DRAFT

ENVIRONMENTAL REPORT

ON

NIGER

prepared by the

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DRAFT ENVIRONMENTAL REPORT ON NIGER

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A department has the same name as its administrative seat.
Niger falls entirely within the arid and semi-arid zones of West Africa, and many of its major environmental problems are related to this fact. Over half the country is uninhabitable even by nomads, while only about one fifth of Niger is suitable for sedentary agriculture. Recurring droughts in the Sahel-Sudan region make life even in these relatively "fertile" areas precarious. Population increases put increased pressure on agricultural and range resources, which leads to degradation even in good years; drought greatly accelerates the process. Niger's major environmental problems include:

1. **Devegetation.** This covers two processes in the two traditional sectors of Niger's economy. In agricultural areas, trees are cleared from the land for farming. Practices of burning off brush and grass cover kill any seedlings. In addition, firewood is the only energy source in most rural areas. In pastoral areas, overgrazing of range land is common. Both of these have led to a serious depletion of ground cover.

2. **Soil Erosion and Depletion.** One direct result of devegetation is soil erosion. This is serious in areas of human activity, but wind and water erosion of soils is by no means confined only to areas of human activities. Sparse ground cover is a characteristic of the arid climate, and erosion proceeds even without man's help. In addition, agricultural soils are being degraded rapidly as traditional methods of maintaining soil fertility can no longer keep pace with the demands on the soil.

3. **Health.** Public health standards are quite low. Much of the problem can be linked to hazardous water supplies, which aid in transmission of communicable disease.

Niger recognizes these and many other problems, and has addressed most of them to some extent in law.

Mark Speece
Compiler
1.0 General Information

1.1 Preface

This draft environmental report is the result of an eight-week review of information available in the United States on the natural resources and environment of Niger. This is the first step in the process of developing an environmental profile for use by the U. S. Agency for International Development and Niger government officials. The next step in this process should be a field study which would evaluate the information contained herein, obtain additional information, define issues, problems, and priorities, and provide direction for future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations presented in this report are preliminary in nature and are not intended to attain the detail and accuracy needed for development planning. This study represents a cooperative effort by the entire staff of the Arid Lands Information Center, but the primary focus, research, and writing were done by Mark Speece. The cooperation of personnel at AID, the Library of Congress, the National Park Service, and the University of Arizona is gratefully acknowledged.
1.2 Geography and Climate

With an area of 1,267,000 sq. km. (489,191 sq. mi.) the Republic of Niger is one of the largest states in West Africa. The country is landlocked, surrounded by (clockwise from the north) Algeria, Libya, Chad, Nigeria, Benin (formerly Dahomey), Upper Volta, and Mali.

Niger falls into the three broad climatic zones of Sahara, Sahel, and Sudan which stretch across all of West Africa. Usually each of these zones is subdivided into latitudinally. The Saharan zone proper and the southern Sahara are characterized by high summer temperatures and little annual rainfall. Vegetation and livestock can survive only in oases throughout most of these zones, but in the slightly wetter and cooler southern part an occasional tuft of grass or sagebush can be found.

The northern Sahel zone usually receives less than 250 mm annual rainfall. There is a distinct three-month rainy season and a cooler winter. Agriculture is usually impossible, but this is an area of cattle nomadism. The southern Sahel has similar conditions, except that the 500-750 mm annual rainfall can support dryland agriculture.

The southwesternmost corner of Niger falls into the northern Sudan zone (savanna on the map in App. I). Annual rainfall may be up to 1000 mm and the rainy season extends for 5 or 6 months.

In addition to these general observations on West African climatic zones, Niger can be divided roughly into the extremely arid north and the cultivable, populated southern area. Each of these areas is again conveniently divided in two. The north, about four-fifths of the country, contains the arid highlands of the Aïr Massif. On either side of this centrally-located feature, the sandy regions of the Nigerian Sahara extend southwards. The southern area consists of the Niger River valley in the southwest corner of Niger, and the strip of land along the southern border with Nigeria.

1.2.1 The Northern Highlands

The Aïr Massif is an extension of the Ahaggar mountains of Algeria. A series of plateaus connects these mountains with the Algerian ones as well as with the Tibesti mountains of Chad. Aïr extends about 400 km (250 mi) from north to south, and about 240 km (150 mi) from east to west. The highest point, Mt. Greboun (~ 2000 m, 6562 ft.), is a little over 100 km. from the Algerian border. Although rainfall in general decreases from south to north in Niger, parts of Aïr can receive slightly more rain than other areas in the north. The 250 mm isohyet which roughly marks the northern limit of enough vegetation to support nomadic pastoral life, passes to the south of Aïr. However, parts of the highlands can get 250 mm, and some nomadism can be found there. This rainfall is quite erratic and usually comes in thunderstorms, which can cause severe erosion. Temperatures can be extreme in the highlands and 50°C may be reached. In general, because of the altitude, Aïr is slightly cooler than other areas of

northern Niger. In the mountains, minimum temperatures of -31°C have been recorded.

1.2.2 Northern Deserts

Except for the Aïr Massif and a few scattered oases, Niger north of about 16° is generally uninhabitable, even for nomadic groups. West of Aïr the Talak region is an area of almost pure desert, including great fossil valleys filled with moving sand dunes. East of the Aïr the Tenere region is a vast area of sandy and stony desert. At Bilma, an oasis in the middle of this wasteland, the average daily maximum temperature remains above 100°F for six months. Average annual precipitation at Bilma is around 20 mm. This type of desert extends to the area around Lake Chad.

1.2.3 The Southern Agricultural Zone

The area south of the 300 mm isohyet (roughly 16° N) is able to support cultivation. However, agriculture is not really secure until near the 600 mm isohyet along the Nigerian border. The westernmost part of this region is Djerma Ganda, the area around the Niger valley. Much of this area is still desert, and several fossilized former tributaries to the Niger River are filled with sand. Cultivation and population are concentrated along the river itself, where irrigation is possible, until the southern portion of the rivercourse is reached. The 600 mm isohyet passes through the area around Niamey. The southernmost portion of this region is in the zone of over 800 mm of rain annually.

The belt along the Nigerian border gradually changes from desert in the north to Sahel type climate and vegetation southwards. The southernmost strip is usually categorized as belonging to the Sudan zone. In this narrow strip rainfall averages over 600 mm annually. Temperatures in the whole southern area generally average a few degrees warmer in the winter and a few degrees cooler in the summer than in the north.

1.3 Demographic Characteristics

1.3.1 Population

Figures on Niger's population vary somewhat between various sources (cf app. II, 1). In 1980 there are approximately 5,200,000 inhabitants. All Data and Europa both estimate Niger's urban population to be about 9% (1976, 1978 respectively), and the World Bank gives a figure of 10.3% (1977). None of these sources defines the term "urban". In 1977 there were 8 towns with 10,000 inhabitants or more, constituting about 8% of the population at the time. Population densities are highest along the southern border east of Goure and along the Niger River, and drop off quickly to the north. Except

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in Air, north of about 16° N latitude is virtually uninhabited. The growth rate for Niger is generally estimated to be somewhere around 2.6 - 2.8%. More complete statistics can be found in Appendix II.

1.3.2 Composition

Niger's population can be roughly divided into five major ethnic groups. The largest, the Hausa, made up just under 54% of the population in 1972. They are overwhelmingly sedentary agriculturalists, and also make up the majority of the small merchants and traders. Various groups of Hausa people in Niger can be found all along the Nigerian border as far east as Zinder. They still maintain close contacts with kinsmen in Nigeria, where the majority of the Hausa people live.

The Djerma-Songhai constituted about 24% of the population in 1972. These two related peoples are generally found along the Niger River, are sedentary agriculturalists, and account for the majority of Niger's civil servants. The majority of the Songhai people live in Mali, and the Djerma also inhabit areas south of Niger.

About 9% of the population is made up of loosely-related peoples grouped under the name of Kanuri. They are found in the southeast from Zinder to Lake Chad, as well as in the other countries surrounding the lake. They have a mixed agricultural-pastoral economy.

The Fulani (sometimes called Peul) were just under 11% of the population in 1972. They are primarily cattle nomads, and can be found scattered across habitable Niger where agricultural density is low. Like the other groups, they are found in other countries, mainly in the Sahel zone of West Africa.

The Tuareg constitute only about 3%, but they are predominant in the northern part of Niger. In general they inhabit areas north of the agricultural zone, including the Air Massif, as well as in most other countries which share the southern fringes of the Sahara. Their pastoral economy is based on sheep, goats, and camels. The Tuareg and the other nomadic groups were hard-hit by the 1967-1973 Sahel drought, which caused an increasing trend toward sedentarization among them.

These population composition figures often differ between sources; one source (USAID 1980b) gives Hausa 45%, Djerma-Songhai 21%, Fulani 14%, Tuareg 11%, and Beri-Beri (Kanuri) 8%.

Although language tends to follow ethnic group closely, about 85% of Niger's inhabitants can speak Hausa. By adding Songhai, one can

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be understood nearly everywhere in the country. French is the official language and the language of instruction, but it is understood only by a small minority.

1.3.3 Migration and Urbanization

Despite the low proportion of urban population in Niger, urbanization is an important factor. The urban growth rate is twice that of the overall growth rate, and Niger is probably the country with the fastest growing urban network in the Sahel region. Fully half of this urban growth can be attributed to migration. The case of Niamey is even more striking: a growth rate of 10%, with nearly 3/4 due to migration.

Actual migration from rural areas is much greater than indicated by looking only at urbanization figures. Old figures from the 1960 census show that there were then about 130,000 temporary migrants who left their homes during the dry seasons to look for work. About 80,000 of these went to Nigerien urban centers. The rest left the country, most often to Nigeria, Ghana, or the Ivory Coast. Most of this was only temporary migration during the season when little agricultural activity took place. However, several cases were known even then where lack of manpower due to migration held back rural development.

The drought greatly accelerated all of these processes. For example, the International Red Cross estimated in 1974 that up to 100,000 nomads had fled from their territories to Niamey. Other estimates placed over half a million Nigeriens in Nigeria in 1974.

1.3.4 Public Health

Health care in Niger is in need of improvements. The death rate in 1977 was around 22 per 1,000, which was down from 27 in 1960. Average life expectancy at birth was anywhere from 38 to 42, according to various sources. In general, the death rate is much higher in the north than in the south and much higher among nomads than sedentary peoples. Malnutrition, lack of sanitation facilities, poor personal hygiene, and severe shortages of medical personnel and facilities are all contributing factors to the low standards of public health.

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The Sahel drought of 1967-1973 hit Niger very hard, and the country is only now beginning to recover in many factors, including health and nutrition. For example, the per capita daily caloric intake, estimated at 2,175 in the early 1960's, had recovered by 1977 to only about 2,140, approximately 78% of the estimated daily requirement. The situation was worse among nomads. Incidence of several diseases also increased during the drought years.

Malaria was the leading cause of death in the early 1970's, responsible for about 28% of all deaths. Malaria does not occur north of the 200 mm isohyet, is seasonal during the rainy season south to the 500 mm line, and south of the 700 mm isohyet is a continuous year-round problem. Measles is a close second, and is particularly deadly among children. There were 28,423 cases and 937 deaths reported in medical facilities during 1972. Considering the shortage of these facilities, actual incidence and deaths must have been much greater.

Cerebro-spinal meningitis is another important cause of death, and seems to become epidemic every four years. The following table shows reported cases and deaths over five years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>3,131</td>
<td>134</td>
</tr>
<tr>
<td>1969</td>
<td>2,989</td>
<td>190</td>
</tr>
<tr>
<td>1970</td>
<td>11,791</td>
<td>1,105</td>
</tr>
<tr>
<td>1971</td>
<td>4,142</td>
<td>246</td>
</tr>
<tr>
<td>1972</td>
<td>2,233</td>
<td>180</td>
</tr>
</tbody>
</table>


Although they may not result in as large a number of deaths, a number of other diseases are common and are major problems in Niger. Among these are trachoma and conjunctivitis, venereal disease, intestinal parasites, and tuberculosis. Perhaps because of the large-scale population displacements due to the drought, cholera became a problem after 1970, and 10,000 cases were reported in the first half of 1971, with 2,000 deaths.

Tables showing incidence of a number of diseases can be found in App. II.
1.4 Economic Characteristics

Niger is one of the poorest countries in the world. Less than 3% of its territory is under cultivation, but agriculture remains a major sector of the economy. The per capita GNP in 1977 was somewhere around US$ 190, and the average annual per capita real GNP growth rate from 1960-1977 was -1.4%. Agriculture contributed approximately 50% to the GDP in 1976, but perhaps a better measure of its influence in Niger is the observation that 92% of the labor force is involved in this sector (1977).

