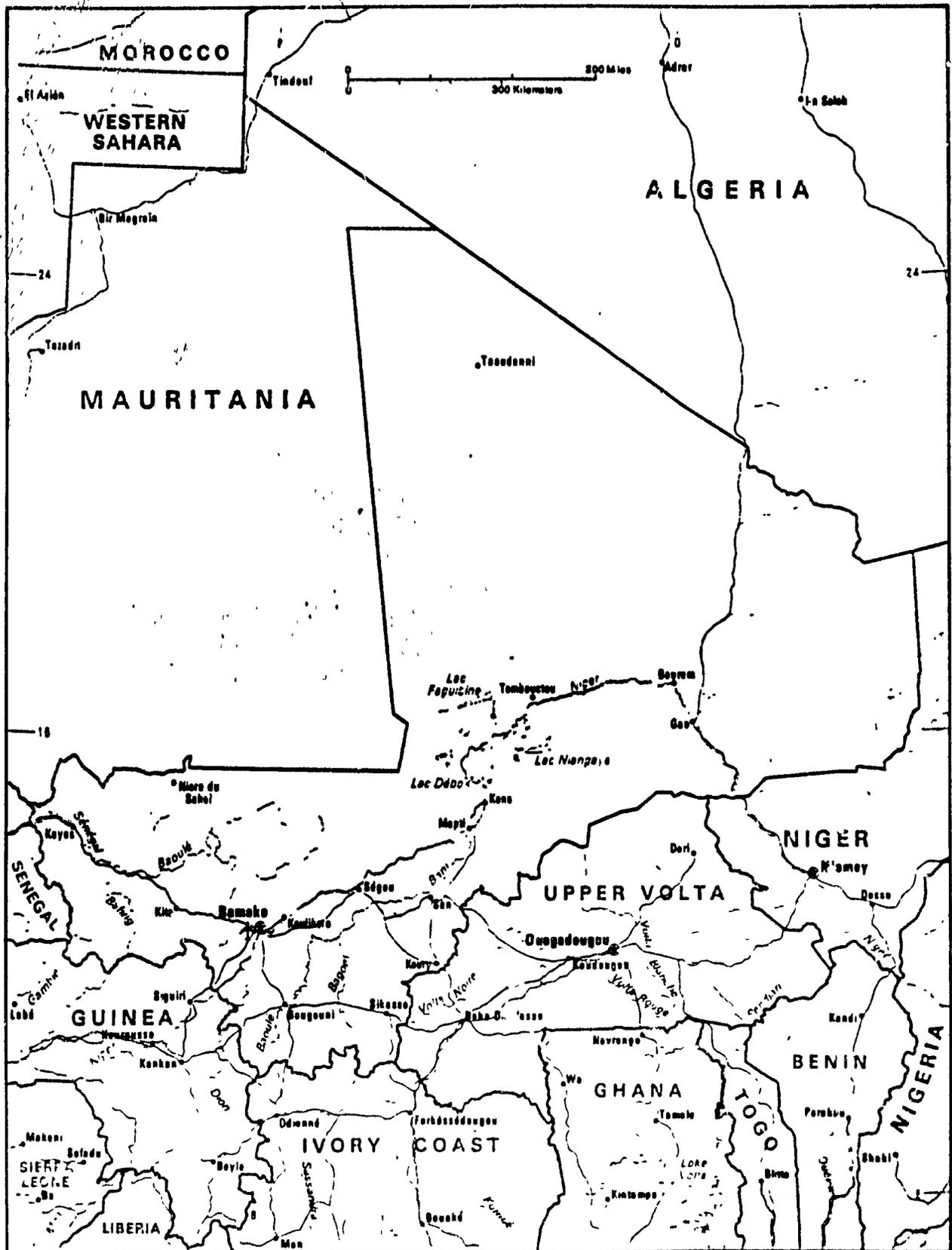
Comments on the attached draft report would be welcomed by USMAB and DS/ST and should be addressed to either:

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# Mali



502726 6-77 1642104  
 Lambert Conformal Projection  
 Standard parallels 8° and 22°  
 Scale 1:1 000,000  
 Boundary representation is  
 not necessarily authoritative

1977.

- Railroad
- Road
- ↑ Airport

## Summary

Mali is dominated by an arid and semiarid climate. Nearly half the country is covered by dry savanna. The Niger and Senegal Rivers provide Mali with an abundant although somewhat irregular supply of water. The recent southward expansion of aridity in West Africa and the resultant desertification has hit Mali very hard and has disrupted the social patterns and livelihood of the nomadic peoples of the savannas.

The effect of the recent drought in the Sahel has been amplified by the high levels of human and livestock populations responding to a period of greater rainfall in the 1950s, setting in motion a series of events that have resulted in the desertification of large areas of the country. Most of the major environmental problems in Mali are associated with this cycle of desertification. These problems include:

1. Soil erosion and degradation - present land use patterns together with the increase in aridity have created a tremendous soil erosion problem. Soil fertility problems beset most of the croplands away from the Senegal and Niger Rivers.
2. Deforestation - desertification and brushfires have contributed to vegetation loss, but forest destruction for firewood and charcoal production has been the primary factor.
3. Rangeland degradation - high livestock numbers and poor distribution of herds on pastoral lands have contributed to the degradation of large areas of grazing lands.
4. Health hazards - malaria and onchocerciasis are major health problems, particularly in the Senegal River Basin. The increase in perennial irrigation due to water projects suggests that schistosomiasis may become a problem as well.

Mali has set out a strategy to control the problems of desertification in its recent Plan for Development 1974-1978. An attempt is being made to bring the activities of humans in the arid regions of Mali into harmony with the environment, so that future periods of drought will not be as disruptive as in the past.

A. Paige Grant  
Compiler

with assistance from  
Douglas F. Stotz

# DRAFT ENVIRONMENTAL REPORT ON MALI

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## 1.0 Preface

This report represents a desk study compiled from many and varied sources. The major task was to integrate and synthesize the material available in the U.S. on Mali's environment and natural resources.

## 2.0 Introduction

### 2.1 Geography <sup>1/</sup>

Mali covers an area of 1,240,000 square kilometers, which is slightly smaller than Niger and larger than the states of California and Texas combined. It is a land-locked country, and the climate is arid or semi-arid except in the southwestern corner. 43.7 percent of the country is covered by savanna type vegetation. The northern part of this zone is much influenced by the southward expansion of the Sahel, which is the semi-arid border of the Sahara Desert.

The reasons for this expansion have been much debated since the catastrophic drought that afflicted the Sahel region of West Africa in the middle of the last decade. The drought itself has been interpreted as indicative of regional change toward drier conditions.<sup>2/</sup> It has been suggested that devegetation due to overgrazing and increased woodcutting for fuel for growing populations have resulted in a higher albedo (index of reflectivity) in arid lands, thereby causing drier conditions.<sup>3/</sup> Alternatively, it is suggested that increased air pollution has caused suppression of the monsoon cycle.<sup>4/</sup> On the other hand, there is a hypothesis that overgrazing has reduced the amount of organic particles that serve as ice nuclei which generate clouds and rainfall, and that for this reason rainfall has declined in the Sahel.<sup>5/</sup> However, the bulk of evidence and opinion is that drought is a recurrent phenomenon in the Sahel.<sup>6/</sup> This is demonstrated in the chart below.

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<sup>1</sup>Source: Church. 1974.  
Interafrican Committee for Hydraulic Studies. 1978.  
Europa. 1980.

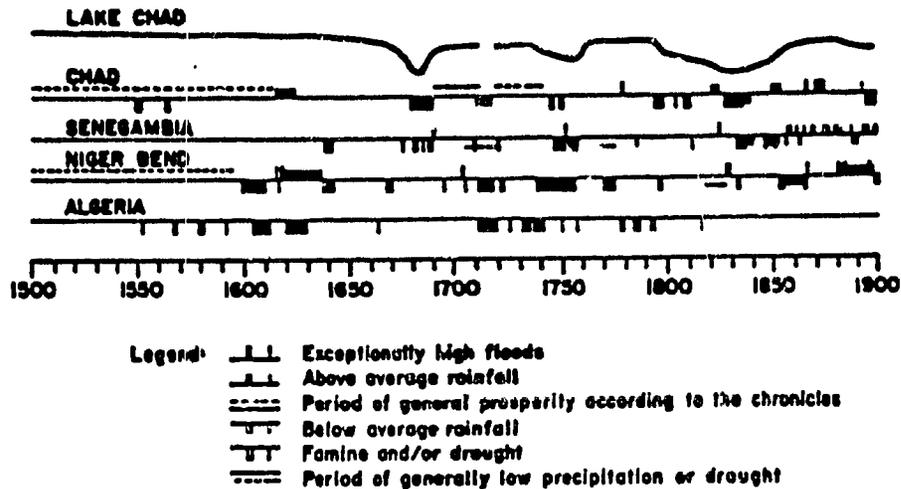
<sup>2</sup>Source: Wood and Lovett. 1974.

<sup>3</sup>Source: Charney. 1975. Ripley and Charney. 1976.

<sup>4</sup>Source: Bryson. 1973.

<sup>5</sup>Source: Schnell. 1974.

<sup>6</sup>Source: Landsberg. 1974. National Academy of Science. 1975.  
Nicholson. 1978. Tanka, et al. 1975



Chronology of famine and drought in Chad, Senegambia, the Niger Bend and northern Algeria, 1500 to 1900.

Source: Nicholson. 1978.

The effects of drought have been particularly damaging at this time because the human and livestock populations have expanded to exploit the levels of resources in the area which are produced during cycles of greater rainfall (such as occurred in the 1950's), but which cannot sustain such heavy use during dry periods. When the drought occurs, local populations have no choice but to attempt to wring a livelihood from the reduced resource base. The hardiest remnants of vegetation are then removed, and the savanna is reduced to desert.

There is little relief in Mali. In most of the country the Precambrian schists and gneisses are overlain by loose sands or by flat-bedded Ordovician and Silurian sandstones with sheet intrusions of dolerite and gabbro. In a few places the sandstone is eroded into steep scarps, the principal ones being the Tamboura south of Kayes, the Manding Mountains, and the long rise along the border with Upper Volta. The other major relief feature is Adrar des Iforas, an extension of the Ahaggar Mountains across the Algerian border, where the Basement Complex rocks of Africa are uplifted in a pile of Precambrian schists with granitic intrusions.

## 2.2 Population <sup>7/</sup>

The population of Mali in 1979 was estimated at 6,437,000, with a density of only 5.2 people per square kilometer. The growth rate of 2.5% (1978 estimate) is therefore not perceived as a problem by the government. <sup>8/</sup> However, the rate of seasonal and permanent

<sup>7</sup> Source: USAID. 1980 a. Europa. 1980.

<sup>8</sup> Source: USAID. 1980 b.

migration of workers to Senegal, the Ivory Coast, and to France, indicates that the resources of the country are not mobilized sufficiently to provide a livelihood for the present population. The following is a list of basic population statistics:

Population Per  
Square Mile of Arable Land: 42 in 1979, up from 26 in 1960

Per Capita GNP: \$110 in 1977

Population Per  
Medical Practitioner: 2800 in 1972

Infant Mortality: 120 per 1000 live births in 1970

Life Expectancy: 38.1 in 1975

Adult Literacy: Male: 5 percent 1970  
Female: not available

The principal tribes in the order in which they are represented in the population are Bambara, Fulani, Sénoufo, Marka, Jauareg, Sonaghai, Malinké, and Dogon. Although the official language is French, these tribes retain their own languages. Until recently, all instruction was in French. Islam is somewhat more widely practised than native animist beliefs.

As in the other Sahel countries, urban migration is a recent but increasing phenomenon. Seventeen percent of all Malians lived in urban centers in 1975, compared with 9.9 percent in 1960. The urban growth rate is 4.5 percent; 65.4 percent of the population growth in Bamako is attributed to immigration.

MALE POPULATION BY REGIONS, 1972

	Population		Percent Urban	Density (Persons per Km <sup>2</sup> )
	Total	Urban		
	('000)			
Moiti	1109.5	31	3.3	12.3
Bamako	978.0	213	21.0	11.0
Sikasso	967.9	27	3.8	12.6
Sogou	784.0	36	4.3	14.2
Kayes	751.8	34	4.3	6.3
Cao	641.4	n.a.	n.a.	00.8
Total	5243.2	351	6.7	

<sup>1/</sup> The urban population for Cao was not available.

Source: Cohen et al., 1979.

<sup>9</sup>Source: Cohen et al., 1979.

## 2.3 Economy and Administration

The state of the economy of Mali is subject largely to fluctuations in agricultural output, which are subject in turn primarily to weather patterns. The drought of 1972/73 brought millet/sorghum production down from 700 to 525 thousand tons. Cattle and sheep production prior to the drought was the highest in Francophone West Africa, but 27 percent of the cattle herd and 30 percent of the sheep flocks were lost in the drought. These setbacks added to a serious imbalance of payments situation and hit at the same time as a series of budget restrictions required by the French as the price of rejoining the franc zone, which Mali had quit shortly after gaining its independence from France in 1960. The result was that the Gross Domestic Product (GDP) dropped 6 percent in 1973 and remained static the following year. With a per capita GNP of \$108, Mali was the eighth poorest country in the world.