1.4.1 Agriculture and Livestock

Agricultural production is heavily oriented toward food crops. Over 50% of the total planted area is usually used for millet. Other major food crops are sorghum and cowpeas. Niger's major cash crops are groundnuts and, less importantly, cotton and vegetables. Groundnuts have been the major foreign exchange earner until recently. Although production was hurt by the drought, groundnuts accounted for nearly 40% of exports by value in 1972. Since then, production has been further cut by crop diseases. In 1976 groundnuts were only about 6% of exports. Uranium had become a major export by then, but these figures also represent a real drop in production. Cotton production had all but ceased by 1980.

Livestock production, which is largely in the nomadic sector, was severely hit by the drought. However, exports of animals and animal products did not suffer, because of widespread forced sales as the animals could no longer be supported. In 1972 animals and animal products were about 16% of total exports. By 1976 improved production kept this figure at about 16%. The 1979-83 five year plan, however, calls for restricting the growth of these exports in order to raise the domestic nutritional status.

Agriculture is one of the priorities in government development plans. Improvements in rainfed agricultural productivity and recovery of livestock herds to at least 65% of pre-drought levels are two of the main factors on which the government is depending for economic growth. Toward this end the 1976-78 Three Year Plan allocated 22% of the budget to investment in those sectors. The 1979-83 Five Year Plan earmarks 30% of public spending to rural development and irrigation. However, World Bank projections forecast a food deficit for Niger by 1990 under the best conditions.

West Africa. 28 April, 1980.
1.4.2 Other Sectors

The third and by far the single most important factor contributing to economic growth is uranium. Although not yet a large percentage of the GDP (about 6% in 1976), it is a fast-growing industry and the major foreign exchange earner. In 1970 uranium contributed nothing to export earnings; by 1977 it accounted for nearly 75% by value.

Manufacturing is the least developed of all the Francophone African countries. It takes the form mostly of processing agricultural goods, and contributed 11.6% to the GDP between 1970-1976. During that period 15% could be attributed to trade and finance.

1.4.3 Foreign Aid 7/

Interest in Niger by the international community developed only in the later phases of the Sahel drought and was then primarily relief aid. Since then, Niger has been able to attract non-emergency funds to be used for development. In Niger, as in most other Sahel states, a great deal of development effort is associated with CILSS/Club du Sahel and its donor-beneficiary framework. In 1978 France provided about 27% of all aid to Niger. Other major donors were the EEC, the World Bank, West Germany, Japan, the U.S., and Arab states, but a great many other countries and organizations were also involved.

Projects range from watershed management schemes involving several Sahel countries to the establishment of individual industrial concerns. U.S. AID projects are focusing on the areas of transportation networks, crop production, rural development, and livestock management. Appendix IV lists AID projects.

U.S. AID. 1980c.
2.0 Natural Resources

2.1 Mineral Resources and Energy

Minerals are the sector which shows the most potential for economic development in Niger. By far the most important mineral at present is uranium. Proven reserves are about 200,000 tons, with another 200,000 tons reasonably assured, amounting to about 15 percent of the world's known resources. Niger's first uranium mine went into production in 1971 at Arlit. A second was opened in 1978, a third will begin in 1980, and several others should come into production within the decade, all in the Air region north-northwest of Agadez. Niger hopes to be producing 8,000 tons a year by 1984, up from 2,100 tons in 1978.

Cassiterite (tin ore) is the only other economically important mineral which has been in production for some time. Deposits are also found in Air northeast of Agadez. Production of 90 tons in 1978 was down considerably from the peak of 140 tons in 1974, but there are indications of new deposits which could be developed. The following table shows both uranium and cassiterite production and exports for 1969-1978.

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International Monetary Fund. 1970.
Niger, Ambassade des Etats-Unis. undated.
West Africa. 21 January 1980.
## Production and Sales of Mineral Products

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Ventes</th>
<th>Cassitérite</th>
<th>Ventes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Minerai d'uranium</strong></td>
<td><strong>Tonnes</strong></td>
<td><strong>Millions de francs c.f.a.</strong></td>
<td><strong>Tonnes</strong></td>
</tr>
<tr>
<td></td>
<td><strong>PRODUCTION</strong></td>
<td><strong>VENTES</strong></td>
<td><strong>PRODUCTION</strong></td>
<td><strong>VENTES</strong></td>
</tr>
<tr>
<td>1969</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>124</td>
</tr>
<tr>
<td>1970</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>106</td>
</tr>
<tr>
<td>1971</td>
<td>410</td>
<td>400</td>
<td>2000</td>
<td>126</td>
</tr>
<tr>
<td>1972</td>
<td>869</td>
<td>300</td>
<td>1484</td>
<td>137</td>
</tr>
<tr>
<td>1973</td>
<td>949</td>
<td>1090</td>
<td>5011</td>
<td>136</td>
</tr>
<tr>
<td>1974</td>
<td>1114</td>
<td>1250</td>
<td>2396</td>
<td>140</td>
</tr>
<tr>
<td>1975</td>
<td>1305</td>
<td>1400</td>
<td>13999</td>
<td>127</td>
</tr>
<tr>
<td>1976</td>
<td>1459</td>
<td>1500</td>
<td>21005</td>
<td>118</td>
</tr>
<tr>
<td>1977</td>
<td>1441</td>
<td>1466</td>
<td>28421</td>
<td>105</td>
</tr>
<tr>
<td>1978</td>
<td>2109</td>
<td>2249</td>
<td>52352</td>
<td>90</td>
</tr>
</tbody>
</table>


Several other minerals are of little importance to the national economy at present rates of production. These include gypsum and limestone in the area of Tahoua, and silica, salt, and gold. Past production of these is noted in the following table:

<table>
<thead>
<tr>
<th>Production (tons)</th>
<th>Year</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>gypsum</td>
<td>2,000</td>
<td>1974</td>
</tr>
<tr>
<td>limestone (cement)</td>
<td>40,000</td>
<td>1974</td>
</tr>
<tr>
<td></td>
<td>(21,000)</td>
<td>(1974)</td>
</tr>
<tr>
<td>silica</td>
<td>1,900</td>
<td>1966</td>
</tr>
<tr>
<td>salt</td>
<td>2,000</td>
<td>1974</td>
</tr>
<tr>
<td>gold</td>
<td>3.7 kg</td>
<td>1971</td>
</tr>
</tbody>
</table>

**Source:**
Several other minerals are presently entering the production stream and may be of some importance eventually. An estimated reserve of 4.5 million tons of coal near Agadez is being developed. Production is scheduled to be 120,000 tons a year by 1982. Coal will be used to fuel the uranium mines, thus lessening dependence on oil imports. There are large phosphate deposits near Tahona and south of Niamey in the "W" National Park (at least 100 million tons averaging 23 percent \( P_0 \) in the Park), which could supply domestic fertilizer needs. An estimated 700,000 tons of iron ore at Say, just south of Niamey, is being jointly developed with Nigeria to supply that country's new Ajaokuta iron and steel complex.

Oil has been discovered in the area just north of Lake Chad, but it is not yet certain the deposits are large enough to make development worthwhile.

Several other minerals have been found also, such as manganese, lithium, and molybdenum deposits northwest of Niamey. Again it is not certain whether these deposits can be economically developed. At any rate, exploitation must await an improved transportation network.

2.1.1 Mineral Policy

Ownership of all minerals, including petroleum, is vested in the state. Jurisdiction over all exploration, geological research, and mining is held by the Bureau de Recherche et Exploitation Miniere (BUREMI). Mining companies are privately held, but the government is usually an important stockholder (e.g. holdings of 33 percent in the Arlit uranium mine).

In the uranium industry, Niger's pricing and tax structure allowed about 14 percent of the total profits to go to foreign shareholders, while nearly all of Niger's share goes into a national investment fund. It has been Niger's policy not to develop a uranium deposit until there is a long-term guaranteed market. Specific legislation on minerals may be found in Appendix VI.

West Africa. 21 January 1980.
2.1.2. Energy

In 1970 per capita energy consumption in Niger was estimated at 4.96 $10^6$ Btu (World Bank estimate: 25.0 kg. of coal equivalent, 1970). About 93 percent of this energy was derived from wood, the implications of which are discussed in later sections. Various forms of annual energy consumption are noted in the following table:

<table>
<thead>
<tr>
<th>Source</th>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel wood consumption</td>
<td>1969</td>
<td>$2.0 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>Electric power</td>
<td>1975</td>
<td>$70 \times 10^6$ kwh</td>
</tr>
<tr>
<td>Oil consumption for transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petrol</td>
<td>1970</td>
<td>$14.3 \times 10^3$ m$^3$</td>
</tr>
<tr>
<td>Diesel</td>
<td>1970</td>
<td>$15.1 \times 10^3$ m</td>
</tr>
<tr>
<td>Total petroleum products</td>
<td>1970</td>
<td>51,623 tons</td>
</tr>
<tr>
<td>Total energy consumption</td>
<td>1970</td>
<td>25.0 kg. of coal equivalent</td>
</tr>
<tr>
<td>per capita</td>
<td>1977</td>
<td>37.0</td>
</tr>
</tbody>
</table>


Non-wood energy comes primarily either directly or indirectly from petroleum, which must be imported. A number of projects, some of which may have environmental implications, are underway or being contemplated to lessen this dependence. A bilateral agreement with Nigeria concerning hydroelectric power was implemented in 1976, allocating 30 MW annually to Niger from the Kainji dam in Nigeria. Small dams are being considered on the Mekrou River or on the "W" of the Niger River. Either would probably require agreements with Benin, Upper Volta, or both. The planned Kandadji dam on the Niger

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10 Source: Niger, Ambassade des Etats-Unis. undated.
River near the border is a larger multi-purpose project which will include hydroelectric power. The Liptako-Gourma Organization (Mali, Niger, Upper Volta) has already sponsored one study of this project.

Nuclear power is another possibility which has been considered for some time. Although earlier in the decade the option had been rejected because of costs, by 1978 it had been revived and international loans secured to build a 250 m kwh plant in Aïr near the uranium mines.

A small Office of Solar Energy (ONERSOL) was established in 1966, which be 1976 had 4 full time researchers and 3 technicians on the staff. The 1978-1983 five year plan calls for research into solar and wind energy. Economic uses in Niger will essentially be limited to small-scale energy needs, such as domestic heating, cooling, or cooking. Solar powered groundwater pumps have also been experimented with. These kinds of energy sources are still largely in the research and experimental stage as of 1980.

2.2 Water

2.2.1 Surface Water

Niger Basin

The majority of Niger falls within the Niger River basin, and the Niger River itself flows across the southwestern portion of the country. To the north of the river a set of shallow stream channels is left from a period when a wetter climate prevailed. These extend into the Air Massif and other mountain regions in Mali and Algeria. Though these dry beds, call dallol, many occasionally flow during heavy rains, they are more important for their shallow water tables. Such conditions prevail all across Niger, with more southerly stream beds more likely to flow for a few months. There are no perennial tributaries to the Niger in the Nigerien Niger basin.

The Niger River rises in West Africa in the region of eastern Guinea, northern Ivory Coast, and southern Mali. From Timbuctou in Mali to the Niger border, there are no tributaries, and the river loses about 10 percent of its volume to evaporation. Small southern

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Arid Lands Natural Resources Committee. 1979.
Inter African Committee for Hydraulic Studies (CIEH).
Vol. 1, 2, 3. 1979.
bank tributaries nearly offset evaporation losses from
the border to Niamey, where the average flow is about
33.1 x 10^9 cubic meters. A number of tributaries between Niamey
and Gaya, all of which originate south of the border,
increase the annual flow to 37.8 x 10^9 cubic meters by the
time it reaches Gaya.

Peak low on the Niger is during January or February at
Niamey, when the volume is normally over twice the average.
The lowest flow is normally during July, and can be as little
as 10 to 20 percent of the average. At Gaya the January-
February peak is also over twice the average flow. Since
Gaya is in the wettest part of Niger, there is also a smaller
second peak in September due to local rains. Peak flow
on all the tributaries is due solely to local rains, rather
than basin-wide collection, and thus comes in August-Sept-
ember. These tributaries are all dry for several months
during the dry season.

Little water quality data is available beyond the general
observation that surface water is usually low in hardness,
alkalinity, and total dissolved solids. Analysis of a
sample of Niger River water taken at Tillabery in November
1979 showed the following:

<table>
<thead>
<tr>
<th>Field Ph</th>
<th>ppm of: Na</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>Cl</th>
<th>SiO</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>1.9</td>
<td>2.0</td>
<td>3.4</td>
<td>1.8</td>
<td>&lt;1</td>
<td>9</td>
</tr>
</tbody>
</table>

Chad Basin

Niger shares Lake Chad with three other countries, and the
eastern portion of the country falls within the Chad basin.
The only tributary to the lake of even minor importance any-
where near Niger is the Komadugu Yobe. This streambed starts
in northern Nigeria and serves as the Niger-Nigeria boundry
for the last 150 km of its course. The Komadugu Yobe flows
only during the wet season, and contributes only .5 x 10^9 cubic
meters of water annually to the lake, which is 1.2 percent of
the total.