Since then there has been considerable recovery in the economy, with the help of foreign aid from a great number of sources, mostly in grant form. Cash crops have done well; cotton in particular was responsible for a 49 percent increase in export earnings, sharply narrowing the trade gap. However, Mali will probably not be able to reduce considerably its dependence on foreign aid at any point in the near future.

Participation in the labor forces is presented in the table below:

ECONOMICALLY ACTIVE POPULATION  
(ILO estimates, '000 persons at mid-year)

	1960			1970		
	Males	Females	Total	Males	Females	Total
Agriculture, etc. . . .	1,143	1,078	2,221	1,349	1,244	2,593
Industry . . . . .	18	45	64	33	54	117
Services . . . . .	68	11	79	117	22	140
<b>TOTAL . . . . .</b>	<b>1,229</b>	<b>1,133</b>	<b>2,364</b>	<b>1,499</b>	<b>1,320</b>	<b>2,819</b>

Source: Europa, 1980.

Mid-1977 (estimates in '000): Agriculture, etc. 2,884; Total 3,266 (Source: FAO, *Production Yearbook*).

Eighty-nine percent of the population is still employed in agriculture, despite the high rate of urban migration. Principal crops and live-stock production are summarized in the following tables:

**PRINCIPAL CROPS**  
('000 metric tons)

	1975	1976	1977*
Millet, Sorghum and Fonio . . . . .	676	804	850
Rice (Paddy) . . . . .	218	237	182
Maize . . . . .	71	81	85
Sugar Cane . . . . .	94*	94*	102
Sweet Potatoes and Yams . . . . .	35*	36*	36
Cassava (Manioc) . . . . .	40*	40*	40
Other roots and tubers . . . . .	9*	9*	10
Vegetables . . . . .	94*	95*	96
Fruit . . . . .	9*	9*	10
Pulses . . . . .	33*	34*	34
Groundnuts (in shell) . . . . .	227	254	230
Cottonseed . . . . .	62*	73*	78
Cotton (Lint) . . . . .	39*	41*	43

\* FAO estimates      \* Unofficial figure.

Source: Europa. 1980.

**LIVESTOCK**

(FAO estimates, '000 head, year ending September)

	1975	1976	1977
Cattle* . . . . .	3,826	4,060	4,079
Sheep . . . . .	4,000	4,219	4,437
Goats . . . . .	3,800	3,929	4,057
Pigs . . . . .	23	25	26
Horses . . . . .	140	150	150
Asses . . . . .	370	400	420
Camels . . . . .	165	170	155
Poultry . . . . .	9,700	9,992	10,254

\* Unofficial figures

Source: Europa. 1980.

**LIVESTOCK PRODUCTS**  
(FAO estimates, metric tons)

	1975	1976	1977
Cows' Milk . . . . .	65,000	68,000	71,000
Sheep's Milk . . . . .	21,000	22,000	23,000
Goats' Milk . . . . .	23,000	24,000	24,000
Butter . . . . .	1,558	1,605	1,652
Beef and Veal . . . . .	29,000	30,000	32,000
Mutton and Lamb . . . . .	16,000	17,000	18,000
Goat Meat . . . . .	11,000	11,000	12,000
Hen Eggs . . . . .	5,295	5,521	5,743
Cattle Hides . . . . .	6,356	6,772	7,158
Sheep Skins . . . . .	3,817	4,049	4,261
Goat Skins . . . . .	1,064	1,028	1,093

Source: Europa. 1980.

The fisheries sector produces some 112,000 metric tons per year. The contribution of agricultural production to the economy is indicated by the comparison of value of commodities imported and exported:

PRINCIPAL COMMODITIES  
(million Mali francs)

IMPORTS	1975	1976	EXPORTS	1975	1976
Food products . . . . .	18,900	12,000	Cotton and cotton products . . . . .	12,100	24,100
Petroleum products . . . . .	8,600	10,300	Groundnuts . . . . .	4,400	7,300
Textiles . . . . .	3,600	3,300	Cereals . . . . .	—	2,400
Construction materials . . . . .	7,000	6,900	Live animals . . . . .	4,900	5,300
Chemicals and pharmaceuticals . . . . .	8,900	12,000	Fish . . . . .	1,300	1,000
Machinery and vehicles . . . . .	17,300	21,200			
<b>TOTAL (incl. others)</b> . . . . .	<b>75,400</b>	<b>73,700</b>	<b>TOTAL (incl. others)</b> . . . . .	<b>30,800</b>	<b>43,100</b>

Source: Europa. 1980.

Industry has developed more than any other sector since independence. As an indicator, electrical production doubled between 1961 and 1971. Bamako electric plants produced 80.8 million kilowatt hours in 1976. Seventy-five percent of industrial turnover tabulated below is accounted for by State companies:

INDUSTRY  
SELECTED PRODUCTS

		1971	1972	1973	1974	1975
Groundnut oil (crude)* . . . . .	metric tons	38,000	37,000	36,000	24,000	29,000
Raw sugar . . . . .	" "	6,000	8,000	10,000	13,000	14,000
Sugar confectionery . . . . .	" "	1,000	1,303	1,300	1,200	1,100
Beer . . . . .	hectolitres	2,000	3,000	9,000	10,000	9,000
Soft drinks . . . . .	" "	20,000	22,000	22,000	21,000	22,000
Cement . . . . .	metric tons	33,000	42,000	47,000	42,000	49,000
Soap . . . . .	" "	4,917	4,389	4,300	4,100	5,300
Electric energy . . . . .	million kWh	63	69	80	69	94

\* Estimates by the U.S. Department of Agriculture.

1976: Raw sugar 13,000 metric tons, Beer 12,000 hectolitres, Electric energy 94 million kWh (provisional)  
1977: Raw sugar 13,000 metric tons

Source: Europa. 1980.

The mining sector is discussed in Section 3.5.

Much effort has gone to improving transportation facilities in the country. There are now 14,000 kilometers of roads and track, 7500 kilometers of which are all-weather; 1650 kilometers of road are tarred. A single railroad line links Bamako and Koulikora with Dakar. Improvement of transportation is recognized as crucial to improving agriculture and livestock production as well as raising the quality of life for the great majority of Malians who live in rural areas.

## 3.0 Resources

### 3.1 Water

#### 3.1.1 Description<sup>10/</sup>

##### 3.1.1.1 Surface Water

Most of Mali is dry, since practically no rain falls north of the 19th parallel. Virtually the whole population of Mali is limited to the southern half of the country. Rainfall increases toward the south from Gao, with an annual average of about 230 mm, to Mopti, with about 500 mm per year, to Kayes with 760 mm annually, to Bamako with 1120 mm and Sikasso with 1400 mm. Evaporation values decrease with increasing rainfall. Yet these average values are misleading. Rainfall is actually extremely erratic from year to year, and its fluctuations can be measured in agricultural production and thence in performance of the economy. Of paramount importance to Mali's development is establishment of a consistent water supply.

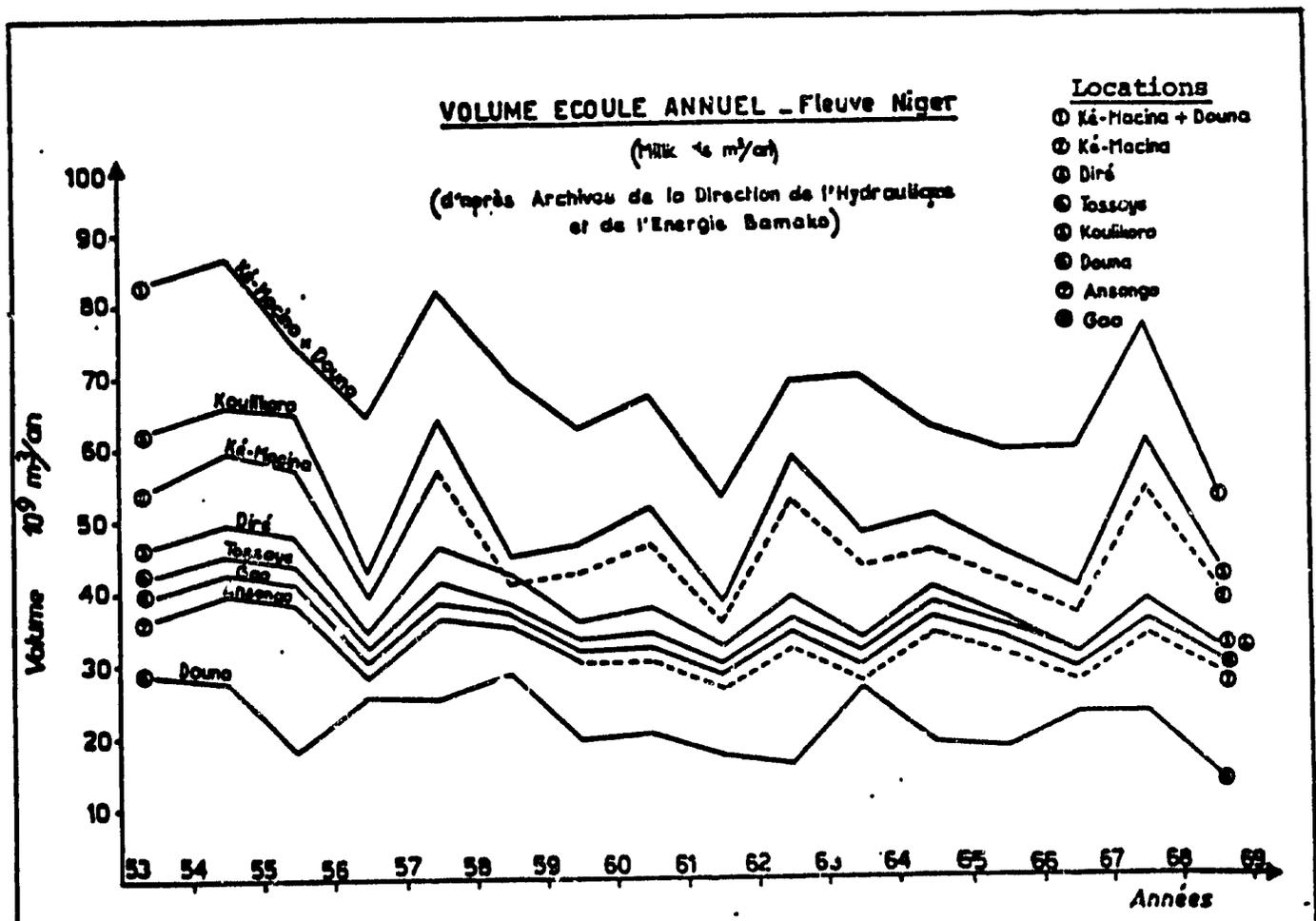
Streamflow data from the Senegal River illustrates the point. At Kayes, the Senegal River watershed is about 157,400 square kilometers. During the period 1903 to 1975, the average annual flow of the river was 62 cubic meters per second (cumecs) with a maximum recorded as 982 cumecs and a minimum of only 210. Within each year the fluctuation in streamflow is also great. At Bakel in Mauritania, some 40 kilometers downstream of the Malian border, streamflow in the Senegal at the end of the dry season (April to mid-June) generally declines to about ten cumecs.

The Niger River and its tributaries are the most important river system in Mali. Flowing from southwest to northeast and then southeast again in a great arc, the more than 1700-kilometer length of the Niger is divided into two navigable stretches by its fall over a sandstone outcrop below Bamako. The region around the southwestern section above the falls is known as the Upper Valley. The flow of the river in this section is managed to some extent with canals and simple barrages. In the Djo'liba region from Koulikoro to Samsanding north of Mopti, the river flows in a slightly confined valley, so that flooding is restricted. There are numerous water management schemes in this

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<sup>10</sup>source: Church. 1974.  
Europa. 1980.  
Gannett et al. 1979.  
Saad. 1970a, 1970b, 1971.  
Club du Sahel, CILSS. 1978.  
United Nations, Sudano-Sahelian Office. 1979.

section as well, and the area is intensively cultivated. The next reach of the river flows through the inland delta region, site of an old lake in pre-Tertiary times. This section is intensively managed by the Office of the Niger, with a dam at Sansanding and a network of irrigation canals. At Diarafabé the river divides, to rejoin again at Lake Débo. Water control in this section consists of modifying gaps and strengthening the banks of natural levees. From Lake Débo to Kabara, the riverport for Tombouctou, the Niger flows slowly in a network of streams and lakes. This is the region used for a mix of agriculture, pasture, and fishing following the inundation and recession of floodwaters. Above Kabara the Niger flows in a single stream again, making its great turn southward at Bourem to create the Niger Bend. The following graph summarizes annual streamflow volume of the Niger at several points on the river.



Legend: X-axis reads: Years  
 Y-axis reads: Volume, billion cubic meters per year.  
 Title reads: Annual Streamflow Volume at the Niger River  
 (billion m<sup>3</sup>/yr) (from the archives of the General  
 Directorate of Hydrology and Energy, Bamako.)

Source: Saad. 1971.

### 3.1.1.2 Groundwater

There are no deep aquifers in the southern part of Mali, and the surface alluvium that covers much of the region is too shallow to hold much water. Nonetheless, this surface layer is quite heavily exploited. It is recharged by runoff and direct rainfall. The only true aquifers in the south occur in fissures of the Combro-Ordovician sandstones of Koutiala, Sotuba and Sikasso and the pediment sandstones at a few other sites. Depth to a water table varies from only half a meter at Komakara (near Kilikomou) to 35 meters at Taotoma.

North of the Niger Bend and between Gao and the Mauritanian border, groundwater is found in the Continental Terminal aquifer in three distinct but interactive basins:

- 1) The Niger Bend basin, which is characterized by good quality water with satisfactory discharge. This portion of the aquifer is recharged by infiltration from the Niger River, to the extent of 5 billion cubic meters per year from the left bank and 2.3 cubic meters per year from the right. These estimates are of net recharge to the aquifer after deducting the water which returns to the river during floods. Depth to the water table varies from 17 to 74 meters. This zone, including Lake Faguibine, is favourable for exploration, and is already in considerable use.
- 2) The southern Azaoud basin, which lies between the Tilemsi Valley and the Azaoud ridge in the west. The water in this basin is of high quality, but receives only very little recharge from the Tilemsi drainage and from occasional rainfall on the outcrops of the Continental Intercalary aquifer in the north. The latter source of recharge has not been quantified; the recharge from the Tilemsi is estimated at 2.2 million cubic meters per year. This zone is not recommended for groundwater exploitation.
- 3) The northern Azaoud basin, which is delimited by the Azaoud ridge and runs northwest. This basin receives some 37.2 billion cubic meters of recharge per year, but the water quality is very poor and highly saline. It is not recommended for exploitation.

(  
In the Gao region of eastern Mali, there are three important aquifers: the Continental Intercalary, the Cretaceous, and the Continental Terminal. The recharge and storage of these aquifers is considerable, and would support substantial agricultural and livestock improvements in this hitherto little-developed region.

The Continental Intercalary aquifer is some 1500 meters thick. Its water table varies from 395 meters above to 400 meters below sea level in a lateral distance of 350 kilometers. The aquifer surfaces in the plains of Ténéré and l'Irhazer, in a portion of the Tégama, and in the Tilemsi Valley and receives some recharge from rainfall on these outcrops. However, its most important source of recharge is the Air massif in Niger. Recharge is estimated at 116 million cubic meters per year, and storage at 740,000 cubic meters per square kilometer of one meter's depth. Water quality is generally good, with less than 720 milligrams of salts per liter.

The Continental Intercalary aquifer is little known east of the Adrar des Iforhas range, but there are indications that the aquifer may be artesian in that zone.

The Cretaceous aquifer is about 400 meters thick and closer to the surface than the Continental Intercalary. Recharge amounts to about 65.3 million cubic meters per year. Quality of the water varies widely, from 400 to 5,000 milligrams of salts per liter. South of the Adrar des Iforhas the aquifer is fairly close to the surface and the water quality is reasonably good. This zone is recommended for exploitation. West of the Adrar des Iforhas especially in the Tilemsi valley, exploration may be warranted if zones of sweet water can be located.

The most heavily used aquifer of the three is the Continental Terminal, which occupies a large area west and south of Adrar des Iforhas. Recharge is partially from infiltration from the Niger River and partially from an area southwest of the Adrar des Iforhas. Due to the thin permeable layers of the aquifer, recharge is only about 839,000 cubic meters per year. Water quality varies depending on the zone of recharge. South and southeast of the Adrar des Iforhas, the water is sweet, but to the west and north saline content is around 5,000 mg/liter. In addition to the water quality problems, this aquifer yields its water at the very low rate of one cubic meter per hour per meter of depth. These constraints limit use of the aquifer to wells to satisfy the needs of nomads and grazing animals.

### 3.1.2 Fisheries <sup>11/</sup>

The fisheries sector is third in importance in the Malian economy after agriculture and herding. Annual production amounts to some 112,000 tons on the average. Domestic consumption accounts for more than 65,000 tons of fresh fish per year, and about a third of the annual production is exported to the Ivory Coast, Ghana, and Upper Volta in the form of smoked and dried fish.

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<sup>11</sup> Source: Club du Sahel, CILSS. 1978.  
United Nations, Sudano-Sahelian Office. 1979.

Ninety percent of the fish produced in Mali comes from the Mopti region, where the Niger and Bani Rivers flood the great delta during the rainy season. The Senegal River fishery accounts for most of the balance, including some saltwater species that arrive with the seasonal seawater intrusion. Fishing in Mali is due to undergo some great changes associated with CMVS Project. (see Section 4.1.1).

### 3.1.3 Water Regulation<sup>12/</sup>

Specific legislation pertaining to water is listed in Appendix I.

Virtually all waters are considered to be in the public domain, including groundwater. Exceptions are rainwater, which may be collected in cisterns, and springs or wells on private land. Private waters are regulated by the Civil Code. Privately owned waters may change hands through sale, inheritance, gift, or by way of any lawful contract. Public waters, on the other hand, may not be appropriated, and the right to their use is subject to the prior authorization regime. However, this law is not always honored in some of the more remote parts of the country, where water users act as owners.

Although not legally specified, the order of priority in water uses is generally

- 1) drinking water supplies;
- 2) animal watering and irrigation; and
- 3) industrial and recreational uses.

The government may expropriate private waters if this private use is seen to be contrary to the public interest.

Water concessions are granted by the governmental authority to a particular person for an approved, specific purpose and for a period of no more than 25 years. The grantee must abide by the terms of the concession, which include provisions reserving third-party rights, a fixed term for the concession, and a clause of cancellation. The authorization may be cancelled by the administration for breach of contract or in the public interest.

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<sup>12</sup>Source: Caponera. 1978.

There are no taxes on water, but urban water users pay for delivery at a rate not to exceed a maximum set by the government. The concessionaire of a public water distribution service is neither morally nor financially responsible for any epidemics or damage resulting from poor quality of water distributed, unless ill will or faulty service is involved. In fact, drinking water has never been legally defined in Mali as to "fitness." It is estimated that in 1975, only 9% of all Malians had access to water that would be termed "potable" by WHO standards.<sup>13/</sup> Protection of water quality is limited to (1) requiring a protected zone to be set up around any well sunk on public land, and (2) prohibiting the discharge of noxious materials or litter into a public watercourse.

A high degree of cooperation exists between Mali and its neighbouring states, which are drained by the Niger and/or Senegal Rivers. Navigation and transport on the Niger River is governed in part by the Niger River Commission. Through its participation in the trilateral Organization for the Development of the Senegal River (OMVS), Mali has committed itself to joint management of that river with Senegal and Mauritania. Member states of the OMVS must approve any change in use of the Senegal River that is likely to affect other partners in the Convention.

## 3.2 Soils

### 3.2.1 Description

Southern Mali is included in the Interafrican Committee for Hydraulic Studies (CIEH) assessment of the resources of the savanna region of west and central Africa.<sup>14/</sup> The CIEH report is primarily concerned with the classification of soils by their productive potential when used for range or agriculture. There are five classes in the system, defined as follows:<sup>15/</sup>

Class 1: Generally good soils. These soils do not have any serious limitations, and are able to produce good yields of suitable climatically adapted crops.

Class 2: Generally moderate to good soils having slight to moderate limitations which may restrict their use. Yields of climatically adapted crops are moderately good.

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<sup>13</sup>Source: U. S. AID. 1980.

<sup>14</sup>Source: Interafrican Committee for Hydraulic Studies. 1978.

<sup>15</sup>Source: *ibid*, pp. 6-16 and 6-17.

Class 3: Generally poor to moderate soils. These soils have one or more limitations of moderate intensity, are usually of fairly low natural fertility, and generally give low to moderate yields of climatically adapted crops under traditional systems of management.

Class 4: Generally poor soils. These soils have moderately severe to severe limitations and, under traditional systems of management, give generally poor yields.

Class 5: Soils generally unsuited to cultivation, though sometimes locally suitable for rough grazing or other extensive uses. They suffer from limitations which are generally severe enough to exclude cultivation, such as shallow depth, steep slope or very unfavorable soil reaction (extreme acidity or salinity/alkalinity) virtually preventing crop growth unless improved.

It should be noted that the capability classification of the soils assumes traditional cultivation practices.

Soils of capability Class 1 are hydromorphic. They are formed in damp conditions, and occur in Mali mainly along the Senegal River, along the Niger River between Segon and Tombouctou, and along the Bani River and its tributaries. There are many smaller pockets of hydromorphic soils in the country as well, often developed in local alluvial deposits.

Class 2 soils are also hydromorphic, but their productive potential is lower than that of Class 1 soils due to some moderate limiting factor, such as acidity, a substratum of sand, or some other negative trait. The substantial occurrence of Class 2 soil in Mali is an area about 210 km long and 75 km wide at its widest point, beginning some 55 km south of Bamako.

Class 3 soils are primarily Tropical Ferruginous Soils, and Ferralitic Soils that have been desaturated to a greater or lesser degree. The former are typical of moderately dry savanna areas; slightly desaturated Ferralitic Soils are found in more humid savanna areas.

Soils in Class 4 fall into two groups that are complete opposites in terms of texture. The first group contains sandy, light-textured soils classified mainly as Immature Soils, Reddish-Brown Semi-arid Soils, and Tropical Ferruginous soils that overlie wind-deposited sands. These soils are very common in the northern part of the area mapped by the CIPII, and it is assumed that Class 4 and Class 5 soils extend into the wedge of Sahel and desert that occupies the northern half of Mali.

The second group of soils in Class 4 are Vertisols, heavy-textured and tending to develop deep cracks when dry. It is believed that these soils are of limited distribution in Mali.

Class 5 soils are either loose shifting dune sands, shallow lithosols, or saline soils. Most of the Malian Sahara falls into this class, and there are several occurrences of Class 5 soils in the west of the country as well. One long lens of it runs roughly 600 km from northeast of Bamako to the southwestern border.

### 3.2.2 Regulation of Use

Soil erosion control is addressed legislatively by laws regulating land use in general. Owners of woods and forests may not be allowed to clear their lands if that action is expected to result in soil erosion and/or flooding. Brush-burning and pastoralism are also subject to legislative control. (see Appendix I).

## 3.3 Vegetation

### 3.3.1 Description

Throughout the following discussion, please refer to the vegetation map (fig. 3.1). Vegetation type numbers and designations are taken from the IUCN classification of West and Central African biotic communities.<sup>16/</sup>

#### #11: Sudanian *Isoberlinia* Woodland

These open stands of trees, 8 to 20 meters tall and with a 40 percent canopy cover, occur in the most humid part of the country. The woods are dominated by the endemic *Isoberlinia doka* and by *I. tomentosa*. *Monotes kerstingi* occurs on sandy and eroded slopes and *Uapacatogoensis* on low hills or slopes of ironstone boulders. *Daniella oliveri*, *Burkea africana* and *Erythrophleum africanum* are other members of the community.

#### #12: Sudanian Undifferentiated Woodland

This type occupies an area of the country that has undergone centuries of cultivation, woodcutting, grassfires and grazing. The woods remain only on rocky hills and ironstone plateaus. Larger trees are 8 to 12 meters high. They include *Anogeissus leiocarpus*, *Balanites aegyptica*, *Lanea microcarpa*, *Prosopis africana*, and *Sclerocarya birrea*. The shorter trees, about 6 meters tall, are mainly *Combretum glutinosum*, *Strychnos spinosa* and *Terminalia avicennioides*. Both types of Sudanian woodland are much degraded. They are often called "savanna".

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<sup>16</sup> source: IUCN. 1979.