Lake Chad itself fluctuates greatly in area by year and
season. In the 20th century its recorded area has varied
from 10,000 to 25,000 sq. km. Maximum depth is only from
7-12 meters. Lake Chad loses over 90 percent of its in-
flow to evaporation, but rather surprisingly is a freshwater
lake. There are several possible explanations. The most
important salt removal mechanism seems to be that constant
seepage into the clay and water bearings sandy layers on the
northern rim of the lake causes the salt to be deposited in
the sands. Salinity of wells in this area is 10 times greater
than in water discharged into Lake Chad.
2.2.2 Groundwater

The African Shield, or Precambrian basement complex, underlies most of Africa, including Niger. The Aff Massif, the western corner of Niger, and a small area near Zinder are part of this but in the rest of the country various sedimentary formations overlie the ancient basement complex. The Nigerien portions of these sedimentary basins are generally good groundwater reservoirs, and Niger is one of the most well-situated Sahel countries with regard to groundwater resources.

Groundwater depth in certain sedimentary basins may average 40-60 meters; in others it is 200-300 meters. In general, central Niger is overlain by basins with deeper aquifers, and in the eastern and western portions groundwater is closer to the surface.

Groundwater level fluctuations can be 5-10 m or even greater between rainy and dry seasons. Recharge of aquifers is nearly all due to rainfall, and thus is practically nil in areas of less than about 400 mm annually. Estimated safe yield from southwestern Nigerien aquifers is about $1.8 \times 10^9$ cubic meters per year. For the aquifers in southeast Niger, which is part of the Chad basin, this figure is only slightly greater, not quite $1.9 \times 10^9$ cubic meters per year. Total storage in the aquifers of southern Niger is estimated at about $200 \times 10^9$ cubic meters which means that the safe yield is around 2 percent.

Water quality in the sedimentary basins is generally quite good, and in the basement it is excellent. Total dissolved solids may be in the range of 250 mg/liter and 500-1000 mg/liter for basement and sedimentary groundwater respectively.

Detailed water resources data for the area of southern Niger and for a small study area west of Agadez can be found in Appendix V.

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Arid Lands Natural Resources Committee. 1979.
2.2.3 Water Use

Although irrigation potential is still largely undeveloped, one of the major uses of surface water is for irrigation. Present consumption (1976-1978) of water for agriculture on the Niger River is shown in the following table:

<table>
<thead>
<tr>
<th>Irrigated area:</th>
<th>24,000 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water use (irrigation):</td>
<td>$720 \times 10^6$ m$^3$/yr</td>
</tr>
<tr>
<td>Flood recession area:</td>
<td>50,000 ha</td>
</tr>
<tr>
<td>Water Use (flood recession):</td>
<td>$750 \times 10^6$ m$^3$/yr</td>
</tr>
</tbody>
</table>


In addition, about 1,100 ha are irrigated from small reservoirs near Tahoua and a few hundred hectares are irrigated with water from Lake Chad. Groundwater is usually used for household water needs and for livestock. Wells are most often hand dug and water is hand drawn.

The Niger valley has a potential irrigable area of about 140,000 ha, which depends largely on the completion of the Kandadji dam near the Mali border. Another 100,000 ha could potentially be irrigated through the construction of hundreds of small dam reservoirs on small watercourses throughout the country. The Nigerien portion of the Lake Chad area has only about 7,000 ha potential. The Inter African Committee for Hydraulic Studies projects that water use in the savanna portion of Niger in the year 2000 will be about $4,264 \times 10^6$ cubic meters per year, about 92 percent of which is for irrigation. Projections are shown in the following table, and a number of proposed dam projects which will help realize irrigation potential can be found in Appendix V.

---

**Sources:**
Year 2000 Projected Water Use ($10^6 \text{ m}^3/\text{yr}$)

<table>
<thead>
<tr>
<th>Total Irrigation</th>
<th>Human Consumption</th>
<th>Livestock</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Total Rural Small Towns Niamey)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4264</td>
<td>3920 (92%)</td>
<td>237 (67)</td>
<td>150 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>57 85 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2%) (1%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(6%) (&lt;1%)</td>
</tr>
</tbody>
</table>


2.2.4 Water Law

Legislation in force concerning water is primarily based on French colonial laws, unless amended on superseded by subsequent legislation. Appendix VI includes water legislation. In the event no legislation applies, Islamic and other customary law is used. Ownership of water is generally in the public domain, except in certain cases such as a well built by private means on private land. In practice, water users further from administrative influence may tend to act as owners themselves. The issue of priorities is not addressed in legislation. Thus customary and Islamic law is referred to, and sets these priorities in decreasing order of importance as: drinking water, animal watering, irrigation, then industrial and recreational use. Though not formally law, these priorities tend to give urban areas with higher population concentrations needing drinking water preference over rural and grazing areas.

In general, legislation does not cover the amount of water which may be used either in rural or urban areas. However, pumping stations in livestock areas may only be opened once surface water from the rainy season is exhausted.

Water quality is controlled only in urban areas, where the supplier must meet certain standards and test its water periodically. Companies may be held liable for poor quality if they are determined to be at fault; otherwise the urban administration is empowered to trace the source of pollution and take action against those at fault.

Niger is a member of several international organizations which regulate water resources to some extent. The Lake

Chad Basin Commission is made up of Niger, Nigeria, Chad, and Cameroon. It is charged with seeing that exploitation and development of water resources in the area do not have detrimental effects on water courses in the basin or on the lake itself. This broad definition of powers allows the commission to take an interest in such things as livestock production, agriculture, fisheries, transport and communication, tse-tse fly eradication, and hydrology.

The Niger River Commission consists of nine African states which share the Niger Basin. Its purpose is similar to the Chad Basin Commission. Activities include projects and studies on fishing, hydrology, hydrography, solar energy, and transport. Both of these organizations may recommend legislation to member states, and theoretically are responsible for ensuring implementation by member states of any agreements reached.

The Inter African Committee for Hydraulic Studies is charged primarily with facilitating exchange of information and cooperation on research. The committee also conducts its own research. The Liptako-Gourma Region Integrated Development Authority (Mali, Niger, Upper Volta) is to promote regional development of the contiguous parts of these three states. Water, water use for agriculture and livestock, and fishing are among the interests of this body.

Several internal agencies are also concerned with various aspects of water resources. The Ground Water Authority (OFEDES) is charged with construction, operation, and maintenance of wells and baseholes in rural areas. The Water Commission is responsible for determining Niger's water policy, for coordinating projects of various governmental agencies, and for evaluating the impact of such projects. It may also examine and advise on any legislation on water matters.

2.3 Soils and Agricultural Land Use

2.3.1. Soils

The Sahel-Sudan portion of Niger has been included in a study on resources by the Inter African Committee for

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15Source: Church, R. J. H. 1974.
Arid Lands Natural Resources Committee. 1979.
Inter African Committee for Hydraulic Studies. 1979.
Vol. 1, 6.
Hydraulic Studies (CIEH). Soils were classified by their agricultural or range potential and divided into five categories as follows:

**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 which have slight to moderate limitations which may restrict their use. Yields of climatically-adapted crops are moderately good.

**Class 3**: Generally poor to moderate soils. These soils have 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 of salinity/alkalinity), virtually preventing crop growth unless improved.

Class 1 soils are hydromorphic soils by the French terminology. In the FAO mapping system they are Gleysols (humic, eutric and undifferentiated), Fluvisols, cutric and undifferentiated gleyic Luvisols, and gleyic Cambisols. In Niger these are found along the Niger River and its tributaries, in the major dalls extending towards Air, in some of the dry stream beds of south-central Niger, and along the border with Nigeria near Lake Chad.

Class 2 soils are also hydromorphic soils excluded from class 1, such as acid humic and vertic hydromorphic soils, those gleyed throughout, or immature soils over sandy alluvium. A few ferruginous or brown subarid soils are also included here. Their distribution is in general similar to class 1, and like class 1 they are usually found in association with other classes.

Soils of class 3 are Tropical Ferruginous (plinthic and ferric luvisols in FAO terminology) and desaturated Ferallitic soils (FAO: ferric and orthic Acrisols, some Nitosols). The are common in southwest and southcentral Niger.
Class 4 soils are made up of two major groups. Light textured and sandy soils with little profile development, mainly immature, Reddish Brown Subarid, and Tropical Ferruginous over eolian sands (FAO: Regosols, luvic, cambic, and ferralic-Arenosols), comprise the first group. The second group consists of heavy textured vestisols. This class, especially the light textured group, is the most common one of the Sahel, and these soils extend all across Niger south of about 17° N.

Class 5 is comprised of loose shifting sands, shallow lithosols, and saline soils. The vast majority of Niger is of this type. Generally, a band of shallow lithosols extends from the Sahel into the desert until it merges with the completely raw mineral soils of the Sahara. In the east, these raw desert soils extend to the area around Lake Chad.

Unfortunately, the CIEH has not published a soils map which is usable for specific countries. The following map from another source gives an idea of soil distribution in Niger.
Soils throughout Niger are often subject to severe erosion. Causes can sometimes be attributed to human mismanagement, but often are unconnected to agriculture or pastoralism. With such sparse plant cover, many areas are subject to wind erosion or water erosion during short, heavy rains. Estimates for Zinder district show that human activities are the major factor only in localized areas, as shown in the following map.
While agriculture is a major sector of the economy, and a major land use in southern Niger, cultivation only takes up a small proportion of total surface area. For 1976-77, only 2.2 percent of Niger's surface was under cultivation, and in the most heavily cultivated district, Dosso, this figure was only 16.7 percent. The following table shows area under cultivation by district for the early 1970's and 1976-77.

### Area under Cultivation by Region, 1971-73

<table>
<thead>
<tr>
<th>Districts</th>
<th>Total Area (‘000 ha.)</th>
<th>Area under Cultivation</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niamey</td>
<td>9,030</td>
<td>970</td>
<td>1,021</td>
</tr>
<tr>
<td>Dosso</td>
<td>3,100</td>
<td>484</td>
<td>402</td>
</tr>
<tr>
<td>Tahoua</td>
<td>10,668</td>
<td>368</td>
<td>380</td>
</tr>
<tr>
<td>Maradi</td>
<td>3,858</td>
<td>384</td>
<td>424</td>
</tr>
<tr>
<td>Zinder</td>
<td>14,543</td>
<td>430</td>
<td>434</td>
</tr>
<tr>
<td>Diffa</td>
<td>14,022</td>
<td>92</td>
<td>16</td>
</tr>
<tr>
<td>Agadez</td>
<td>71,479</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>126,700</td>
<td>2,729</td>
<td>2,677</td>
</tr>
</tbody>
</table>


It is estimated that nearly another 12 percent of Niger's area may be potentially cultivable, so there is quite a lot of room for expansion. Only about 1 percent of the cultivated land in 1976-77 was irrigated.

Agriculture in Niger is overwhelmingly subsistence-oriented. Over 95 percent is on small farms of less than five hectares, which average holdings of around three hectares.

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Food and Agriculture Organization. 1976.
The land is worked by hand, as farmers do not keep livestock. Herding is almost entirely the provenance of the nomadic groups. Over half the cultivated area is planted in millet as soon as the first rain comes in June, and the other major food crops are planted soon after. Cowpeas (Nieber) and peanuts are usually intercropped. Cotton may be planted last after a farmer feels he has enough food crops. There tends to be little specialization in cropping. Most farmers produce a mixture, including some cash crops. Production by district of major crops is shown in the following table and is followed by a general map showing economic activity including agriculture.

### Regional Production of Major Crops 1972-1976

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>A</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>TAMOUA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAMET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MALI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAHARI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TANDA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CILSS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vol. 2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P - Production (1000 Tons)  A - Area (1000 Hectares)  Y - Yield (kg/ha)
NA - Not available
Source: Available from U. S. Government Printing Office, Map No. 59203, 4-69.
Final rights to the land are usually vested in the tribal chief, but for practical purposes land belongs to the patrilineage as a group. It is parcelled out to members of this kin group on the basis of need. Decisions, direction, and actual work involved in farming are usually collectively carried out by the patrilineage.

Farmers are generally aware of elementary procedures which can improve productivity. They often treat seed, and are aware of the beneficial effects on the soil of groundnut cultivation and of manure application. However, the effectiveness of such measures is not very great due to poor application of such methods. Yields of major food crops gradually dropped throughout the 1970's, to the extent that even with increased planting area, production has dropped. This trend can be seen in the following table.

**Millet and Sorghum, 1964-75**

<table>
<thead>
<tr>
<th>Year</th>
<th>Area ('000 ha)</th>
<th>Production ('000t)</th>
<th>Yield/hectare (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>2,230</td>
<td>1,328</td>
<td>595</td>
</tr>
<tr>
<td>1965</td>
<td>2,275</td>
<td>1,055</td>
<td>464</td>
</tr>
<tr>
<td>1966</td>
<td>2,273</td>
<td>1,119</td>
<td>492</td>
</tr>
<tr>
<td>1967</td>
<td>2,421</td>
<td>1,342</td>
<td>554</td>
</tr>
<tr>
<td>1968</td>
<td>2,491</td>
<td>948</td>
<td>380</td>
</tr>
<tr>
<td>1969</td>
<td>2,867</td>
<td>1,384</td>
<td>483</td>
</tr>
<tr>
<td>1970</td>
<td>2,903</td>
<td>1,101</td>
<td>379</td>
</tr>
<tr>
<td>1971</td>
<td>2,935</td>
<td>1,226</td>
<td>418</td>
</tr>
<tr>
<td>1972</td>
<td>2,761</td>
<td>1,126</td>
<td>408</td>
</tr>
<tr>
<td>1973</td>
<td>2,456</td>
<td>753</td>
<td>307</td>
</tr>
<tr>
<td>1974</td>
<td>2,772</td>
<td>1,100</td>
<td>394</td>
</tr>
<tr>
<td>1975</td>
<td>2,800</td>
<td>1,000</td>
<td>357</td>
</tr>
</tbody>
</table>


1/ Average index of three years, 1964-66, which may be considered "normal" years.

The use of chemical fertilizers, insecticides, and mechanical equipment is very rare in Niger. In 1975 there were only 50 tractors in the country, and 130 tons of fertilizer were used. Chad and Mali, countries with roughly similar populations and climates, had 300 and 200 tractors respectively. They used 2,000 and 5,000 tons of fertilizer respectively.
Major Problem in Agriculture

One of Niger's most obvious problems is its climate. Even in normal years the agricultural situation is precarious. Production falls drastically during droughts, such as between 1967-1973, because 99 percent of crop production is by dryland farming. Moreover, the traditional farming methods are no longer adequate to sustain a population which is no longer in balance with the environment. Emigration from rural areas further aggravates the situation by increasing even more rapidly a segment of the population which is non-productive in terms of agriculture. Cultivation must be intensified, but with traditional methods this only results in further degradation of the land. Niger has very little agricultural infrastructure which might be able to rapidly introduce modern techniques into rural areas, and the cost of many such techniques remains quite high by local standards. Crop disease is yet another problem that the traditional farmer cannot cope with. Groundnut production, which survived the drought with only slight decreases, was hit immediately afterwards by disease. Production was severely hurt for several years and is not yet up to early 1970's levels.

2.4 Vegetation17

The International Union for the Conservation of Nature and Natural Resources (IUCN) has mapped and described the vegetation cover of West Africa. The following vegetation zones are found in Niger (refer to map following this section):

1. **Sudanian undifferentiated woodland (mapping unit 12)**

Most of the region has been inhabited for centuries and practically all the vegetation has been deeply modified by cultivation, cutting, grass fires and grazing.

Woodland remains only on rock hills and ironstone plateaux. Larger trees are 8 to 12 meters high and the most common species are Anogeissus leiocarpus, Balanites aegyptiaca, Lannea microcarpa, Prosopis africana, and Sclerocarya birrea. The lower tree stratum, about 6 meters tall with short boles, includes Combretum glutinosum, Strychnos spinosa, and Terminalia avicennioides.

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2. South-Saharan zone (mapping unit 17)

This is a zone of contrasting seasons due to the extreme difference between rainy and dry seasons. In the rainy season pastures are dominated by annual plant species which, providing it rains in a regular fashion, ensure their perenniability by producing a vast quantity of seeds. Pastures, which become dry due to the change of season, continue to vegetate, and a considerable amount of plant matter is produced so long as there is water available.

Hay pastures include the following:

a. *Aristida mutabilis* and *Eragrostis tremula* pasture cover wide areas of land, ranging from the lower part of Senegal to Chad.

b. *Schoenefeldia gracilis* pastures consist of loamy sand soils, which are very suitable for livestock but their production very much depends upon climatic changes.

c. *Aristida* pastures of the group *pallida*, with low agrostologic value, perennial and hard stubble, abandoned by livestock.

Trees providing fodder are just as important for livestock as for wild fauna, gazelles in particular. In the middle of the dry season these are the only source of green fodder and proteins. Among the true evergreen trees, the most important are *Balanites aegyptiaca* and *Maerua crassifolia*. Trees with deciduous leaves include *Commiphora africana*, *Grewia spp.*, *Zizyphus*, *Cordia rothii*, and *Combretum aculeatum*, which shed their leaves during part of the dry season, e.g. *Acacia raddiana*.

These trees have suffered greatly from the continuous drought. In some of the Nigerian and Chadian zones, more than half of the *Acacia raddiana* died. It is difficult for trees to regenerate; the young ones are always mutilated and herdsmen use the "green" trees in order to give fodder to their herds. The disappearance of trees accelerates desertification. Animals are deprived of protection against the intense heat of the sun and of food plants which grow under trees, sheltered from excessive heat.

Desert grasslands on sands in West Africa are dominated by two species of tufted perennial grasses: *Panicum turgidum* and *Stipagrostis* (Aristida) *pungens*. Woody species include *Acacia senegal*, *Balanites aegyptiaca*, *Commiphora africana*. Further north *Acacia tortilis* becomes the principal woody species.
3. **North-Sahelian zone (mapping unit 19)**

   This is a steppe, herb-like vegetation, of which the plants cover less than 3 percent of the soil. The main types of pastures are:

   a. *Panicum turgidum*, very much sought after by pastoralists, is the basic food of the addax and oryx.

   b. *Cyperus conglomeratus* pasture - on poor soils; is low-quality fodder.

   c. *Aristida longiflora* pasture, in sub-desertic regions, which retains nutritive value even when dry.

   d. *Aristida acutiflora* pasture found along the desert fringe; good fodder for camels, gazelles and addax.

   The only shrubs and trees are to be found on the edges of the Quadis, of which the principal species are *Zizyphus mauritiana*, *Acacia raddiana*, *Balanites aegyptiaca*, *Maerua crassifolia*, and *Combretum aculeatum*.

4. **The Sahara desert (mapping units 24, 26, 27, 28)**

   The Sahara is the largest desert in the world and most extreme in its climatic conditions. Daily amplitude in temperature can exceed 35° C and annual amplitude 60° C.

   Apart from the high mountains of limited extent, the Sahara consists of several basins isolated from the sea and lacking any outward drainage. Depressions are either sand desert (erg) or gravel desert (reg). Between the depressions, the stratified terraced landscape forms a stone desert (hamada) incised by dry valleys (ouadi or wadi). Oases occur wherever water of low salt content issues as spring in the desert.

   Wadis are the only habitats where trees and large bushes are found. There are three main vegetation communities: *Tamarix* communities in larger sandy wadis; *Acacia* communities on rocky beds of wadis and gravelly alluvium of outwash fans, the most widespread of which is characterized by *Acacia tortilis* and *Panicum turgidum*; and *Hyphaene* ("Doum") communities in the larger wadis radiating from the south-western slopes of the Tibesti and which locally form well grown fringing forests. Dominant trees are *Hyphaene thebaica*, *Salvadora persica*, *Tamarix articulata*, and *Acacia nilotica*. 
a. Vegetation of ergs – after heavy rains, desert dunes may have a 50 percent cover or otherwise may be completely sterile. *Stipagrostis pungens* and *Cornulaca monacantha* is present throughout in western Sahara.

b. Vegetation of sandy regs – extremely homogeneous and almost exclusively composed of xerophytes. Frequent species are *Danthonia forskalii*, *Plantago ciliata*, and *Polycarpaea fragilia*.

c. Vegetation of hamadas – plants only grow in rock crevices and water receiving depressions. The vegetation is relatively uniform throughout and rather rich in species, which include *Forskalea tenacissima*, *Asteriscus graveolens*, *Salvia aegyptiaca*, and *Reseda villosa*.

There is also a tiny area of semi-aquatic vegetation (mapping unit 30) which the IUCN does not describe. Another classification scheme calls this undifferentiated swamp, and describes the vegetation as follows:

*Cyperus papyrus* is a common sedge fringing the edges of swamps and lakes and some of the more characteristic hydrophilous grass species of the perennial swamps are *Echinochloa pyramidalis*, *E. stagnina*, *Vossia cuspidata*, *Brachiaria mutica*, *Vetiveria nigritana*, *Oryza barthii*, *Phragmites spp.*, *Leersia hexandra*, *Acroceras macrum*, *Panicum repens*, *Pennisetum purpureum*, *Chasmopodium sp.*, *Anadelphia arrecta*, *Saccharum spontaneum* and *Paspalum commersonii*. Common sedges are species of *Typha*, *Juncus* and *Scirpus*.

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Vegetation Map of Niger

2.4.1 Forestry

Except for local stands in such places as dallol beds, trees are found only in the Sudan and to some extent the southern Sahel zones of vegetation (units 12 and 17 on map respectively). These "forests" are not dense, compact areas of trees, but rather dispersed trees which very seldom have crowns touching one another. This "forest" area corresponds roughly with the area of sedentary agriculture, and since most energy needs in Niger are met by wood fuel, even these sparse tree resources are being depleted rapidly. Under the most optimistic conditions it is estimated that in the Department of Zinder wood resources will be depleted within 23 years. More pessimistic estimates see these resources gone within 11 years. The situation is slightly better in the departments with more area in the Sudan zone; however even these have major problems.

The areas around urban centers often have no wood left at all, and farmers find it profitable to gather wood in rural areas for sale in the city as well as for their own use. The following table shows that wood use was slowly increasing in the early 1970's.

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Roundwood Removals

(FAO estimates, '000 cubic metres, all non-coniferous)

<table>
<thead>
<tr>
<th></th>
<th>1971</th>
<th>1972</th>
<th>1973</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel wood</td>
<td>160</td>
<td>165</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>2,180</td>
<td>2,250</td>
<td>2,320</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,340</td>
<td>2,415</td>
<td>2,490</td>
</tr>
</tbody>
</table>


This increase in use was taking place at the same time that desertification was rapidly spreading, and must be counted as at least a minor contributing factor. Depletion of tree cover has serious consequences not only in terms of rural energy needs, but also because the cover helps prevent soil erosion and desert encroachment.

The government of Niger has been well aware for some time of the problems inherent in allowing such trends to continue. A number of programs to reverse the trend have been implemented or are being considered. From 1965-1968 a program aimed at reforesting 3,290 hectares was only partially successful and actually reforest ed 775 hectares. Similar programs since then have also only been partially successful, but over 8,300 hectares have been planted with over 830,000 trees by the early 1970's. The main trees used for these plantings have been Acacia albida or other Acacia species.

Other work being carried out includes managing areas of fast growing trees to relieve pressure on natural growth, developing green belts around towns, and attempts to maintain stricter controls over exploitation of wood resources. Most activities in the area of forestry are carried out by the Department of Water and Forestry (or Water and Forest Service), within the Ministry of Local Economy. The effectiveness of such programs is limited by lack of funds and trained personnel.

2.4.2 Pastoralism

Pastoralism is the major activity of the northern Sahel zone.
(unit 19 on map), and is also widespread in the southern Sahel (unit 17 on map) in areas where agriculture is not practiced. After the rainy season, some vegetation can be found in the southern Saharan regions (units 27 and 28), and nomads may move their animals to take advantage of this. In general, Fulani cattle pastoralists utilize the more southern portions of these areas, and the Tuareg live in the northern portions.

The livestock sector has always been a major factor in the traditional economy. Even in the modern economy it still contributed about 12 percent to the GNP in 1971, and about 17 percent to export earnings in 1976. Herd sizes may be seen in the following tables, which also serve to show the extent to which the livestock sector, especially cattle, were hit by the 1967-1973 drought.

### Livestock Population

<table>
<thead>
<tr>
<th>Breed</th>
<th>1958</th>
<th>1968</th>
<th>1969</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>3,500,000</td>
<td>4,500,000</td>
<td>4,000,000</td>
</tr>
<tr>
<td>Sheep</td>
<td>1,800,000</td>
<td>2,470,000</td>
<td>2,070,000</td>
</tr>
<tr>
<td>Goats</td>
<td>5,000,000</td>
<td>6,140,000</td>
<td>5,700,000</td>
</tr>
<tr>
<td>Horses</td>
<td>110,000</td>
<td>170,000</td>
<td>170,000</td>
</tr>
<tr>
<td>Donkeys</td>
<td>300,000</td>
<td>360,000</td>
<td>330,000</td>
</tr>
<tr>
<td>Camels</td>
<td>350,000</td>
<td>360,000</td>
<td>330,000</td>
</tr>
</tbody>
</table>


### Livestock

<table>
<thead>
<tr>
<th>('000 head)</th>
<th>1975</th>
<th>1976</th>
<th>1977*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horses</td>
<td>191</td>
<td>206</td>
<td>210</td>
</tr>
<tr>
<td>Asses</td>
<td>344</td>
<td>384</td>
<td>370</td>
</tr>
<tr>
<td>Cattle</td>
<td>2,508</td>
<td>2,581</td>
<td>2,900</td>
</tr>
<tr>
<td>Camels</td>
<td>257</td>
<td>283</td>
<td>265</td>
</tr>
<tr>
<td>Pigs</td>
<td>26*</td>
<td>27*</td>
<td>28</td>
</tr>
<tr>
<td>Sheep</td>
<td>2,159</td>
<td>2,523</td>
<td>2,560</td>
</tr>
<tr>
<td>Goats</td>
<td>5,395</td>
<td>5,940</td>
<td>6,200</td>
</tr>
<tr>
<td>Poultry</td>
<td>7,200*</td>
<td>7,300*</td>
<td>7,400*</td>
</tr>
</tbody>
</table>

* FAO estimates.