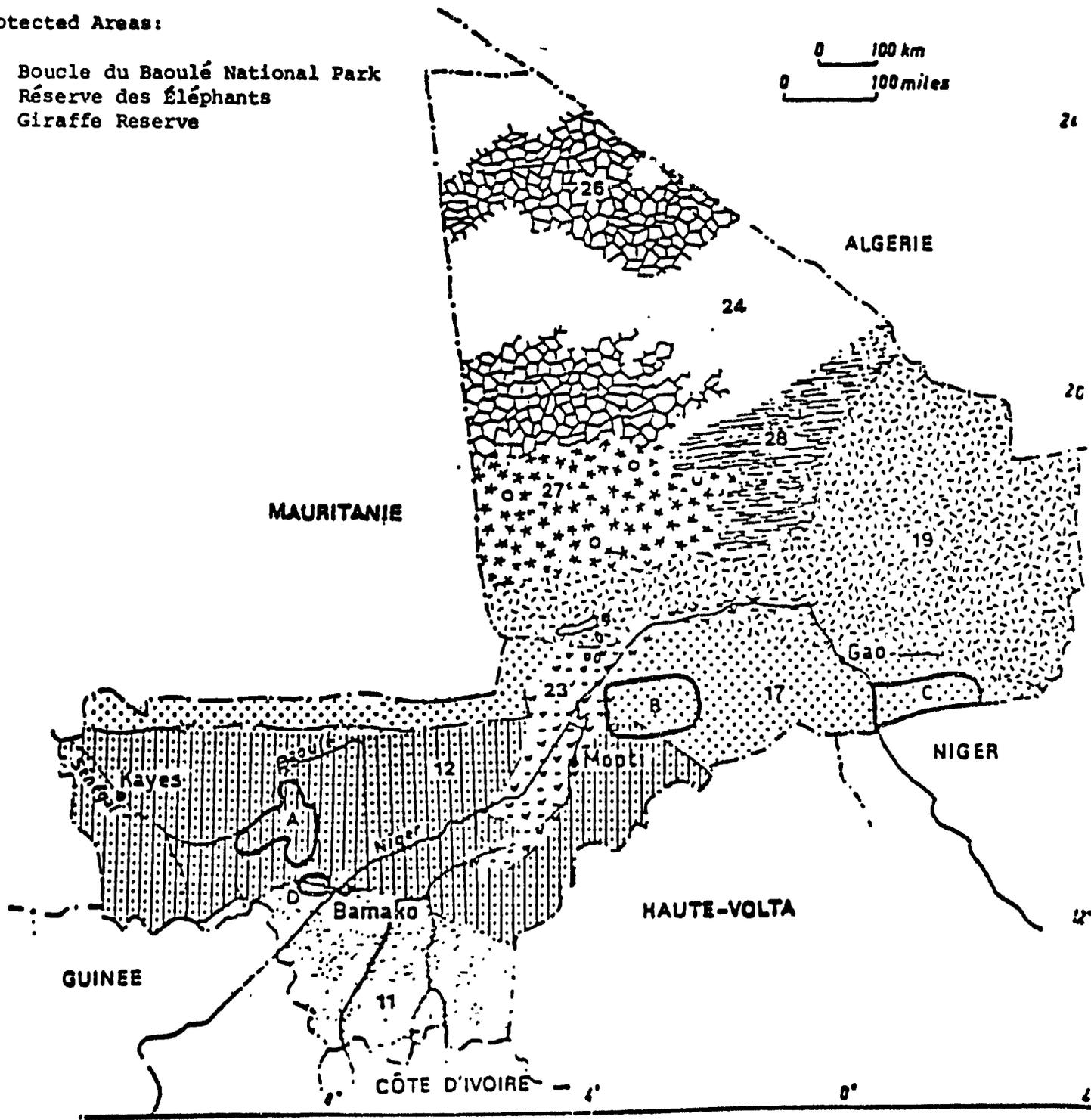
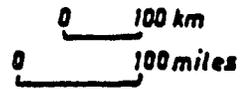
Figure 3.1

**Vegetation Types.**

**Protected Areas:**

- A: Boucle du Baoulé National Park
- B: Réserve des Éléphants
- C: Giraffe Reserve

**MALI**



Source: IUCN. 1979.

#17: South-Sahelian Zone and 19: North Sahelian Zone

Together these form the climatic grassland that is found in the Sahel transition zone and in the southern fringe of the Sahara. This biotic type is an association of grasses and shrubs, with the woody species prevailing on stony substrates and at the edges of wadis.

The climatic grasslands form the extensive but fragile grazing lands of the country. In the South-Sahel zone, the hay pasture types include:

- a) *Aristida mutabilis*/*Eragrostis tumula*;
- b) *Schoenefeldia gracilis* on loamy sands, which provides excellent pasture but is sensitive to drought; and
- c) *Aristida pallida*, of low grazing value.

Trees in the region are also valuable for fodder, both for livestock and for wildlife. *Balanites aegyptica* and *Maerua crassifolia* are the most important evergreens, and can be the only source of food for grazing animals during the dry season. *Acacia raddiana* and some other species keep their leaves for at least part of the dry season. Deciduous species include *Commiphora africana*, *Grewia* spp., *Zizyphus* spp., *Cordia rothi* and *Combretum aculeatum*.

Desert grasslands on sands are dominated by the bunchgrasses *Panicum turgidum* and *Stipagrostis pungens*. Woody species include *Acacia senegal*, *Balanites aegyptica* and *Commiphora africana*.

In the North-Sahelian zone, *Panicum turgidum* is also a major type. It is the principal food of the addax and oryx and is much sought-after by pastoralists for their flocks. *Cyperus conglomeratus* predominates on poor soils and is a low-quality fodder. *Aristida longiflora* is a sub-desert grass that retains its nutritive value even when dry. Finally, *Aristida acutiflora*, along the desert fringe, makes good fodder for camels, gazelles and addax.

Trees and shrubs in the North Sahel grow only on the edges of wadis. Principal species are *Zizyphus mauritania*, *Acacia raddiana*, *Balanites aegyptica*, *Maerua crassifolia*, and *Combretum aculeatum*.

#23: Edaphic Grasslands

This community occurs on the heavy clay soils of the seasonally flooded valleys and floodplains of the Niger River. The grasses form dense stands up to 3 meters high. Species are *Hyparrhenia cyanescens*, *Beckeropsis cuniseta*, and *Pennisetum polystachrum*.

Trees, widely spaced in the grassland, include *Terminalia macrocarpa*, *T. glaucescens*, and the fan palm *Borassus aethiopicum*.

Vegetation types #24 through 28 are Saharan biotic communities. The plants and animals which survive in this zone are adapted to the most extreme desert climatic conditions in the world. Daily fluctuation in temperature can exceed 35°C, and temperatures vary annually by 60°C or more. Parts of the Saharan wedge of northern Mali receive virtually no rain. These regions are denoted by the blank areas on the vegetation map numbered #24, which represent absolute desert, and #26, which indicates desert dunes without vegetation.

#### #27: Desert Dunes With Vegetation

The sand deserts of the Sahara, called "ergs", may bear a flush of grass after a heavy rain. This ephemeral growth, mainly *Stipagrostis pungens* and *Cornulaca monochantha*, may provide 50 percent ground cover for a time. However, some dunes remain completely sterile.

#### #28: Vegetation of Regs, Hamada, and Wadis

In addition to the ergs described above, the Saharan topography is characterized by "regs", or gravel deserts. The ergs and regs form in depressions with no outward drainage. Between these depressions, a stony desert called "hamada" develops stratified terraces crossed by dry valleys (wadis). The distribution of vegetation of regs, hamadas, and wadis is indicated on the map by #28.

The sandier regs give rise to a cover of xerophytes such as *Danthonia forskalii*, *Plantago ciliata* and *Polycarpa fragilia*. On the stony hamada, *Forskalea tenacissima*, *Astericus graveolens*, *Salvia aegyptica* and *Reseda villosa* will grow in rock crevices and cavities that hold water. The only woody vegetation occurs in the wadis, and consists of *Tamarix* communities in the larger sandy wadis and *Acacia* communities on the rocky beds of wadis and on the gravelly alluvium of outwash fans.

### 3.3.2 Legislative Protection of Flora

Woodlands are quite specifically protected whether in reserves, on state or on private land by making all forest exploitation subject to control by the Water and Forest Service. Certain tree species are totally protected. However, judging from the data available on the rate of devegetation in Mali (see Section 4.2.1), these protective laws are forfeited to the immediate needs of local people for fuelwood and fodder. Refer to Appendix I for pertinent articles of legislation.

### 3.4 Wildlife and Protected Areas<sup>17/</sup>

#### 3.4.1 Description

Although some species of wildlife exist outside of designated reserves in Mali, and the protected status of such reserves is moot, the two topics are best considered together, since the survival of native fauna is dependent on the survival of its habitat.

The Boucle du Baoulé complex of reserves is located to the northwest of Bamako in the Sudanian woodland biotic community. The component reserves of the complex are:

Bouclé du Baoulé National Park	350,000 ha
Fina Faunal Reserve	136,000 ha
Badinko Faunal Reserve	193,000 ha
Kangosombougou Faunal Reserve	<u>92,000 ha</u>
	771,000 ha

The flora and fauna of the reserves is quite rich. The main vegetation types of the area have been described in Section 3.3. Some of the outstanding fauna includes Anubis baboon, vervet, and patas and other primates (chimpanzees occur in the western corner of the country, but not within the reserves); lion, leopard\*, cheetah\*<sup>18/</sup>, civet, spotted hyena, common and side-striped jackals and other carnivores; warthog, giraffe, giant eland\* (in the Fina Reserve), bushbuck, roan antelope, various kobs, red-flanked duiker, oribi and other ungulates. The whole region is reported to contain several hundred elephants. There is a great variety of bird life, including many migratory species.

Also in the Sudanian woodland biotic type, in the Mouts Mandingo zone between the Baoulé complex and Bamako, there are several forest reserves:

Kémélbaoulí Forest Reserve	67,500 ha
Talikourou Forest Reserve	13,900 ha
Nafadji Forest Reserve	43,000 ha
Bossofola Forest Reserve	<u>12,000 ha</u>
	136,400 ha

This region is the habitat of buffaloes and the giant eland.

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<sup>17</sup> Source: IUCN. 1976.  
IUCN. 1979.  
Sayer. 1977.

<sup>18</sup> Animals indicated with an asterisk are endangered or threatened species.

In the Faya-Sousan zone, still in Sudanian woodland, there are three reserves:

Faya Forest Reserve	80,000 ha
Banifing-Baoulé Forest Reserve	13,000 ha
Sousan Faunal Reserve	<u>37,600 ha</u>
	130,600 ha

The Sahel zone contains two nominal reserves: the 1.2 million-hectare Réserve des Éléphants northeast of Mopti, and the Ansongo Menaka Partial Faunal Reserve (Giraffe Reserve) of 1.75 million hectares, southeast of Gao. The Réserve des Éléphants harbors small populations of red-fronted, dorcas and dama gazelles, konigum, topi, lions, and ostriches, but the elephants are the most notable. They are believed to have suffered heavily in the drought.

The Giraffe Reserve actually has no legal protected status. The "Reserve" designation dates from a period from 1958-1963 when it was made a "temporary wildlife refuge". Before the drought, there were some 150 to 175 giraffes in the area, as well as topi and dama gazelle.

In the rugged Adrar des Iforhas range in the Saharan zone of northern Mali, there are populations of barabary sheep, three species of gazelle, topi, and possibly oryx. Addax and oryx survive in the northern desert plains, but are under heavy pressure from poaching, both for food and for sport. The Adrar des Iforhas animals appear to be secure for the time being because of the difficulty of access to their home range. The plains-dwellers, however, are likely to be exterminated unless some strong protective measures are undertaken on their behalf.

One other important and unique wildlife habitat in Mali is the Niger flood plain, with its characteristic floating pastures. The West African manatee and hippopotamus are found in this zone, and it is an important wintering area for palearctic ducks. To date there is no reserve in the region.

#### 3.4.2 Laws Regarding Wildlife and Protected Areas

Wildlife protection in Mali dates back to 1938 to ratification of the International Convention for Protection of African Flora and Fauna, and now recent legislation regulates hunting and specifically bans killing of specifically protected animals. However, there are very few authorities with meagre resources to enforce these regulations, and poaching both for food and for sport is generally acknowledged to be widespread. Appendix I lists pertinent legislation.

## 3.5 Minerals<sup>19/</sup>

### 3.5.1 Description

Mali's mineral industry is in its infancy, but the potential exists for development. At present, the only important extractive operations are the marble quarry at Bafoulabe and limestone quarrying at Diamou. The latter goes to the cement industry, which produced 49,000 metric tons in 1976. The long-established salt mines in the north produce some 5,000 metric tons per year.

Gold mining was begun recently at Kalama, with Soviet aid. West German and Japanese companies have contracted with the government for exploitation of radioactive materials. The governments of Mali and Senegal are planning joint explorations for iron ore. Malian iron reserves are estimated at greater than 3.5 billion tons of 50 percent grade ore. Petroleum and manganese explorations are also in progress. Manganese reserves are estimated to be in excess of 3.5 billion tons of about 45 percent grade ore. Other mineral resources include:

bauxite - reserves estimated at 800 million tons, with a 40 percent aluminum content and less than 4 percent silicon dioxide; and

phosphates - about 20 billion tons of reserves with an anhydrous phosphate content of 28 to 30 percent. The Malian phosphate has been tested for its use in agriculture<sup>20/</sup>, and that from Tilemsi has been found to be an effective fertilizer.

Indications of lithium, calcium, kaolin, copper, tin, zinc, lead, and diamond reserves have also been found. Locations of some of these reserves are indicated on the following map.

### 3.5.2 Mining Law

Permits for mineral exploration and mining are issued by the Ministry of Mines, and mines are owned by the State. Quarries, on the other hand, may be privately owned. Production licenses are granted by Decree for 25 years with 10-year renewal options. Net profits are taxed by 50 percent except in the case of petroleum and natural gas, in which the regulations seem to be negotiable. Refer to Appendix for specific legislation.

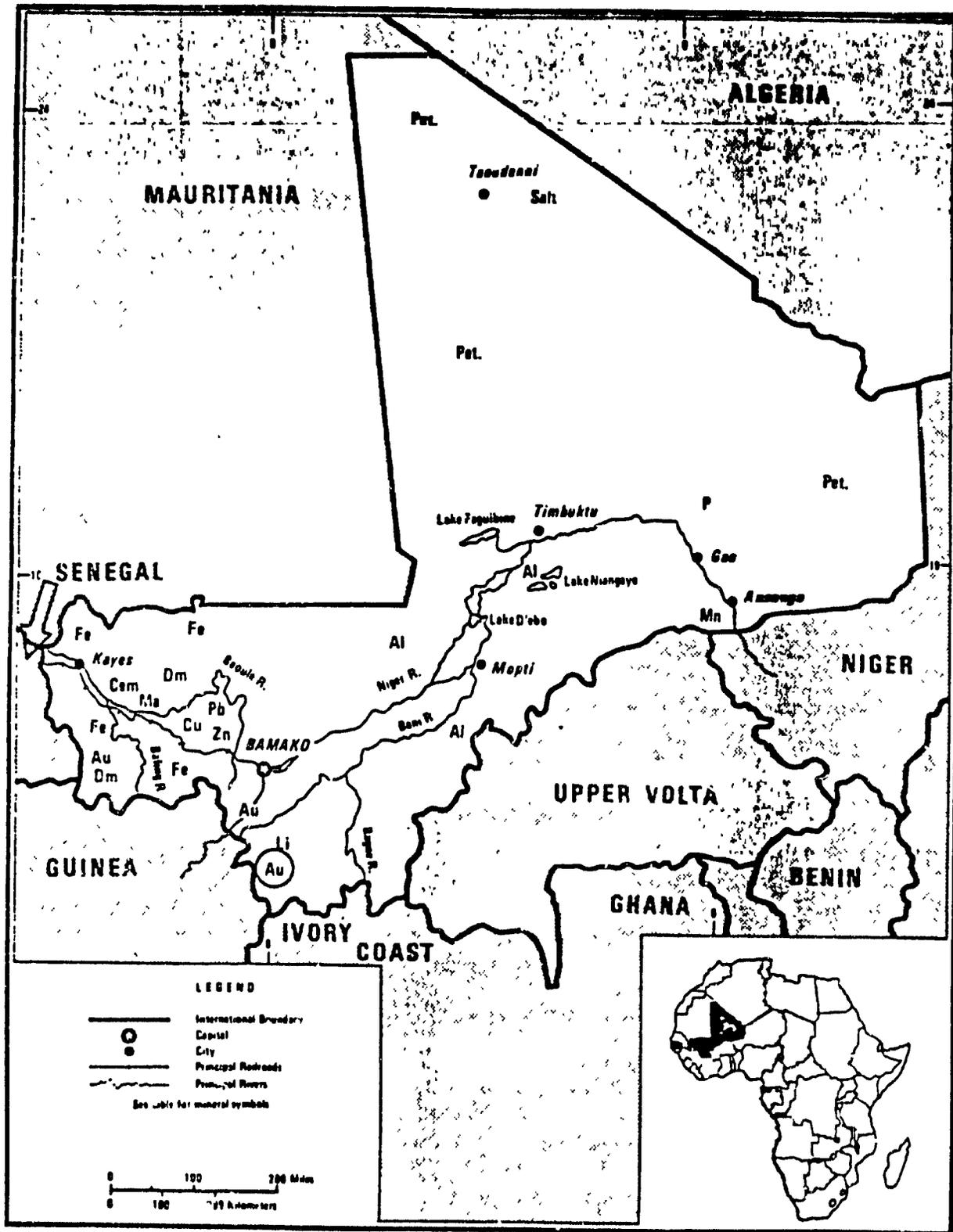
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<sup>19</sup>Source: U. S. Bureau of Mines. 1976.  
Europa. 1980.  
United Nations, Sudano-Sahelian Office. 1979.

<sup>20</sup>Source: Jenny. 1973.  
Truong B. et al. 1978.

# MALI

AREA 1.2 Mill. Sq.Kms.



Source: U.S. Bureau of Mines. (1976).

Cem: cement	Pet: petroleum
Ma: marble	P: phosphates
Pb: lead	Al: aluminum (bauxite)
Cu: copper	Mn: manganese
Zn: zinc	Fe: iron
Au: gold	Dm: diamonds
Li: lithium	

## 4.0 Environmental Problems and Environmental Projects

### 4.1 Water Resources

The most important water resources in Mali are the two river systems of the Senegal River and the Niger River. Groundwater supplies are generally limited and poor in quality except in the Niger bend region and the Gao region (see section 3.1.1.2).

The Niger River has been managed fairly intensively with water management systems along much of its length and a dam at Sansanding. Selingiré Dam on a tributary of the Niger is the major project planned for the Niger basin. Its cost is estimated to be \$139 million US. The dam will provide electricity for Bamako, increase irrigated acreage, and improve river navigation.

The major water resource development project in Mali involves the Senegal River and is discussed below.

#### 4.1.1 Organisation pour la Mise en Valeur du Fleuve Senegal (OMVS)<sup>21/</sup>

The OMVS was created on March 11, 1972 by its member states Mali, Mauritania, and Senegal. It is responsible for the development and execution of projects which utilize the resources of the Senegal River Basin (SRB). OMVS has been given a degree of autonomy and resolutions adopted by its Council of Ministers are binding on member countries.

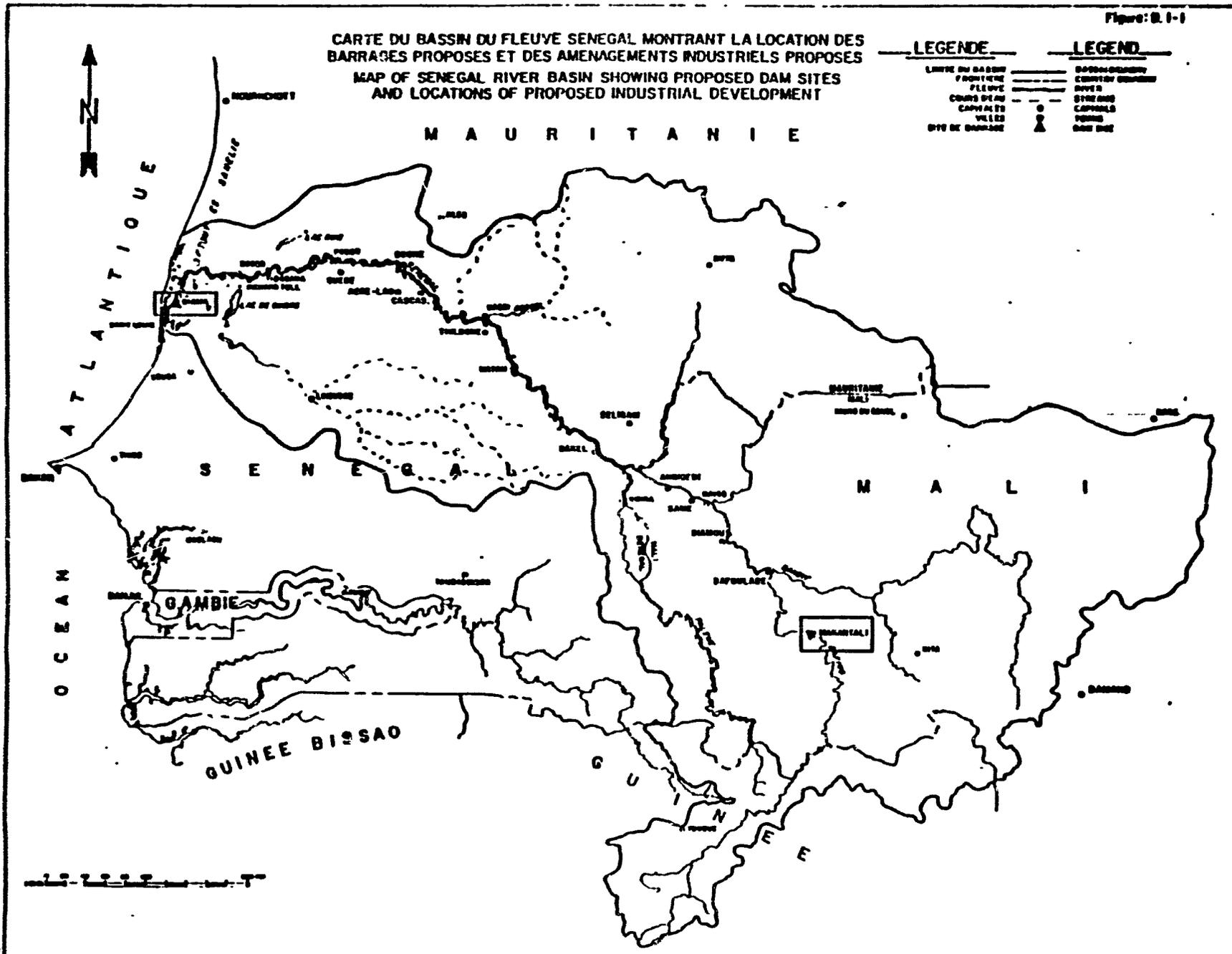
The planned development of the SRB involves the construction of dams at Diama, Senegal and Manantali, Mali, and development of a deep-water harbor at Saint-Louis, Senegal with a navigation system developed as far up-river as Kayes, Mali (see Map 4.1). Development of 255,000 hectares of irrigated agriculture is planned along the river valley in combination with extensive industrial development. The Diama dam has as its primary purpose the prevention of saltwater intrusion upstream during the dry season. The Manantali Dam will provide hydroelectric power, augment low dry season flow to allow navigation of the river, and supply water for perennial irrigation in the valley.

The development of the Senegal River as a transportation artery is expected to give impetus to the development of the basin. Proposed industrial development in Mali associated with the OMVS plan includes breweries, cotton mills, lime processing, peanut oil refineries, rice and sugar cane processing, and shoe and textile factories. Mining activities are projected to begin extraction of major deposits of iron ore, magnetite, and bauxite.

Such extensive development will have a number of environmental impacts. The impact on the water quality of the Senegal River

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<sup>21</sup> Source: Gannett, Fleming, Corddry and Carpenter, Inc. and ORGATEC Societe Africaine d'Etudes Techniques (Dakar, Senegal). 1979.



Source: Gannett, Fleming, Corddry and Carpenter, Inc. and ORGATEC Société Africain d'Études Techniques (Dakar, Senegal). 1979.

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and groundwater in the area is potentially great. The use of pesticides and of fertilizers is expected to increase groundwater pollution, so wells will need to be monitored carefully in the region to prevent irreversible damage. The Manantali Reservoir will experience thermal stratification for most of the year, resulting in limited mixing of the water column. As a result the dissolved oxygen concentration at various depths will be reduced and hydrogen sulfide and dissolved nutrient levels increased. These nutrient-rich waters discharged downstream could result in fish kills and algae blooms. However, careful management of fertilizers and industrial wastes should avoid damage to water quality.

Development of the basin is expected to bring about an increase in population due to immigration. It is anticipated that employment will be available for this increased population. However, the problems inherent in an increase in population will be difficult to avoid. Disruption of present social and cultural patterns by the population increase could be a serious problem.

The building of the two dams will have a great effect on the fishing in the SRB. Present production is about 30,000 tons per year. Most of the fish are harvested during the flood season, although a smaller amount are saltwater species harvested during the dry season when extensive intrusion occurs. The dam at Diana will eliminate this latter harvest but improved habitat in the reservoir and an almost constant river flow are expected to improve the overall fish yield.

Disease in the SRB is presently a serious health problem. Major diseases include malaria, onchocerciasis, tuberculosis, and leprosy. Malaria is a particularly serious problem. In the upper basin infection rates run from 50 to 74 percent or more. In this area children under the age of two may have a mortality rate of 10 to 15 percent due to malaria alone. The construction of the Manantali Dam is expected to increase the malaria problem. Onchocerciasis will become more of a problem below Manantali Dam with the perennial river flow, but World Health Organization blackfly control programs should help the situation.

Urinary schistosomiasis, which is transmitted by Schistosoma haematobium, is endemic throughout the SRB. However, it is not considered to be a major disease problem at present. The expansion of irrigation canals may lead to an increase in schistosomiasis transmission. Currently transmission does not occur in the irrigation canals in the SRB, so an increase in schistosomiasis is not expected but is considered possible. There is no evidence that S. mansoni, which causes the intestinal schistosomiasis that has been so devastating elsewhere, occurs in the SRB.

The dam at Manantali will inundate about 500 square kilometers of woodland. Resettlement of the 13,000 people whose villages will be flooded will destroy about the same amount of woodland. However, much of this will be replaced by new riparian habitats along the stabilized river. The effect on wildlife is discussed in section 4.3.

## 4.2 Devegetation and Soil Loss <sup>22/</sup>

### 4.2.1 The Problem

The loss of vegetative cover and soil in semiarid zones proximal to deserts has been termed "desertification". This process affects virtually all of Mali, but especially the Mopti and Gao regions.

Desertification appears to begin with years of anomalous high rainfall developing better-than-usual pasturage and good crop yields, which encourage farmers and pastoralists to increase the size of their herds and the extent of their fields. Then come the dry spells and the productive capacity of the land is reduced, while still being called upon to support the same use levels as it did with greater rainfall. Grazing animals strip grasses and shrubs and even tree foliage, and the reproductive ability of the remaining plants is greatly impaired. The farmers of marginal fragile lands shorten fallow periods and mine the soil nutrients until they are spent, then leave the field prey to wind and water erosion. The dry "harmatan" wind does particularly great damage.

Fires are set to improve pasturage and to clear agricultural residues. Burning provokes considerable soil destruction and can damage woodlands when the fires escape from control.