### Problems of the Livestock Sector

As with agriculture, the livestock sector is heavily influenced by climate. In years of good rains, pastoralists increase herd size, since animals are regarded as the main source of wealth. When drought comes, such as in 1967-1973, the reduced pasture is more intensively grazed.
Eventually this pasture fails from a combination of over-grazing and the effects of drought, and herds must be drastically reduced. Some animals may be sold for emergency cash. More often they simply die, and the nomads lose their livelihood and must become refugees. The effect on the land is to increase erosion, reinforcing the effects of the drought and complicating desertification problems.

The same cycle can be set in motion even without drought. In years of good rains, the agricultural sector tends to expand into the best grazing areas, and herds are restricted from grazing many former pastures. The result can be the same as during drought, since herds are concentrated on less pasture.

Under these conditions, the combination of private ownership of animals with collective rights to grazing land can compound range problems. Many individual herders are actually quite well aware of the dangers of overgrazing. However, if a herder restricts grazing by his animals, someone who does not recognize the problem will immediately step up grazing in the area. The net result for the conscientious herder is simply to deprive his animals of pasture without anything at all having been accomplished in terms of range conservation.

Other constant problems include animal diseases. Although the health status of Nigerien herds is generally good, locally certain diseases can be a significant factor. The Niger valley south of Say is infested with tse-tse fly, and trypanosomiasis is a major concern to cattle owners in this area. Bovine and caprine pleuropneumonia are both present, as are aphic fever, blackleg, Rinderpest, anthrax, sheep pox, and a number of other diseases. Internal and external parasites are problems in all herds, and ticks especially transmit a number of diseases such as piroplasmosis.

**Government Involvement**

A number of programs are being carried out by the Government of Niger in the livestock sector. A large scale immunization program for Rinderpest and CLPP has been underway for some time. Other activities have been aimed at rebuilding herds, and at reestablishing nomads who lost their animals in the drought. Several research stations have been set up, and some regulation on burning does exist.

Most activities are carried out by various departments of the Ministry of Rural Economy. As in every other endeavor, extreme shortages of trained personnel have hampered progress. In addition, there is often a lack of understanding of nomadic life, or of the impact of various programs on this life or on the range itself.
Wildlife is best considered in conjunction with protected areas. The population of wildlife is generally lower where human density is greater. In addition, data on wildlife populations is in general only available for protected areas. All types of wild fauna are hunted as a supplementary food source, and even protected areas are not usually well-patrolled. Hunting regulations and laws protecting some species are on the books, but the means do not exist for rigorous enforcement.

"W" National Park (334,375 ha)

This park extends over three countries and has areas of both Sudanian and to a lesser extent, Sahelian vegetation and climate.

<table>
<thead>
<tr>
<th>&quot;W&quot; National Park Area</th>
<th>1,186,425 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>of which in Benin:</td>
<td>502,050</td>
</tr>
<tr>
<td>Upper Volta:</td>
<td>350,000</td>
</tr>
<tr>
<td>Niger:</td>
<td>334,375</td>
</tr>
</tbody>
</table>

The park abounds with large numbers of antelops. Species like roan (Hippotragus equinus), hartebeest (Alcephalus bucephalus), and kob (Kobus kob) roam the savannas. Sitatunga (Tragelaphus spekii), Defassa water buck (Kobus defassa), Bohor reedbuck, oribi (Ourebia ourebia), and red-fronted gazelle can be found near aquatic habitats, and topi (Damaliscus korrigum) graze on the northern plains near the Tapoa River. Several duiker species (Cephalophus sp.) and the grey duiker (Sylvicapra grimmia) also occur. Warthog (Phacochoerus aethiopicus), elephant (Loxodonta africana), and buffalo (Syncerus caffer) are found throughout the park, and hippopotamus (Hippopotamus amphibius) are present along the rivers. Baboons, vervets, and several monkeys are often encountered. Carnivores include serval (Felis serval), caracal lynx (Felis caracal), lion (Panthera leo), leopard (Panthera pardus), cheetah (Acinonyx jubatus), spotted hyaena (Crocuta crocuta), striped hyaena (Hyaena hyaena), jackal (Canis mesomelas), and sand fox. Migratory aquatic birds visit the region when the rivers leave their beds and flood the surroundings (Dec.-May). Species include geese, ducks, cormorants, pelicans, waders, ibises, storks,

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IUCN. 1977.
IUCN. 1971.
herons, and egrets. Guineafowl, Abyssinian ground hornbills, and secretary birds inhabit the wooded savannas. Vultures, brown harrier eagles, fish eagles, martial eagles, and swallow-tail kites are frequently seen.

Vast grasslands provide food for an abundance of seed-eaters, including doves, finches, weavers, Denham's bustards, pipits, and larks.

The most conspicuous reptiles are crocodiles, monitor lizards, pythons, and turtles.

In general, protection throughout the park is poor, and poaching is heavy. However, each section of the park is managed separately by the individual countries. Niger's portion, administered by the Ministry of Rural Economy, seems to be better managed and controlled than the other two portions. This is the area where large phosphate deposits have been discovered, and the Nigerien "W" National Park could be seriously jeopardized if future development of these deposits are not carefully managed.

The park is open to tourism from December through April, and is closed the rest of the year when heavy rains occur.

**Tamou Total Reserve (142,640 ha)**

This reserve adjacent to the "W" National Park on the northwest is covered with degraded secondary forest and gallery forest, and contains fauna similar to "W". The reserve covers part of the regular seasonal movements of several species such as lion, elephant, buffalo, roan, topi, and gazelle. Among the birds recorded are white pelican, egrets, saddle-bill stork, marabou stork, and secretary bird.

Villages still practice shifting cultivation within the reserve, and much illegal grazing and burning occurs. Officially, entry is by permit only and hunting is prohibited, but poaching is nevertheless intense.

A partial reserve apparently extends beyond the borders of the total reserve and the "W" park.

**Tadress Total Fauna Reserve (1,600,000 ha)**

Hardly any information is available on this unofficial reserve in the Air massif. Because agreements have not yet been reached with the local nomadic populations, Niger has not yet been able to declare this an official reserve as of 1979.
Termit Massif (900 sq. km.)

This reserve in the desert southeast of Agadez contains a wealth of fauna, including dama gazelle, dorcas gazelle, ostrich, cheetah, mouflon, and possibly addax, as well as many birds. No other information is currently available.

Tenere Partial Fauna Reserve (8,600,000 ha)

Also in the Tadrouss area, this reserve is still in the planning stage.

Niger also has plans to institute protection of the giraffe in the Tillaberi region and migratory aquatic birds along the Niger River. No other information is currently available about these projects. A Gadabegi Fauna Reserve is listed by IUCN (1977, 1971) without further identification or information.

2.5.1 Endangered Species

The IUCN Red Data Book lists the following four species in Niger as endangered:

- *Lycaon pictus*  
- *Oryx dammah*  
- *Addax nasomaculatus*  
- *Gazella leptoceros*

African wild dog  
Scimitar-horned oryx  
Addax  
Slender-horned gazelle

The Leopard (*Panthera pardus*) and cheetah (*Acinonyx jubatus*) are listed in the Red Data Book under neighboring countries, but their status in Niger is unknown. The Federal Register List of Endangered and Threatened Wildlife and Plants includes the African Elephant and Western African ostrich on its lists, as well as those mentioned above.

2.5.2 Fishing

Fishing is important only locally in a few areas. The total catch in the mid 1970's was about 12,000 tons per year. About 10,000 of this is from the Niger River and its tributaries; the rest is from Lake Chad and the Komadugu River. For the sake of comparison, Mali's catch from the Niger River is 110,000 tons per year, and the total Lake Chad catch is about 90,000 tons per year.

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3.0 Major Environmental Problems

3.1 Drought

One of Niger's greatest problems is largely natural. Most research indicates that drought is a recurring climatic phenomenon in the Sahel. This is not likely to be changed, although careful management and planning could help alleviate many of the hardships caused by drought.

Droughts typically last at least several years in the Sahel. The latest, 1967-1973, actually became noticeable in Niger around 1968. Rainfall may decrease to much less than half the average. For example, at Agadez, with a 30 year average of 165 mm per year, the drought figures were 86 mm in 1969, 40 mm in 1970, and 74 mm in 1972. In addition to less rain, the rainfall pattern is much more irregular.

The nomadic sector is usually the hardest hit by prolonged drought. In Niger the last drought caused the loss of nearly 48 percent of the cattle herd, nearly 36 percent of sheep, and about 16 percent of goats. By 1970, nomads who had any animals left were migrating en mass to the southernmost areas of the country, or even into Nigeria and Benin. Those who had no or too few animals left to support them converged on the cities, especially after relief camps were established.

The agricultural sector was also severely affected. Niger was self-sufficient in food in the early 1960's, but had to import 120,000 tons of grain in 1972/73 and 250,000 tons in 1973/74. Cash cropping was all but abandoned as farmers concentrated on growing what food they could. Many farmers were also forced into the relief camps as crops often failed entirely.

Public and animal health also suffers during drought. Disease can be much more serious in victims weakened by hunger. In addition, the mass population movements resulting from drought facilitate the spread of communicable disease. Cholera apparently first became a major problem in Niger during the drought. Migrations further to the south than normal exposed cattle to trypanosomiasis, to which most cattle in Niger are quite susceptible.

That careful management and good planning can help alleviate some of the hardship should be evident from even the modest progress Niger

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has made since 1973. Niger was probably the hardest hit country in West Africa during the 1967-1973 drought. In 1979 the rains failed again, possibly signalling the beginning of a new drought. Conditions as of early 1980 were reportedly as serious as during 1973.

Crop failures throughout the western Sahel have led to requests for food aid by every CILSS member except Niger. Niger, however, announced a modest grain surplus and may actually ship small amounts of grain to Nigeria.

3.2 Desertification25/

If drought is an inevitable fact of life in the Sahel, many of the consequences of drought are greatly aggravated by man's activities. Desertification has been defined as:

"the impoverishment of arid, semiarid, and some subhumid ecosystems by the combined impact of man's activities and drought. It is the process of change in these ecosystems that can be measured by reduced productivity of desirable plants, alterations in the biomass and the diversity of the micro- and macro- fauna and flora, accelerated soil deterioration, and increased hazards for human occupancy."

(Dregne, 1977)

Desertification does not proceed uniformly in a steady advance, but occurs at scattered points, very often in areas where human activity has degraded the environment. These local areas then expand and link up. A number of man-made causes are responsible for desertification. These have been analysed for Zinder department, and since these causes are applicable to Niger as a whole, they are list here:

a. Overgrazing. The combination of a period of favorable weather, improved animal health, and increasing human population resulted in a dramatic increase in animal numbers in Zinder. When drought occurred in 1968-73, many areas were subjected to intense grazing pressure and many mini-deserts were created, especially around wells and surface water supplies. Overly intensive grazing also can cause irreparable damage in the wet season.

b. Tree cutting faster than regrowth. Wood is the principal source of energy for the farmers and herders in Zinder who comprise about 90 percent of the population, and is a major construction material. Extensive cutting of trees for fuel and construction without adequate programs of replacement has resulted in gradual but continuous depletion of forest resources. People now travel greater and greater distances to find wood. The loss of the trees results in increased soil erosion, laterization, decreased infiltration and increased runoff. All are factors contributing to land degradation and ultimately desertification.

25Source: Arid Lands Natural Resources Committee. 1979.
c. **Cultivation of marginal lands.** Population pressures caused, and
good weather permitted, the movement to the north of crop cultivation.
When the drought came (1968-73), the crops failed; cleared fields
were quickly and severely eroded by strong winds and the infrequent
rains, and inherent soil fertility was lost. Many years of fallow
will be required to restore fertility to previous levels.