Loss of forest area from uncontrolled brushfire damage is apparently less important than from fuelwood demand, however. Wood is the primary source of energy for the Malian population. With a consumption rate of about 360 kilograms per person per year in the cities and 270 kilograms per person per year for rural dwellers, total firewood requirements are estimated at more than 1,700,000 tons per year.

The situation is most critical on the periphery of urban areas. Around Bamako annual demand is estimated at 200,000 tons, a figure that will rise to some 500,000 tons by 1990. Wood production figures run to about 250,000 tons per year, but transportation difficulties make it impossible to bring all of that wood to market. As a result the cost of firewood has risen some 15 percent per year for the last seven years. Other urban centers are in more arid parts of the country and their situation is even worse. In Mopti most of the fuelwood consumed goes to make charcoal for smoking fish. This industry has consumed the forest within 50 kilometers of the city, and firewood costs 40 percent more than

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<sup>22</sup>Source: United Nations, Sudano-Sahelian Office (UNSO). 1979.

in Bamako. Even in the well-watered south, forests have usually been cleared to a distance of two hours walk from any village of 1500 inhabitants. This loss of forest area is a major cause of soil damage. In arid regions, it opens the land to wind erosion. Under more humid conditions it allows the intense leaching and oxidation of the soil that results in the creation of sterile laterites.

#### 4.2.2 Remedial Measures

A strategy to counter desertification is not yet fully developed in Mali. However, the 1974-1978 Plan for Development includes a number of proposals that fall within the plan of action to combat desertification that was adopted at the United Nations Conference on Desertification in Nairobi in 1977.

Mali's anti-desertification activities are directed toward the three principal objectives of defense and restoration of soils, integrated development of pastoral zones, and reforestation.

##### Defense and Restoration of Soils

Soil conservation measures have been focused on lands particularly subject to erosion and lands that have already undergone some degradation due to present land use practices. A wide range of activities in this field are planned:

- a. inventory and mapping of the use and capabilities of soils;
- b. control of shifting agriculture by classifying 30 percent of the land as forests with protected perimeters;
- c. creation of silvo-pastoral reserves in border areas;
- d. development of management and administrative plans for border areas;
- e. education of the populace regarding anti-erosion techniques and improvement of cultural practices; and
- f. control of brushfires.

##### Integrated Development of Pastoral Zones

Integrated development is conceived of as a long-term solution directed toward the maintenance of the health of the arid and semiarid ecosystems that are so susceptible to desertification. Toward this end, studies of village and pasture water supplies are planned in view of the effect supplies have on the distribution of nomads and their herds. Improvement of the distribution of social services such as dispensaries and veterinary assistance to the pastoralists are also planned. Knowledge of water supplies should aid in this effort. Other planned activities directed toward the development of the pastoral lands include agrostological investigations, improved animal production techniques, and assistance in the commercialization of livestock raising.

## Reforestation

Reforestation activities are planned primarily to satisfy the needs for firewood in urban centers and secondarily for timber. Both dry and irrigated plantations are planned toward these ends. For rural firewood needs, the creation of village forests is proposed. Other activities include reforestation of border areas, plantations of gum trees in pastoral locations, research on the properties of savanna forests, and improved management of the remaining natural forests.

The planned activities listed above for soil conservation, pastoral development, and reforestation are envisioned as aiding in the reestablishment of the agro-silvo-pastoral equilibrium broken by a combination of man's activities and climatic effects in Mali.

### 4.2.3 Government Structure and Planning for Remedial Measures

The planning for anti-desertification activities is done by the planning cell of the Institute of Rural Economy.

At the operations level the Water and Soils Service provides the workers necessary for any activities. It has at its disposal the National Forest Fund, which receives revenues from the sale of wood and from fishing and hunting permits. The Fund is used for management and protection of the forests.

At the level of State Societies and Enterprises a 1977 committee was created to deal with problems of the environment, called the National Committee for the Protection of Nature. It is no longer functional, and a new plan (October 1979) is to create a High Council for the Protection of Nature and Wildlife.

United Nations Sudano-Sahelian Office, an arm of the United Nations Environment Program, is involved in the analysis of the problem of desertification in each of the Sudano-Sahelian countries and the planning of activities to counter desertification. Programs are developed in consultation with the governments of each country. Donor agencies are encouraged to contribute to the programs that are designed. Malian authorities used UNSO assistance in writing anti-desertification plans into the Plan for Development (as listed in section 4.2.2). The following table lists projects submitted to UNSO by the Malian government for aid in mobilizing resources necessary to execute them.

PROJECTS SUGGESTED BY MALI FOR UNSO FUNDING

Title	Description or Purpose	Estimated Cost in Millions of Malian Francs
Establishment of a national system of surveillance of the silvo-pastoral zone	Permit rational management of rangeland	912,847
Creation of village nurseries and plantations in ten villages	Lessen the effect of the harmattan, produce firewood , and reconstitute vegetative cover	332
Protection and restoration of soils	Balanced use of soils, monitor degradation of of ecosystems, and identification of activities to undertake	360
Management of the National Park of Bouclé du Baoulé and its adjacent reserves	Development of hunting tourism for the protection of fauna and flora; construction of necessary facilities	532
Reforestation around eight cities: Mopti, Tombouctou, Goundam, Gao, Gourma-Kararous, Bourem, Kidal, and Menaka	Production of firewood and other timber and protection of existing forests	8,396
Feasibility study of the development of livestock-raising in the lake zone	Restoration of village harimas, revegetation of bourgou ranges, and popularization of rational methods of exploitation of these pastures	to be determined
Integrated development of the Menaka-Ansongo-Talataye zone		to be determined
Training in remote sensing	Request for five scholarships	to be determined
Reinforcement of the means of operation of the General Directorate of Hydraulics and Energy	Pumping trials to better understand outputs of drilling and recharge of groundwater	400
Program for drilling equipment	Assistance of a specialist to install and maintain a certain discharge in chosen pilot areas	219

Title	Description or Objective	Estimated Cost in Millions of Malian Francs
Water points in Mali: studies on the mean discharge (2nd phase)	Extension of the above project to develop potable water supplies and irrigation for small farms	160
Creation of secondary bases of hydraulic operations at San and Dilly		to be determined
Construction of 185 water points in the sectors of Kayes, Yelimané, Nioro, Nara, and Bamomba	Meet drinking water needs	2,300
Unifying industrial production and solar energy equipment	Construction of solar collectors	to be determined
Improvement and maintenance of roads in the Sahel		8,000
Assistance in developing plans for settling farmers and anti-desertification activities, to be included in the National Plan for Social and Economic Development		to be determined

Current projects being coordinated by UNSO include the following:

1. Inventory of soil and water resources, with large-scale maps being prepared that detail the potential uses of soils, to be used in planning. Funded by U.S. AID and FAC (Fondes Français d'Aide et de Coopération) to the amount of \$3,283,000 US over three years, beginning April 1979.
2. Assistance to the Direction Générale de l'Hydraulique for the purchase of equipment, compilation and cataloging of all existing documents, and a terrain analysis study of 50,000 square kilometers. Canada and the FAC have funded this 4 year project to the amount of \$4,512,500 US.
3. Forage in the regions of Bagouin, Kolomdieba, and Yanfofla. In progress, and funded with Swiss aid to the amount of \$1,667,000 US.
4. Forage in the regions of Bamako and Ségou. In progress and aided by UNDP.
5. Forage in Gao, Ansongo, and Kidal. Funded by Japan at \$2,000,000 US.
6. Irrigating borders by pumping water from the Niger River in the Gao region. Objectives include a study of 1500 hectares of rainfed agriculture and 1500 hectares of irrigated agriculture in Gao, establishment of an agricultural research station, and formation of extension groups. Funded for 5 years by FAC, FED, and U.S. AID at \$3,528,000 US.
7. Irrigating borders (500 hectares) by pumping Niger River water in the Tombouctou region. The project will furnish 650 pumps to small groups of producers, provide support for extension activities, assure supplies for agricultural activities, and begin a program of training and applied research. Funded by U.S. AID for 1978-1982 at \$4,426,000 US.
8. At the border of Korioumá (Tombouctou region) the management of 600 hectares of wheat and sorghum using pump irrigation. Funded by Belgium at \$1,064,000 US.
9. Hydro-agricultural management of the plain of Diré, with 315 hectares to be completely irrigated and management regimes to be set up for the border regions, agricultural methodology trials, and the installation of a solar pumping station. Funded by FAC at \$3,250,000 US.
10. Applied research in pastoralism near Bamako and Nioro to improve the vegetation in those zones, to undertake soil analysis and planting trials for erosion control and forage

establishment, to observe the customs of nomads and the impact of animals on vegetation, and to make recommendations to improve the techniques of range management in the Sahel zone. Funded by the Netherlands at \$5,500,000 US to be completed in 1980.

11. Preparation of preliminary studies of range management activities in the Gao region. Near Gourma there is an agrostological study in progress and socioeconomic, hydrogeological, and faunal research is beginning. In Ansongo-Ménaka breeders cooperatives are being formed. Funded by FAO at \$750,000 US.
12. Preparation of a project for the development of small ruminant raising. Funded by U.S. AID at \$353,000 US.
13. Integrated development of pastoral zones of northeast Mali. Management of the entire Sahelian environment and progressive rehabilitation of the ecosystem. Funded by FED in the area east of Lake Faguibine at \$22,500,000 US. Saudi Arabia, UNDP, and FAO will be funding the project in the area between Lake Faguibine and Nara. Saudi Arabian investments will total \$13,000,000 US. UNDP is financing technical assistance on behalf of the Central Institute of Planning of Mali.

The following table lists several other projects that have a direct or indirect effect on the environment in Mali.

**PROJECTS WITH A DIRECT OR INDIRECT EFFECT ON THE ENVIRONMENT IN MALI**

<b>Project Description</b>	<b>Funding in Millions of Malian Francs</b>	<b>Sources of Funding</b>
Ranch at Yanfoliba	1,490	FED
Southern Mali	2,400	Submitted to FED, which could finance a more reduced project of livestock pasture to profit small herders, and to raise draft animals
Pastoral zone of Dilly, pasture workshop -of the High Valley of Segou, of Baguineda, of Tienfala, and of Doukoloma	2,240	U.S. AID
Pastoral zone of Mopti	2,450	IBRD
Pastoral zone of east Nara and Kayes-Nioro	2,990	Saudi Arabia
Pasture workshop at Gao	390	Libya
Pasture workshop at Nioro	1,160	Submitted to FED
Improvement of bourgou fields in the 5th Region	1,000	Experimental project of the IBRD; extension of the project has been solicited
Improvement of leathers and skins	640	Equipment Fund of the UN
High Valley dairy project	50	U.S. AID
Baguineda dairy project	230	FAC
Sotuba dairy project	10	PAM

#### 4.3 Wildlife and Protected Areas <sup>23/</sup>

Some indication was given in section 3.4 as to the problems of protecting wildlife and protected areas in Mali. Sayer <sup>24/</sup> points out that human settlement in West Africa is largely limited to regions with rainfall between 400 and 800 mm annually, or along the Niger floodplains for livestock, millet, and peanut production. Only a few nomadic pastoralists can utilize the huge area north of the Niger. Settlement in the more humid areas is limited by the occurrence of onchocerciasis and trypanosomiasis. Wildlife generally occurs outside the areas of human settlement, and game parks and reserves are set up around these areas. Many reserves in West Africa are located very close to the 900 mm rainfall cline. This is close enough to the existing cultivated areas that pressure for increasing agricultural and livestock production are causing movement of these activities into the reserves. If these activities are not carefully managed the reserves are unable to maintain their goal of conserving natural fauna and flora. All of the reserves in Mali have agricultural and/or pastoral activities and cutting of fodder and firewood within their boundaries.

Poaching has had a severe impact on reduction of wildlife numbers. There are undocumented but consistent reports that even into the 1960s the Sahelian ungulates (addax, topi, korrigum, antelopes, and gazelles) were quite numerous. The open country facilitates hunting from vehicles, and the fact that herds of these animal do not disperse when chased makes them vulnerable to sport hunters. Hunting by traditional methods most certainly has a minor impact by comparison.

Wild ungulates are competitors with livestock for the scant resources of the Sahel. However, in the opinion of one expert <sup>25/</sup>, if hunting were reduced it would probably be possible for most of the ungulates to coexist in small numbers with domestic stock. Protection of the wild ungulates at this stage would later give Mali the option of exploiting them for meat, for tourism, or for controlled sport hunting.

A different threat to wildlife is posed by the Manantali Dam associated with the OMVS development <sup>26/</sup>. The dam will inundate 500 square kilometers of savanna woodland and riparian habitat, and resettlement of the population will make approximately the same amount of land uninhabitable for wildlife. Fauna in the area to be flooded includes small game ungulates such as orim, bushbuck, and red-flanked duiker, as well as other small mammals and reptiles. During filling

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<sup>23</sup> Source: IUCN. 1979.  
Sayer. 1977.

<sup>24</sup> Source: Sayer. 1977.

<sup>25</sup> Source: Sayer. 1977.

<sup>26</sup> Source: Gannett, Fleming, Corddry and Carpenter, Inc. and ORGATEC Societe Africaine d'Etudes Techniques (Dakar, Senegal). 1979.

of the reservoir most of these animals will drown, and survivors will be in competition for habitat already at carrying capacity. After the reservoir reaches its stable level, a new habitat will develop which may attract hippopotamus, Nile crocodile, waterbuck, roan antelope, and bahor reedbuck. The effect on avifauna will be neutral or beneficial. However, the net effect on Malian wildlife is predicted to be negative. It has been suggested that the damage could be reduced by designating a refuge by the reservoir and mounting a wildlife rescue operation as the waters rise.

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**Appendix I**

**Environmental Legislation**

Appendix I

Environmental Legislation<sup>27/</sup>

A. Water

1. Colonial legislation regulating water resources conservation, development and utilization throughout former French West Africa.
  - a. The Civil Code (Articles 640-645)
  - b. Decree, 14 April 1904: protection of public health.
  - c. Decree, 5 March 1921: on the status of water.
  - d. Decree, 21 March 1928: status of water.
  - e. Decree, 29 September 1928: governing Public Domain and compulsory servitude; Articles 1 and 2 amended by Decree No. 52-679, 3 June 1952. Original decree again supplemented by Decree No. 55-490 of 5 May, 1955.
  - f. Decree, 4 July 1935 (Article 30): status of forests.
  - g. Decree, 30 October 1935: protection of drinking water.
  - h. Order No. 9929, 15 December 1955: from the Ministry of Public Works, on conditions of implementation of Decree No. 55-490 of 5 May 1955. In part, regulates use of groundwater.
2. Municipal order No. 11 of April 1954.
3. Convention on the concession of public water supplies in Mali, January 1961.
4. Specifications (Cahiers des Charges) covering the concession of public water supplies in the Republic of Mali, 12 October 1961.
5. Act relating to navigation and economic cooperation among the states of the Niger Basin, Niamey, 24-26 October 1963.
6. Law No. 63-87 AN/RM of 30 December 1963.

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<sup>27/</sup>Source: Caponera. 1978.  
Christy, 1971.  
Johnson and Johnson. 1977.

7. Agreement concerning the Niger River Commission and navigation and transport on the Niger River, Niamey, 25 November 1964.
8. Law, 1965, governing navigation and transportation on the Niger River.
9. Decree No. 138 PG of 14 November 1966 on the organization of the General Directorate of Hydrology and Energy of Mali.
10. Decree No. 109 PG of 2 August 1967 on the organization of the Agricultural Engineering and Rural Water Services.
11. Ordinance 1969. River Niger Commission; navigation and transportation.
12. Convention on the Status of the Senegal River, 11 March 1972. Member states Mali, Mauritania and Senegal must approve any change in use of the Senegal River that is likely to affect other partners in the Convention. Origin of OMVS.

#### B. Soils

1. Law No. 68-8, 17 February 1968. Regulates land use in general: prohibits brush-burning in the pre-desert steppe; forbids grazing in the desert except in "managed areas." No new land may be cleared for cultivation without permission. Cultivation is prohibited on erosion-prone slopes and "in areas of water catchment or flow." (Christy, 1971, p. 50). All soil use rights are subject to regulation by the Water and Forest Service.

#### C. Protected Areas

1. Decree 1954: on protection of fauna and flora in reserves.
2. Decree 1956: on National Parks and Natural Reserves.
3. Decree 1959: on classification of several faunal and floral reserves.
4. Ordinance No. 60, 1969: establishes the hunting code.

#### D. Flora

1. Act No. 68-8, 1968: promulgates the Forest Code. Establishes control over all forest exploitation, whether on state or private lands. Certain tree species are protected.

#### E. Wildlife and Fisheries

1. 1938: ratification of the 1933 International Convention for Protection of African Flora and Fauna.
2. Law, 1962: Protection of Game. Lists protected species.
3. Law, 1962: international accord between Mali and the International Organization against the Migratory African Locust (OICMA).
4. Law, 1963: regulates fishing.
5. Decree, 1965: relates to creation of national and several regional fishing committees.
6. Ordinance No. 60, 1969: institution of the Hunting Code.
7. Decree 14 March 1975: regulation of fishing.

#### F. Mining

1. Law, 1963: regulates mining.
2. Decree, 1965: amplifies 1963 mining law.
3. Ordinance No. 34/CMLN, 30 September 1970: the Mining Code.<sup>28/</sup>

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<sup>28</sup>Source: U.S. Bureau of Mines. 1976.

**Appendix II**

**Organizations with Environmental  
Interests/Responsibilities**

## Appendix II

### Organizations with Environmental<sup>29/</sup> Interests/Responsibilities

#### Malian Governmental:

##### A. Administrative Agencies

##### 1. Ministry of Production, Bamako

###### a. Water and Forest Service

- i. Operation Forest Management and Production
- ii. Operation Baoulé National Park
- iii. Operation Fishing.  
Administers fishing regulations.

###### b. Hydrologic Service

B.P. 66  
Bamako

Established in 1966. Exercises all governmental authority in water matters. Responsible for study and implementation of coordinated river basin schemes for agriculture, livestock, fisheries, navigation, and energy production, transport, and distribution. Responsible for studying flowing rivers with a view to their use in fulfilling industrial, urban, and other requirements. Also responsible for flood and erosion control.

##### 2. Ministry of Health Bamako

##### 3. Ministry of Industrial Development, Mining and Tourism

###### a. National Directorate of Mines and Geology

B.P. 223  
Koulouba, Bamako

###### b. General Directorate of Hydrology and Energy Proposes regulations governing groundwater use.

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<sup>29</sup> Source: Berquist, et al. 1978.  
Caponera. 1978.  
Current Agricultural Research Information System (CARIS). 1978.  
Europa. 1980.  
Europa. 1978.  
Gannett, Fleming, Cordry and Carpenter, Inc. and ONGATEC  
Société Africaine d'Études Techniques (Dakar, Senegal). 1979.  
Sierra Club. 1976.  
United Nations Environment Program. 1979.

i. Solar Energy Laboratory.  
Founded in 1964.

ii. Hydrogeological Division

c. National Company for Mineral Research (SONAREM)  
B.P. 2  
Kati

Founded in 1961. Documentation of geology, mining, and technology.

4. Ministry of Rural Development  
B.P. 6  
Bamako

Organizational headquarters of 20 development "operations" and smaller "actions." The Minister of Rural Development serves on the Council of Ministers from the eight Sahelian countries that make up CILSS: The Permanent Interstate Committee for Drought Control in Sahel.

a. Agricultural Engineering and Rural Water Service

Administers water supply and animal-watering programs.

b. Institute of Rural Economy  
B.P. 258  
Bamako

The Director of the Institute is the Malian representative of the M&B program.

i. Division of Agronomic Research

-National Center for Fruit and Vegetable Research  
B.P. 30  
Bamako

Malian mission of the French Overseas Institute of Fruit Research (IFAC). Chiefly involved with introduction and adaptation of new fruit and vegetable species. Training provided for technicians and for students from Rural Polytechnic Institute, Katibougou. Publications: Technical notes and Annual reports to the Committee for Agronomic Research.

Substations:

Station Régionale de Farako (25 km from Sikasso)  
Annexe de Gaguineda (40 km from Bamako)  
Point d'Appui de Yanfolila (240 km from Bamako)  
Point d'Appui de Fari (1st administrative region)

**-New Plants Section**  
B.P. 16  
Sikasso

Main area of activity: agronomy and techniques of tea culture. 24 - week training sessions provided for technicians and students from Katibougou, in vegetative reproduction, pruning, harvesting formulas, etcetera. Facilities include 13 hectares of experimental fields and a nursery. Publications: Annual reports to the Committee for Agronomic Research.

Substations:

Point d'Appui de Banankoui. (3 ha. of experimental fields).  
Point d'Appui de Finkola (10 ha. of experimental fields).

- ii. Division of Livestock
- iii. Division of Forestry
- iv. Division of Information and Documentation

5. Ministry of Transport

6. Ministry of Public Works

7. Mali Navigation Commission (COMANAN)

8. Ministry of Planning

- a. Social Affairs Commission
- b. Commission on the Rural Economy

9. Ministry of Nature Protection

10. Malian Statistical Services.

11. O.P.I.: (Operation ?)

Responsible for construction and management of all agricultural projects associated with OMVS.

12. National Topographic Institute  
B.P. 240  
Bamako

**B. Research Institutions - Governmental Affiliation Uncertain**

1. National Center for Animal Science Research  
B.P. 262  
Bamako

Founded in 1927: experimental farm with sections on genetics (bovine, sevine, poultry), nutrition and biochemistry, pasture, veterinary medicine. Library of 1,000 volumes.

2. Rice Research Centers: at Kankan and at Abetemi.

3. Office of the Niger  
B.P. 1660  
Segou

Founded in 1932, taken over by the Malian government in 1958. Cotton research stations at Bougoumi and Sabel, rice research at Kayo, and fruit research at Soninkoura.

4. Malian Institute of Scientific Research  
Koulouba, Bamako

5. Institute of Tropical Ophthalmology of Francophone West Africa  
B.P. 248  
Bamako

Founded in 1953. Specializes in trachoma research.

6. Institute of Leprosy Research  
B.P. 951  
Bamako

Founded in 1935. Medical research, teaching, treatment and epidemiology, specializing in leprosy.

7. Meteorological Service  
B.P. 237  
Bamako

8. Sabel Institute  
P.O. Box 1530  
Bamako

Research and training institute attached to CILSS. Locus of READOC: the Sahelian Scientific and Technical Information Network.

### **C. Libraries and Colleges**

1. **Ahmed Baba Center for Documentation and Historical Research  
(CEDRAB)  
B.P. 14  
Tombouctou**

Founded in 1970. Collects and preserves Arabic MSS. Archive of circa 5,000.

2. **National Library (Institute of Humanities)  
Koulouba, Bamako**

Founded in 1913, contains 6,000 volumes and 215 current periodicals.

3. **National Archives (Institute of Humanities)  
Koulouba, Bamako**

Founded 1913.

4. **National School of Engineering  
B.P. 242  
Bamako**

5. **National School of Medicine and Dentistry  
Bamako**

Founded 1968.

6. **Rural Polytechnic Institute  
B.P. 6  
Koulikoro**

7. **Higher Normal School  
B.P. 134  
Bamako**

a. **Center for Research on Uses of Solar Energy**

### **D. Foreign Countries/International Agencies**

1. **FED (EDF): European Development Fund**

Supplies water and road infrastructure projects and some food aid.

2. **UNSO: United Nations Sudano-Sahelian Office of the United Nations Environmental Program (UNEP).**

Assists in governmental planning pertinent to implementation of the Plan of Action for the Control of Desertification (Nairobi Conference on Desertification, 1977).

3. **UNDP: United Nations Development Program**

Coordinates Malian projects of 13 UN agencies.

4. **IBRD: International Bank for Reconstruction and Development**

Provides IDA (International Development Assistance) credits for road construction and maintenance, telecommunications systems, education, agriculture livestock, forestry and other projects.

5. **ABD/AFD: African Development Bank/African Development Fund.**

Has provided soft loans for the Mali-Sud integrated rural development project, the Marhala-Nioro Road, the Rural Polytechnic Institute and small rural development projects.

6. **OECD Countries**

- a. **France** There are French technical advisors in most Malian government departments. France is the leading bilateral donor among OECD countries.

- i. **Mission of the ICRT to Mali**  
B.P. 114  
Bamako

Cotton research center at N'Tarla-M'Pesoda.

- ii. **Office of Scientific and Technical Research Overseas**  
B.P. 726  
Bamako

Research in hydrology and geophysics, in addition to other topics.

- iii. **Institute of Research in Tropical Agronomy and Food Crops (IRAT)**  
B.P. 438  
Bamako

Founded in 1962; research in general agronomy, land improvement, cultivation techniques, fertilizer requirements

and plant breeding (sorghum, pennisetum, rice, maize, wheat and peanuts). Experimental stations at Bamako, Koulikono, Kogoni, Nioro, Ibetemi (Mopti); Substations at Kita and Koporokenie - Pe.

- b. Federal Republic of Germany (FRG): Aids rural development, transport infrastructure, security food stocks in northern 6th and 7th regions. Major contributor to OMVS Project.
- c. Canada: Contributes to infrastructure development, integrated rural development, food aid.
- d. Netherlands: Assists small rural projects
- e. Other OECD donors include Japan, Belgium, Austria, U.K., Italy, Norway and Switzerland.

7. OPEC Countries and Institutions

- a. Saudi Arabia: Sélingue dam cofinancing, livestock development.
- b. ABAED: Arab Bank for African Economic Development. Has assisted in financing the Sélingue dam; also supports cereals storage projects.
- c. Kuwait and Qatar: also contributed to Sélingue dam project.
- d. OPEC Special Fund and Islamic Development Bank contributing to Sévaré-Gao road project.

8. Communist Countries: China, USSR, German Democratic Republic, Romania, Yugoslavia and Cuba concentrate aid in education, industrial development, and improving irrigation works.

9. Private Agenices: CARE, AFRICARE, Foster Parents, and about ten small European-based agencies do some well-drilling in addition to their health, education and humanitarian work.