The spread of cultivated crops into the grazing zone is being
supported "de facto" by the courts which bring judgements against
herders for destruction of fields by animals. This law was intended
to apply only in the cultivated zone.

d. **Inadequate response to drought.** When the inevitable drought came,
the response capability of the people in Zinder had been greatly
reduced by the increased numbers of humans and animals. Alternate
strategies of coping with drought, mainly by moving south to more
favorable areas, were severely limited by the fact that somebody
else was already there. The result was continued pressure on the
vegetative and water resources at a time when these resources
were already stressed. Additional desertification ensued.

e. **False diagnosis of the problem and poor planning.** Plans formulated
for increased productivity in the early 1960's wrongly or incompletely
identified the problem of the region to be lack of water during the
dry season. The Government of Niger planned on this basis. A
study in the late 1960's by the Institut d'Elevage et de Medecine
Veterinaire des Pays Tropicaux, a French agency, of the grazing
zone did not uncover the fallacy in problem identification. Their
calculations showed that the area had not reached its maximum
stocking rate in spite of rapid increases in herd sizes. They
assumed that the herds were distributed equally throughout the
region. This was and is not the case: pastoral use is discontinuous
in time and in space. Thus while the total region was not over-
loaded, there were very high concentrations of animals around
dependable water sources. By not taking a systems approach, the
planners of the 1960's missed the fact that the animals were
dependent on the vegetation, and the vegetation is dependent on
both the amount and distribution in time and space of rainfall.

The establishment of new markets and new administrative settlements
in the grazing zone increased the number of people in the region in
total and especially during the dry season. Their demands for
wood and other products increased the demands on the local vegetation.

Clearly, many of Niger's major environmental problems can be grouped
under the broad heading of desertification.
3.3 Deforestation and Devegetation

Depletion of ground cover is one of Niger's most serious problems and is, as noted above, a major cause of desertification. In southern Niger where trees exist, wood is widely used for fuel and construction. In addition, expansion of farmland into new areas means that these areas will be cleared of trees and shrubs. The bush is then burned off, which usually kills any seedlings. Thorn branches are the main material used in constructing stock fences. Those few trees which are available in the pastoral zones may also be used for fuel or occasionally for fodder, especially when grasses die during droughts. Niger does have laws against woodcutting, and permits are required to cut any tree. However, field studies show that such measures are and will remain largely unenforceable until the general population has access to wood substitutes.

Overgrazing is another major means of devegetation, and is especially serious in the pastoral zone. A project area between Agadaz and Dakoro, in Maradi Dept., shows evidence that perennial grasses once predominated. Overgrazing of these more palatable grasses gradually shifted the predominence to annual grasses. At present, continued overgrazing over a long period can lead to invasion by inedible shrubs or simply complete devegetation.

As noted above, most of these processes are greatly accelerated by drought.

3.4 Soil Erosion and Degradation

Another of Niger's major problems is soil erosion, much of which is a direct result of the depletion of ground cover discussed above. The short intense rainstoms can carry away much topsoil, but probably an even more important cause is wind. Very few figures are available on the magnitude of erosion except for an occasional local area. At the Ibohamane Dam in Tahoua Dept. 220,000 cubic meters of alluvial material accumulated in 1972. This would represent a soil loss of 31 tons per hectare within the drainage basin, much too large to be attributed to water erosion only.


Soil degradation is also becoming critical in Niger. In agricultural areas, increased pressure on the land has led to more intensive cultivation. Traditional practices of fallow periods can no longer be followed. Intercropping and crop rotation with cash crops such as groundnuts has decreased. The result has been that soils no longer have any opportunity to recover, which has led to declining yields.

Soil depletion can be a problem even on range lands. Overgrazing does not allow normal litter to be recycled into the soil to help maintain fertility.

In addition, salinization can be a problem locally, usually where irrigation is used. Pollution from insecticides or fertilizers is not likely to become a very great problem for some time.

3.5 Water

Most of Niger has problems with shortages of surface water, but the country is relatively well endowed with groundwater. However, if surface water shortages are to be alleviated by sinking new wells, care must be taken that the wells do not aggravate other problems such as desertification. If stockwells are not spaced, for example, to allow stock access to pasture away from the well, the area around the well will be overgrazed.

The major problems in this sphere are those of contamination of water supply and water-facilitated transmission of disease. Traditionally, wells are shallow, hand dug, and remain open. Contamination by livestock or people is very common in these wells, as well as in the streams in southwest Niger. Conditions in the river area especially, but also in local ponds and wells, favor the breeding of schistosomiasis-carrying snails. Simulidae flies (onchocerciasis carriers) require flowing water to breed, such as is found in the Niger tributaries. Onchocerciasis may be one reason why the southwesternmost corner of Niger has very low population densities despite abundant rainfall and relatively good soils. Malaria-carrying mosquitoes breed on still water. Solutions to such health problems can be extremely complex. Damming a stream to deny swift flowing water to Simulidae flies may simply provide them a better environment on the spillway, or it may provide the kind of slow flowing or still water that other vectors prefer. Killing larvae by putting insecticides into streams may have repercussions on water used downstream.

Preservation of wildlife is not perceived as important relative to these other problems, which have a more direct impact on human well-being. However, any success in combating other problems, especially if reforestation can be achieved to some extent, will indirectly relieve pressure on wildlife.

Population must be mentioned as an environmental problem, because increasing population will continue to increase pressure on resources. Religious traditions and ethnic customs favor large families, and the government has been reluctant to take any action on the matter.

Niger's stated goals in its 1979-1983 development plan are food self-sufficiency though the development of the agricultural and livestock sectors, increasing exploitation of the country's mineral wealth, overcoming Niger's geographic isolation, and increasing the number of qualified personnel within the country. The total cost is to be 730.2 billion CFA Fr., broken down as shown in the following table:

**Planned Investment 1979-83**

(CFA Fr. based on 1979 prices)

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>% of Public</th>
<th>Private</th>
<th>% of Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mines, Energy, Industry</td>
<td>70.2</td>
<td>18.3</td>
<td>305.5</td>
<td>88.4</td>
</tr>
<tr>
<td>Rural Sector</td>
<td>116.5</td>
<td>30.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Health, Education</td>
<td>84.8</td>
<td>22.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transport and Infrastructure</td>
<td>67.8</td>
<td>17.6</td>
<td>32.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Tertiary Sector</td>
<td>20.0</td>
<td>5.2</td>
<td>5.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Other</td>
<td>25.2</td>
<td>6.6</td>
<td>1.6</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total (% of total)</strong></td>
<td>384.5</td>
<td>(52.7)</td>
<td>345.7</td>
<td>(47.3)</td>
</tr>
</tbody>
</table>


For comparison, the previous 3 year plan is noted:

**Total Investment 1976-1978:**

$601 million US

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>% of Public</th>
<th>Private</th>
<th>% of Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry (incl. mines)</td>
<td>4.3</td>
<td>12.7</td>
<td>40.8</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>33.6</td>
<td>10.0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>15.3</td>
<td>33.7</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>46.8</td>
<td>43.6</td>
<td>59.2</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Domestic Funding 24.4% (of which govt.: 55%, private: 45%)

Foreign Funding 75.6% (of which official: 66.7%, private: 33.3%)


West Africa, 28 April 1980.
Breakdowns for the 1979-1983 expected finding by foreign or domestic sources are not available, but if the previous plan is used as a guide, about three-fourths of all funding will be from outside the country. The Niger government expenditures will probably be heavily oriented toward infrastructure and human resources development. This does not indicate a downplay of rural development but rather recognition that it is easier to get donor funding for rural development than for most other projects.

In the agricultural sector, the plan calls for modest increases in sorghum and millet production of about 2.2 percent per year. Rice production, however, is expected to increase dramatically with the aid of a number of irrigation projects. The plan also calls for reversing the trend in cash crops and increasing production. Targets for 1983 are shown in the following table:

<table>
<thead>
<tr>
<th></th>
<th>1979 (1000 tons)</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>millet &amp; sorghum</td>
<td>1,589</td>
<td>1,731</td>
</tr>
<tr>
<td>rice</td>
<td>23</td>
<td>60</td>
</tr>
<tr>
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<td>236</td>
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<td>315</td>
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<tr>
<td>onions</td>
<td>80</td>
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In the industrial and mining sector, uranium mining is expected to continue rapid expansion, financed largely by private funds. The government's share of uranium income is to be one of the major sources of Niger's public expenditures, and will be reinvested in other sectors. Coal and phosphates are to come into production and will primarily be used domestically. In industry, food industries receive the most attention. Several other industries to be developed are textiles, chemicals, metal and wood.

Niger hopes to increase primary school attendance from the current 18 percent to 25 percent, and also plans to expand professional and university education. Preventive medicine is a priority as Niger attempts to expand the facilities and personnel in its health field. Water supply and distribution are also priority areas.
Literature Cited


APPENDIX I

Geography

1. Climate Zones of West Africa
2. Physical Features
3. Rainfall Isohyets and Location of Climatic Stations
4. Average Monthly Temperatures (1967-1977) (°C)
5. Rainfall
6. Climatograms of Six Stations
1. Climatic Zones of West Africa

Source: Church, R. J. H. 1974.

2. Physical Features

Source: Donaint, P. 1975.
3. Rainfall Isoyets and Location of Climatic Stations

Source: Donaint, P. 1975.
## Average Monthly Temperatures (1967-1977) °C

<table>
<thead>
<tr>
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<th>Niamey</th>
<th>Zinder</th>
<th>Gaya</th>
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## 5. Rainfall

*(28 to 30 year averages ending 1977)*

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<tr>
<td></td>
<td>Rf</td>
<td>Days</td>
<td>Rf</td>
<td>Days</td>
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<td>Rf</td>
<td>Days</td>
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<td>0.2</td>
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<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>March</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.0</td>
<td>0.4</td>
<td>0.0</td>
<td>3.9</td>
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<td>April</td>
<td>1.2</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.0</td>
<td>5.0</td>
<td>1.0</td>
<td>3.1</td>
</tr>
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<td>May</td>
<td>6.4</td>
<td>1.3</td>
<td>0.5</td>
<td>0.2</td>
<td>6.7</td>
<td>1.0</td>
<td>27.0</td>
<td>3.5</td>
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<td>0.8</td>
<td>0.2</td>
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<td>49.2</td>
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<td>2.2</td>
<td>2.2*</td>
<td>57.3</td>
<td>5.2</td>
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<td>11.4</td>
<td>11.4*</td>
<td>140.8</td>
<td>9.8</td>
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<td>11.0</td>
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<tr>
<td>Sept.</td>
<td>20.0</td>
<td>2.8</td>
<td>3.6</td>
<td>3.6*</td>
<td>22.4</td>
<td>2.9</td>
<td>156.6</td>
<td>10.6</td>
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<tr>
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<td>0.5</td>
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<td>0.1</td>
<td>0.3</td>
<td>0.1</td>
<td>6.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Nov.</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
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<td>0.8</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Dec.</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>Total</td>
<td>164.9</td>
<td>20.6</td>
<td>235.8</td>
<td>592.0</td>
<td>549.1</td>
<td>869.8</td>
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</table>

Rf = average rainfall (mm)

Days = average number of days in the month in which rain fell

NT = no trace

*(sic)*

6. Climatograms of Six Stations

Source: Donaint, P. 1975.
Appendix II
Demographic Characteristics

1. Population
2. Population Projections
3. Miscellaneous Demographic Features
4. Population, Area, Density by Administrative Division
5. Administrative Regions
6. Population Density
7. Map of Population and Ethnic Groups
8. Population by Age Group and Sex
9. Population Pyramid
10. Population of Main Urban Centers
11. Urbanization
12. U.N. Population and Urbanization Projections
13. Incidence of Certain Diseases
14. Cases, Deaths, Case Mortality of Some Infectious Diseases
15. Health Personnel
1. Population

<table>
<thead>
<tr>
<th>Date</th>
<th>Population</th>
<th>Source</th>
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<tbody>
<tr>
<td>1977</td>
<td>4,859,000</td>
<td>Europa Publications. 1980</td>
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(projection)

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<th>Date</th>
<th>Population</th>
<th>Source</th>
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2. Population Projections (in thousands)