**Appendix III**

**AID Projects in Mali**



**EVALUATION DOCUMENTATION****Country/Bureau: Mali****Title: Central Veterinary Laboratory****Project: 6880002****Initial FY: 68      Final FY: 77****Document type: Special Evaluation Report****Publication date: 10/01/73****Title: Narrative Report on the Mali Central****DIC Ref. Center No:****Author: Blumbart, John D.****Organization: AID/W****Projects and Sub-Projects Evaluated: 688000200**

**Abstract:** Reviews development of the Central Veterinary Laboratory (CVL) project near Bamako, Mali from its opening in 1972 through 10/73. The objectives of the CVL are (a) to produce vaccines for protecting Malian cattle against major diseases and (b) to undertake applied research and testing programs to improve vaccine quality and to support AID's Mali livestock program. Producing vaccines is especially important for the current vaccination campaign because so much of the national herd has been weakened by the drought and is particularly susceptible to disease and parasites. Since beginning operations in 6/72, the CVL has been plagued by one breakdown after another. At times, as when the water pump failed, the laboratory has not been able to function at all. Consequently, Mali has had to continue importing some of its vaccine requirements from abroad. At present, the laboratory is still in a precarious position as it faces the 1973/74 vaccination campaign. Delays in the construction of a well and water tower for stand-by water supply cause the CVL to be dependent on municipal water and vulnerable to cut-offs during dry months. The same applies to CVL's source of electricity since the CVL stand-by generator is in disrepair. Other problems, which could interfere with meeting demands for vaccines, are the absence of adequate cold storage for stockpiling and technical difficulties in the production of rinderpest vaccine. USAID has contracted an engineering firm to correct most of the major defects in design and installation.

The author recommends that USAID increase its inputs to enable the CVL to address some of its longer-term problems, particularly technical assistance for laboratory operations and research, follow-on commodities, training, and funds for local operating costs. Such assistance could transform the CVL from an embarrassment for both countries to a truly functional institution in support of the Mali livestock sector.

**Document type: Audit Report****Publication date: 12/11/75****Title: Examination of AID-Financed Livestock  
Activities in Mali****DIC Ref. Center No: ML636 A265****Author:****Organization: AID/W (Area Auditor  
General Africa)****Projects Evaluated: 688020100 688020300 68800200 625061300 625090600 625061000****Abstract: (See top of page 51) - Abstract identical.****Country/Bureau: Central & W. Africa Regional****Project: 6250610****Title: Central Veterinary Lab****Initial FT: 72      Final FT: 79**

**EVALUATION DOCUMENTATION**

**Country/Bureau: Mali**

**Title: Mali Livestock Development**

**Document type: Audit Report**

**Title: Examination of AID-Financed Livestock  
Activities in Mali**

**Project: 6880201**

**Initial FY: 74 Final FY: 80**

**Publication date: 12/11/75**

**DIC Ref. Center No.: ML636A265**

**Organization: AID/W (Area Auditor  
General Africa)**

See page 51

- Abstract identical

**EVALUATION DOCUMENTATION**

**Country/Bureau: Mali**

**Title: Mali Livestock Sector**

**Document Type: Audit Report**

**Title: Examination of AID-Financed Livestock  
Activities in Mali**

**Project: 6880203**

**Initial FY: 75 Final FY: 79**

**Publication date: 12/11/75**

**DIC Ref. Center No.: ML636A265**

**Organization: AID/W (Area Auditor  
General Africa)**

See page 51

- Abstract identical

**EVALUATION DOCUMENTATION**

**Country/Bureau:** Central & West Africa Regional  
**Title:** Central Veterinary Lab:

**Project:** 6250617  
**Initial FY:** 72    **Final FY:** 79

**Document type:** Audit Report  
**Title:** Examination of AID-Financed Livestock  
          Activities in Mali

**Publication date:** 12/11/75  
**DIC Ref. Center No.** ML636 A265

**Organization:** AID/W (Area Auditor  
                  General Africa)

See page 51        - Abstract identical

**EVALUATION DOCUMENTATION**

**Country/Bureau:** Central & West Africa Regional  
**Title:** W. Africa Regional Poultry Production

**Project:** 6250508  
**Initial FY:** 70    **Final FY:** 77

**Document type:** Special Evaluation Report  
**Title:** The Economic Feasibility of the West  
          African Regional Poultry Project  
          (May 18-Sept. 18, 1973)

**Publication date:** 11/1/73  
**DIC Ref. Center No.** AFR338.1765G779

**Organization:** USDA Economic Research  
                  Service

**Author:** Paulhus, Norman G  
          Gray, Leo

**Projects Evaluated:** 688001300 625050800

**Abstract:** USDA Econ. Research Service contracted special feasibility study of AID-supported FY 1970-73 W. African Regional Poultry project with Senegal, Mali and Mauritania, members of Organization Pour la Mise en Valuer du Fleuve Senegal (OMVS) Regional Organization. Project seeks to foster development of broiler production industry to provide low-priced poultry meat/eggs for OMVS citizens. USDA/USAID evaluation team reviewed project files, consulted project principals & conducted interpreter-assisted interviews with sample of 102 poultry-related establishments in all three countries in a 4-month intensive evaluation. Evaluators assessed project operations in each country & project as a whole. No assessment made of Tuskegee Institute technical assistance to project. USDA consultants recommend precipitous termination of regional project due to serious management problems, inefficiencies, underdeveloped facilities & non-compliance of host governments with previous USAID operating recommendations. Evaluators note effect of severe perennial drought and ensuing priority usage of available feed grains for human consumption, but do not emphasize such as rationale for undeveloped operations/unfulfilled objectives. Even with subsidization, poultry meat/eggs from OMVS centers remain non-competitive luxury commodities. Evaluators recommend economies of scale production & emphasis on marketing to increase broiler/egg demand & lower selling prices. USDA consultants note greater success of select independent commercial producers; suggest they might better provide demonstration model. Specific problems observed include inefficiency of hand feed-mixing (automated feed-mixers not yet operational at Mali center; lack of electricity persists at Mauritanian center; inadequate security mgmt for disease prevention (70% mortality rate at Mali Center); problems in cost accounting procedures/programming; and lack of forward planning to facilitate more effective coordination of chick purchase/feed supplies. Project training components as of yet no initiated. Team recommends project termination with subsequent USAID technical guidance only upon OMVS request.

**EVALUATION DOCUMENTATION**

**Country/Bureau:** Mali  
**Title:** Operation MILS-Phase II

**Project:** 6880202  
**Initial FT:** 76      **Final FY:** 81

**Document Type:** Project Evaluation Summary  
**Title:** Operation MILS MOPTI (OMM)  
**Author:** Newton, Alex  
          Lebeau, Fran  
          Jepson, Lance  
          Diallo, Somballo

**Publication Date:** 7/12/79  
**DIC Ref. Center No.:**  
**Organization:** USAID/MALI

**Projects Evaluated:** 688020200

**Abstract:** Evaluates project to increase food production and marketing in Mali. The evaluation covers the period 6/30/76 to 1/1/79, and was compiled through field visits by the evaluation team as well as a review of project documents. After a two-year wait for the arrival of equipment, good progress was made in the road construction component of the project. Fifteen percent of the planned 307 km of roads have been improved. Target levels for increasing the marketing of grain through official government channels was realized (a 6.5% annual increase since 1975). However, because parallel market prices are higher than official prices, there is no incentive to farmers to increase their participation in the official market. Good progress was made in distributing farm implements and supplies through the credit program--increases were 100-200%. Technical packages increased yields on the demonstration plots by 100%. The extension system has so far involved only 1,500 "pilot" farm families annually. The research component has been limited to varietal improvement, with no breakthroughs in developing better millet/sorghum varieties. The vegetable program has been in operation on a limited basis for 2 years, with the groundwork laid for Peace Corps assistance. Well construction did not begin, because of design/cost problems, which have now been removed. Blacksmith training will not begin before the latter part of the year.

Evaluators include that the project goal (to help make Mali self-sufficient in cereal production) was too narrowly defined, reflecting national objectives rather than the needs of the rural population. Government extension agents need more and better training. Also, the extension agents have been too occupied with credit and marketing programs, and have not had enough time for basic extension work. The research component should be expanded beyond varietal research, and data gathering should be intensified. The project is being redesigned to address these matters. The complete evaluation report (BIBID 6880202001701) is attached to this PES.

Document type: Special Evaluation Report  
Title: Evaluation Report of MILS-MOPII

Publication date: 7/12/79  
DIC Ref. Center No. :  
Organization: USAID/MALI

Author: Newton, Alex  
Lebeau, Fran  
Jepson, Lance  
Diallo, Somballo

Projects Evaluated: 688020200

Abstract: Evaluates project to increase food prod/marketing in Mali. The report covers the period 6/30/76 - 1/1/79.

-----I N Q U I R E -----

AID programmed \$8,875,000 and the GRM (Government of the Republic of Mali) has programmed \$1,522,000 to the project. The millet-sorghum production component of the project has received the highest priority. Other components included market gardening, well construction, road construction, and blacksmithing. The evaluators conclude that too much emphasis was placed on grain production and marketing, and not enough emphasis was given to the overall welfare of the rural poor. GRM policies have maintained artificially low prices and discouraged the production of alternative crops. Evaluators note that the existence of a parallel market, which offers higher prices, has stimulated production and encouraged the use of fertilizers. However, for the most part, it has only been the larger farmers who have been able to take advantage of this parallel market. (Smaller farmers must sell most of their surplus to the government because of market crop quotas.) The initial millet technical package was based on the M2D2 variety, thought to be superior to local varieties. This supposition did not prove accurate, and farmers have continued to use local varieties. The OMM (Operation MILS MOPTI) extension division adopted a "pilot farmer approach" which has been criticised because it reaches only a small sample of the population, and because the "pilot farmers" have been wealthier than most

rotation, intercropping, integration of livestock into the farming system, managed fallow systems, etc. The frequent turn-over of high-level personnel (4 directors in the past two years) also hurt project performance. This report is attached to PES dated 7/12/79 (BIBID 6880202001501).

## **APPENDIX IV**

### **Bibliography**

#### **Selected Literature References on the Following Topics:**

- 1. General Bibliographic Sources for Africa**
- 2. Agriculture**
- 3. Development, Social Aspects, and Desertification**
- 4. Vegetation and Soils**
- 5. Water**
- 6. A Selection of Pertinent FAO Documents**

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## 6. A Selection of Pertinent FAO Documents

<u>Document No.</u>	<u>Title</u>
31567-75-WS	The economic development of areas freed from onchocerciasis in Mali.
33657-70-MR	Inventory of main vegetation types provisionally kept in view of the construction of an ecological map of central Nigeria delta.
33658-73-MR	Vegetation map with locust outbreak area in the central delta of Niger (ecological studies)
35211-71-XB	Development project for agronomic research and its applications in the Senegal River Basin. Entomological problems in the Senegal Valley--mission report.
35213-71-XB	Development project for agronomic research and its application in the Senegal River Basin. Preliminary socio-economic analysis for the establishment of experimental irrigated area in the central Senegal Valley.
35407-70-XB	Development project for agronomic research and its application in the Senegal River Basin. Pilot project for horticultural development through hand pumping.
35412-71-XB	Development project for agronomic research and its application in the Senegal River Basin. Technical note on water consumption of sorghum in flooded areas. Experiments carried out at Kardi and Richard-Toll in 1970-71.
35415-72-XB	Development project for agronomic research and its application in the Senegal River Basin. Report of studies on the analysis of rainfall regularity on the Senegal River Basin.
35418-74-XB	Long-term objectives of the strategy for the Senegal River Basin integrated development.
35419-74-XB	Hydro-agricultural study of Senegal River Basin. Final Report.
35689-68-XB	Structures of research institution for animal breeding and veterinary medicine in Senegal. Results and research programs relating to the Senegal River Valley.
35691-69-XB	General synthesis report on agronomic research findings and extrapolation possibilities in the rural environment. V. 1: natural and traditional environment.

- 35692-69-XB            General synthesis report on agronomic research findings and extrapolation possibilities in the rural environment. V. 2: improvement possibilities of rural employment.
- 35693-69-XB            General synthesis report on agronomic research findings and extrapolation possibilities on the rural environment. V. 3: research programme project 1969-1970; proposals for its possible continuation during following field research.
- 35697-70-XB            Animal production on the left bank of Senegal River. Results and perspectives.
- 35698-71-XB            Development project for agronomic research and its application in the Senegal River Basin. Technical note on water use of irrigated sorghum. Results of measurements. Richard Toll-1970.
- 37001-76-MBO           Report on the acceptibility testing of FPC (fish protein concentrate) Type B (in Senegal, Liberia, Niger, Mali, and Indonesia).
- 37453-77-M             Hydro-agricultural study of the Senegal River Basin organisation for Senegal River Basin development. V. 1: Synthesis report of studies and works. V.2: Synthesis report of studies and works.
- 37968-77-W             Collection, processing and marketing of fish in floodplains (in Mali).
- 37969-77-W             The problem of rice-eating fish in the central Niger Delta, Mali.
- 38370-77-W             Problems of trypanosomiases in Mali. Report to the government.
- 38742-77-W             Republic of Mali-report of the 1977 multidonor mission (on food and agricultural situation and impact of the effect of drought on human and animal health).