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<thead>
<tr>
<th>Year</th>
<th>Low Variant Pop.</th>
<th>Growth Rates</th>
<th>Medium Variant Pop.</th>
<th>Growth Rates</th>
<th>High Variant Pop.</th>
<th>Growth Rates</th>
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<tr>
<td>1970</td>
<td>4,016</td>
<td>2.55%</td>
<td>4,016</td>
<td>2.68%</td>
<td>4,016</td>
<td>2.77%</td>
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<tr>
<td>1975</td>
<td>4,562</td>
<td>2.57%</td>
<td>4,592</td>
<td>2.76%</td>
<td>4,611</td>
<td>2.83%</td>
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<tr>
<td>1980</td>
<td>5,186</td>
<td>2.58%</td>
<td>5,272</td>
<td>2.84%</td>
<td>5,313</td>
<td>2.91%</td>
</tr>
<tr>
<td>1985</td>
<td>5,901</td>
<td>2.59%</td>
<td>6,077</td>
<td>2.99%</td>
<td>6,144</td>
<td>3.08%</td>
</tr>
<tr>
<td>1990</td>
<td>6,716</td>
<td>2.51%</td>
<td>7,049</td>
<td>3.06%</td>
<td>7,166</td>
<td>3.22%</td>
</tr>
<tr>
<td>1995</td>
<td>7,613</td>
<td>2.22%</td>
<td>8,212</td>
<td>3.06%</td>
<td>8,419</td>
<td>3.31%</td>
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<tr>
<td>2000</td>
<td>8,505</td>
<td></td>
<td>9,568</td>
<td></td>
<td>9,932</td>
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3. Miscellaneous Demographic Features

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<td>Population density per sq. km.</td>
<td>4.0</td>
</tr>
<tr>
<td>(pop. density/sq. mi.)*</td>
<td>10</td>
</tr>
<tr>
<td>(pop. density/sq. mi. arable land)*</td>
<td>62</td>
</tr>
<tr>
<td>Population growth</td>
<td>2.8</td>
</tr>
<tr>
<td>Crude birth rate (per 1,000)</td>
<td>52</td>
</tr>
<tr>
<td>Crude death rate (per 1,000)</td>
<td>22</td>
</tr>
<tr>
<td>Life expectancy at birth</td>
<td>42</td>
</tr>
<tr>
<td>Average daily caloric consumption (% of estimated requirement)</td>
<td>2,139 (78%)</td>
</tr>
<tr>
<td>Population per practicing physician</td>
<td>42,970</td>
</tr>
<tr>
<td>% literate</td>
<td>8.0</td>
</tr>
<tr>
<td>Per capita GNP</td>
<td>194</td>
</tr>
<tr>
<td>Total labor force (thousands)</td>
<td>2,600</td>
</tr>
<tr>
<td>% women in labor force</td>
<td>10.1</td>
</tr>
<tr>
<td>% labor force in agriculture</td>
<td>92.0</td>
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## 4. Population, Area, Density by Administrative Division (1977)

<table>
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<th>Department/District</th>
<th>Population 1977</th>
<th>Area (km²)</th>
<th>Density (Pers./km²)</th>
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<td>Niamey</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Niamey</td>
<td>1,094,000</td>
<td>90,293</td>
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<tr>
<td>Tera</td>
<td>294,000</td>
<td>12,444</td>
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<td>Tillabery</td>
<td>123,200</td>
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<td>Ouallam</td>
<td>154,500</td>
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<td>Filingue</td>
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<td>Dosso</td>
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<td>31,002</td>
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<td>Loga</td>
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<td>108,500</td>
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<td>Maradi</td>
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<tr>
<td>Madarounfa (incl. Maradi)</td>
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<td>3,540</td>
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<tr>
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<tr>
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<td>140,216</td>
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<td>N'Guigmi</td>
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<td>15,111</td>
<td>4,9</td>
</tr>
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<td>7,2</td>
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<tr>
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<tr>
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<td>0,14</td>
</tr>
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<td>30,000</td>
<td>118,126</td>
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</tr>
<tr>
<td>NIGER</td>
<td>4,972,000</td>
<td>1,267,00</td>
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</tr>
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</table>

Source: Niger, Ministere du Developpement Rural, Direction du Service de l'Agriculture
NIGER
POPULATION DENSITY

One dot equals 3000 inhabitants

ETI WIC GROUPS
(estimated population at July 1st, 1972)

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Population</th>
</tr>
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<tbody>
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<td>Hausa</td>
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</tr>
<tr>
<td>Djerma-Songhai</td>
<td>1,001,000</td>
</tr>
<tr>
<td>Fulani (Peulh)</td>
<td>459,000</td>
</tr>
<tr>
<td>Tuareg, etc.</td>
<td>127,000</td>
</tr>
<tr>
<td>Beriberi-Manga</td>
<td>386,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4,243,000</strong></td>
</tr>
</tbody>
</table>

* Provisional figures. Revised total is 4,239,000.

Source: Europa Publications. 1980. (figures)
Map available from U.S.G.P.O. No. 59203 4-69
8. Population by Age Group and Sex, 1973
(Thousands)
Niger

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>402</td>
<td>403</td>
<td>805</td>
</tr>
<tr>
<td>5-9</td>
<td>305</td>
<td>306</td>
<td>611</td>
</tr>
<tr>
<td>10-14</td>
<td>251</td>
<td>251</td>
<td>502</td>
</tr>
<tr>
<td>0-14</td>
<td>958</td>
<td>963</td>
<td>1921</td>
</tr>
<tr>
<td>15-19</td>
<td>213</td>
<td>215</td>
<td>428</td>
</tr>
<tr>
<td>20-24</td>
<td>186</td>
<td>186</td>
<td>372</td>
</tr>
<tr>
<td>25-29</td>
<td>160</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>30-34</td>
<td>137</td>
<td>137</td>
<td>274</td>
</tr>
<tr>
<td>35-39</td>
<td>115</td>
<td>115</td>
<td>230</td>
</tr>
<tr>
<td>40-44</td>
<td>98</td>
<td>98</td>
<td>196</td>
</tr>
<tr>
<td>45-49</td>
<td>81</td>
<td>81</td>
<td>162</td>
</tr>
<tr>
<td>50-54</td>
<td>63</td>
<td>63</td>
<td>126</td>
</tr>
<tr>
<td>55-59</td>
<td>49</td>
<td>49</td>
<td>98</td>
</tr>
<tr>
<td>60-64</td>
<td>36</td>
<td>38</td>
<td>74</td>
</tr>
<tr>
<td>65-69</td>
<td>1,134</td>
<td>1,142</td>
<td>2,276</td>
</tr>
<tr>
<td>70-79</td>
<td>26</td>
<td>26</td>
<td>52</td>
</tr>
<tr>
<td>80-</td>
<td>19</td>
<td>19</td>
<td>38</td>
</tr>
<tr>
<td>85-</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>2,140</td>
<td>2,164</td>
<td>4,304</td>
</tr>
</tbody>
</table>

Each initial age-specific fertility rate was reduced by 30 percent over a 50 year period.

Fertility decline need not necessarily be the result of birth control programs, but may derive instead from the development process or the social, cultural, and economic change that takes place during modernization (the "demographic transition").


<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niamey</td>
<td>225,000</td>
</tr>
<tr>
<td>Zinder</td>
<td>58,000</td>
</tr>
<tr>
<td>Maradi</td>
<td>46,000</td>
</tr>
<tr>
<td>Tahoua</td>
<td>31,000</td>
</tr>
<tr>
<td>Agadez</td>
<td>20,400</td>
</tr>
<tr>
<td>Birni N'Konni</td>
<td>15,200</td>
</tr>
<tr>
<td>Tessacoua</td>
<td>12,000</td>
</tr>
<tr>
<td>Dogondoutchi</td>
<td>10,200</td>
</tr>
</tbody>
</table>


11. Urbanization

<table>
<thead>
<tr>
<th>Urban population (1975)</th>
<th>430,000</th>
<th>growth rate 5.3</th>
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</thead>
<tbody>
<tr>
<td>Niamey (1976)</td>
<td>122,000</td>
<td>= 28.4% 10.0</td>
</tr>
<tr>
<td>Other urban</td>
<td>308,000</td>
<td>= 71.7% 2.7</td>
</tr>
</tbody>
</table>

% due to migration

| Annual growth of all urban areas (1974) | 25,000 | 49.4 |
| Niamey                               | 12,200 | 73.2 |

### 12. U.N. Population and Urbanization Projections

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Population (thousands)</th>
<th>Urban Population</th>
<th>% of population urban</th>
<th>Urban growth rate</th>
<th>Niamey* population</th>
<th>Niamey growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>4,016</td>
<td>330,000</td>
<td>8.22</td>
<td>7.05</td>
<td>122,000</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.4%</td>
</tr>
<tr>
<td>1975</td>
<td>4,592</td>
<td>430,000</td>
<td>9.36</td>
<td>5.29</td>
<td>176,000</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.4%</td>
</tr>
<tr>
<td>1980</td>
<td>5,272</td>
<td>561,000</td>
<td>10.64</td>
<td>5.32</td>
<td>253,000</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34.5%</td>
</tr>
<tr>
<td>1985</td>
<td>6,077</td>
<td>733,000</td>
<td>12.06</td>
<td>5.35</td>
<td>367,000</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38.2%</td>
</tr>
<tr>
<td>1990</td>
<td>7,049</td>
<td>961,000</td>
<td>13.63</td>
<td>5.41</td>
<td>532,000</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>42.2%</td>
</tr>
<tr>
<td>1995</td>
<td>8,212</td>
<td>1,261,000</td>
<td>15.53</td>
<td>5.43</td>
<td>772,000</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46.8%</td>
</tr>
<tr>
<td>2000</td>
<td>9,568</td>
<td>1,649,000</td>
<td>17.23</td>
<td>5.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*% of urban population

### 13. Incidence of Certain Diseases

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Number of Cases</th>
<th>Number of Deaths</th>
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</thead>
<tbody>
<tr>
<td>Trachoma</td>
<td>2,241</td>
<td>-</td>
</tr>
<tr>
<td>Leprosy</td>
<td>2,477</td>
<td>2</td>
</tr>
<tr>
<td>Whooping Cough</td>
<td>3,732</td>
<td>5</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>47</td>
<td>3</td>
</tr>
<tr>
<td>Acute Poliomyelitis</td>
<td>129</td>
<td>2</td>
</tr>
<tr>
<td>Tetanus</td>
<td>216</td>
<td>49</td>
</tr>
<tr>
<td>Infectious Hepatitis</td>
<td>2,807</td>
<td>54</td>
</tr>
<tr>
<td>Grippe</td>
<td>5,329</td>
<td>26</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3,044</td>
<td>39</td>
</tr>
<tr>
<td>Amosobic and Bacillary</td>
<td>14,388</td>
<td>21</td>
</tr>
<tr>
<td>Dysentery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>1,469</td>
<td>45</td>
</tr>
<tr>
<td>Meningitis</td>
<td>2,233</td>
<td>130</td>
</tr>
<tr>
<td>Measles</td>
<td>28,423</td>
<td>937</td>
</tr>
<tr>
<td>Chicken Pox</td>
<td>4,646</td>
<td>-</td>
</tr>
</tbody>
</table>

## 14. Cases, Deaths, Case Mortality of Selected Infections Disease

<table>
<thead>
<tr>
<th>Year</th>
<th>Typhoid &amp; Paratyphoid Fever</th>
<th>Meningococcal Infections</th>
<th>Malaria</th>
<th>Hepatitis</th>
<th>Malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>D</td>
<td>CH</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>1962</td>
<td>14</td>
<td>1</td>
<td>7</td>
<td>15365</td>
<td>1405</td>
</tr>
<tr>
<td>1963</td>
<td>960</td>
<td>39</td>
<td>4</td>
<td>37</td>
<td>3</td>
</tr>
<tr>
<td>1964</td>
<td>907</td>
<td>41</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1965</td>
<td>717</td>
<td>16</td>
<td>2</td>
<td>70</td>
<td>---</td>
</tr>
<tr>
<td>1966</td>
<td>362</td>
<td>18</td>
<td>1</td>
<td>16</td>
<td>947</td>
</tr>
<tr>
<td>1967</td>
<td>895</td>
<td>24</td>
<td>3</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>1968</td>
<td>1114</td>
<td>8</td>
<td>1</td>
<td>40</td>
<td>---</td>
</tr>
<tr>
<td>1969</td>
<td>16</td>
<td>+</td>
<td>9907</td>
<td>+</td>
<td>1755</td>
</tr>
<tr>
<td>1970</td>
<td>47</td>
<td>+</td>
<td>75</td>
<td>+</td>
<td>5148</td>
</tr>
<tr>
<td>1971</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>29030</td>
<td>---</td>
</tr>
<tr>
<td>1972</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>8</td>
<td>33532</td>
</tr>
</tbody>
</table>

* Estimated figures  
2 Tuberculosis, all forms  
--- Figures unavailable  
5 All cases treated, old and new  
+ Figures not available  
8 Estimates based on first half of year

15. Health Personnel


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td>69 (9)</td>
<td>69 (10)</td>
<td>97 (16)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacists</td>
<td>10</td>
<td>...</td>
<td>9 (5)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td>... (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental Surgeons</td>
<td>4 (1)</td>
<td>5 (2)</td>
<td>6 (3)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dentists</td>
<td>3 (2)</td>
<td>...</td>
<td>3 (1)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midwives</td>
<td>30 (28)</td>
<td>...</td>
<td>36 (33)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registered Nurses</td>
<td>110 (110)</td>
<td>165 (145)</td>
<td>222 (207)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Service Assistants</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Certified Nurses</td>
<td>461</td>
<td>460</td>
<td>603</td>
</tr>
<tr>
<td>Health Engineers</td>
<td>2 (1)</td>
<td>...</td>
<td>1 (1)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygiene Agents</td>
<td>29</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Social Assistants</td>
<td>6 (6)</td>
<td>... (7)</td>
<td>7 (5)</td>
</tr>
<tr>
<td>(of whom are Nigeriens)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Aides</td>
<td>...</td>
<td>9</td>
<td>...</td>
</tr>
</tbody>
</table>

-In addition: "Matrones," Hygienists and "Secouristes" (first-aid volunteers) of the village

-In 1973: 263 active "Matrones"
2 active Health Educators

Appendix III

Economic Characteristics

1. World Bank Economic Data Sheet
3. Map of Agricultural Production
4. Projected Demand and Supply of Food
5. Uranium Exports
6. Industry
7. Principal Commodities
8. Principal Trading Partners
### 1. World Bank Economic Data Sheet

#### Economic Data Sheet 1 - Population, National Accounts, and Prices Per Capita - 1977 (US$) 190

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>GDP at market prices</th>
<th>GDP at factor cost</th>
<th>Net indirect taxes</th>
<th>GDP at market prices</th>
<th>GDP at factor cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>2283.0</td>
<td>1255.0</td>
<td>2876.0</td>
<td>3499.0</td>
<td>3593.0</td>
<td>3690.0</td>
</tr>
<tr>
<td>1965</td>
<td>2380.0</td>
<td>1255.0</td>
<td>2876.0</td>
<td>3499.0</td>
<td>3593.0</td>
<td>3690.0</td>
</tr>
<tr>
<td>1970</td>
<td>2430.0</td>
<td>1255.0</td>
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<td>3499.0</td>
<td>3593.0</td>
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</tr>
<tr>
<td>1975</td>
<td>2480.0</td>
<td>1255.0</td>
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<td>3499.0</td>
<td>3593.0</td>
<td>3690.0</td>
</tr>
<tr>
<td>1980</td>
<td>2530.0</td>
<td>1255.0</td>
<td>2876.0</td>
<td>3499.0</td>
<td>3593.0</td>
<td>3690.0</td>
</tr>
</tbody>
</table>

#### Notes
- GDP at market prices = GDP at factor cost + Net indirect taxes
- GDP at factor cost = GDP at market prices - Net indirect taxes

### Data Sheet 2 - Population, National Accounts, and Prices

#### Data Sheet 1 - Population, National Accounts, and Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>GDP at market prices</th>
<th>GDP at factor cost</th>
<th>Net indirect taxes</th>
<th>GDP at market prices</th>
<th>GDP at factor cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>2283.0</td>
<td>1255.0</td>
<td>2876.0</td>
<td>3499.0</td>
<td>3593.0</td>
<td>3690.0</td>
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<tr>
<td>1965</td>
<td>2380.0</td>
<td>1255.0</td>
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<td>3593.0</td>
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<td>1975</td>
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<td>3690.0</td>
</tr>
</tbody>
</table>

#### Notes
- GDP at market prices = GDP at factor cost + Net indirect taxes
- GDP at factor cost = GDP at market prices - Net indirect taxes

### Source
<table>
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</thead>
<tbody>
<tr>
<td></td>
<td>4341.0</td>
<td>4482.0</td>
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<td>4722.0</td>
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<td><strong>Average annual growth rate (percent)</strong></td>
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<td></td>
<td></td>
<td></td>
<td>(Total, midyear, thousands)</td>
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<tr>
<td>As percentage of GDP</td>
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<td>Construction</td>
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<td>Electricity, gas, and water</td>
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<tr>
<td>Transport and communications</td>
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<td></td>
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<td>Trade and finance</td>
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<td>Public administration and defense</td>
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<td><strong>Average annual growth rate (percent)</strong></td>
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<td>Net indirect taxes</td>
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<tr>
<td><strong>Average annual growth rate (percent)</strong></td>
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<td>GNP</td>
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<td>Factor payments to abroad (net)</td>
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<td>Imports of goods and N.F.S.</td>
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<td>Exports of goods and N.F.S.</td>
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<td>Gross domestic investment</td>
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<td><strong>Average annual growth rate (percent)</strong></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Mil</td>
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<td>470</td>
<td>934</td>
<td>1,885</td>
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<td>977</td>
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<td>Sorgho</td>
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<td>Niébé</td>
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<td>921</td>
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<td>RICE(paddy)</td>
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<td>Y</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Riz(paddy)</td>
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<td>9.1</td>
<td>1.043</td>
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<td>8.7</td>
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<td>15.5</td>
<td>16.4</td>
<td>15.1</td>
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<td>GROUNDNUTS (in shell)</td>
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<td>A</td>
<td>Y</td>
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</tr>
<tr>
<td>Arachides</td>
<td>349</td>
<td>331</td>
<td>435</td>
<td>319</td>
<td>319</td>
<td>621</td>
<td>293</td>
<td>341</td>
<td>355</td>
<td>357</td>
<td>812</td>
<td>342</td>
<td>320</td>
<td>358</td>
<td>644</td>
<td>357</td>
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<tr>
<td>COTTON</td>
<td>P</td>
<td>A</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Coton</td>
<td>3.4</td>
<td>8.2</td>
<td>414</td>
<td>5.1</td>
<td>10.3</td>
<td>498</td>
<td>6.4</td>
<td>14.6</td>
<td>12.9</td>
<td>16.3</td>
<td>19.2</td>
<td>7.0</td>
<td>12.6</td>
<td>10.5</td>
<td>9.0</td>
<td>3.6</td>
</tr>
</tbody>
</table>

P - Production (1,000 tons)  A - Area, Superficie (1000 hectares)  Y - Yield, Rendement (kg/ha)

### 4. Projected Demand and Supply of Food, 1975-90 ('000)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Population ('000)/1</td>
<td>4,591</td>
<td>4,715</td>
<td>4,842</td>
<td>4,972</td>
<td>5,107</td>
<td>5,272</td>
<td>6,077</td>
<td>7,049</td>
</tr>
<tr>
<td>Real requirements (gross) (250 kg/head)</td>
<td>1,148</td>
<td>1,180</td>
<td>1,210</td>
<td>1,243</td>
<td>1,277</td>
<td>1,318</td>
<td>1,519</td>
<td>1,763</td>
</tr>
<tr>
<td>Production (millet and sorghum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assumption A</td>
<td>1,178</td>
<td>1,186</td>
<td>1,196</td>
<td>1,207</td>
<td>1,218</td>
<td>1,225</td>
<td>1,268</td>
<td>1,268</td>
</tr>
<tr>
<td>Assumption B</td>
<td>1,178</td>
<td>1,214</td>
<td>1,308</td>
<td>1,379</td>
<td>1,453</td>
<td>1,531</td>
<td>1,531</td>
<td>1,531</td>
</tr>
<tr>
<td>Balance (millet and sorghum)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assumption A</td>
<td>+30</td>
<td>+6</td>
<td>-14</td>
<td>-36</td>
<td>-59</td>
<td>-93</td>
<td>-251</td>
<td>-494</td>
</tr>
<tr>
<td>Assumption B</td>
<td>+30</td>
<td>+61</td>
<td>+92</td>
<td>+136</td>
<td>+176</td>
<td>+213</td>
<td>+12</td>
<td>-231</td>
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<tr>
<td>Production (paddy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Modern /2</td>
<td>20</td>
<td>24</td>
<td>28</td>
<td>33</td>
<td>37</td>
<td>41</td>
<td>76</td>
<td>111</td>
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<tr>
<td>Balance (food)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assumption A</td>
<td>+65</td>
<td>+45</td>
<td>+29</td>
<td>+7</td>
<td>-7</td>
<td>-37</td>
<td>-160</td>
<td>-368</td>
</tr>
<tr>
<td>Assumption B</td>
<td>+65</td>
<td>+100</td>
<td>+135</td>
<td>+185</td>
<td>+228</td>
<td>+269</td>
<td>+103</td>
<td>-105</td>
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</table>

This Bank projection is somewhat lower than that of the Ministry of Agriculture, Niger in "Situation de l'Agriculture Nigérienne après la Sécheresse", 1975.

With assumptions: 1975-80: irrigation of additional 600 ha/year with 7 tons of paddy/ha (two crops); this is the Government's present target.

1981-85: irrigation of additional 1,000 ha/year with 7 tons of paddy/ha (two crops). This is not yet a target but may be considered a possibility.

5. Uranium Exports (millions of Francs CFA)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Exports</th>
<th>Uranium Exports</th>
<th>% of Uranium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>6,250</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>1970</td>
<td>8,795</td>
<td>---</td>
<td>--</td>
</tr>
<tr>
<td>1971</td>
<td>10,670</td>
<td>931</td>
<td>8.7</td>
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<tr>
<td>1972</td>
<td>13,712</td>
<td>2,604</td>
<td>19.0</td>
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<tr>
<td>1973</td>
<td>13,817</td>
<td>4,625</td>
<td>33.5</td>
</tr>
<tr>
<td>1974</td>
<td>12,621</td>
<td>6,086</td>
<td>48.2</td>
</tr>
<tr>
<td>1975</td>
<td>19,556</td>
<td>11,882</td>
<td>60.8</td>
</tr>
<tr>
<td>1976*</td>
<td>3,978</td>
<td>20,500</td>
<td>64.0</td>
</tr>
<tr>
<td>1977**</td>
<td>39,900</td>
<td>29,500</td>
<td>73.9</td>
</tr>
<tr>
<td>1978**</td>
<td>52,000</td>
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</table>

*estimates

6. Industry

**SELECTED PRODUCTS**

<table>
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<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Beer ('000 hl.)</td>
<td>33</td>
<td>38</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Woven cotton fabrics (million sq. metres)</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Groundnut oil ('000 metric tons)</td>
<td>33</td>
<td>73</td>
<td>21</td>
<td>18</td>
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<tr>
<td>Cement ('000 metric tons)</td>
<td>50</td>
<td>57</td>
<td>65</td>
<td>70</td>
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</table>

1976: Cement 38,000 metric tons, Electricity 70 million KWh.


7. Principal Commodities

**(million francs CFA)**

<table>
<thead>
<tr>
<th>Imports</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road vehicles</td>
<td>2,812</td>
<td>2,397</td>
<td>5,394</td>
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<tr>
<td>Petroleum products</td>
<td>3,139</td>
<td>2,750</td>
<td>3,525</td>
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<tr>
<td>Non-electric machinery</td>
<td>2,224</td>
<td>2,080</td>
<td>3,142</td>
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<tr>
<td>Iron and steel, cast iron</td>
<td>1,202</td>
<td>1,150</td>
<td>2,093</td>
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<tr>
<td>Textile yarn and fabrics</td>
<td>1,380</td>
<td>1,186</td>
<td>1,951</td>
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<tr>
<td>Electrical machinery, etc.</td>
<td>1,173</td>
<td>1,095</td>
<td>1,395</td>
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<td>Paper, paperboard, printed</td>
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<td>338</td>
<td>827</td>
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<tr>
<td>matter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar and confectionery</td>
<td>1,367</td>
<td>642</td>
<td>739</td>
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<tr>
<td>Tobacco</td>
<td>242</td>
<td>374</td>
<td>470</td>
</tr>
<tr>
<td>Pharmaceutical products</td>
<td>407</td>
<td>277</td>
<td>432</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>402</td>
<td>2,086</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total (incl. others)</strong></td>
<td>23,144</td>
<td>21,889</td>
<td>30,383</td>
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</table>

<table>
<thead>
<tr>
<th>Exports</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
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</thead>
<tbody>
<tr>
<td>Uranium concentrates</td>
<td>6,322</td>
<td>11,852</td>
<td>20,700</td>
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<td>Live animals</td>
<td>2,093</td>
<td>3,053</td>
<td>4,075</td>
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<td>Vegetables</td>
<td>1,52</td>
<td>575</td>
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<tr>
<td>Groundnut oil</td>
<td>1,143</td>
<td>690</td>
<td>1,687</td>
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<tr>
<td>Groundnuts, shelled</td>
<td>-</td>
<td>2</td>
<td>687</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>185</td>
<td>155</td>
<td>370</td>
</tr>
<tr>
<td>Hides and skins</td>
<td>607</td>
<td>177</td>
<td>177</td>
</tr>
<tr>
<td>Raw cotton</td>
<td>16</td>
<td>17</td>
<td>54</td>
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<tr>
<td>Meat and offals</td>
<td>124</td>
<td>283</td>
<td>210</td>
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<tr>
<td>Cotton yarn and fabrics</td>
<td>218</td>
<td>32</td>
<td>116</td>
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<tr>
<td>Artificial and synthetic</td>
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<td>250</td>
<td>116</td>
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<tr>
<td>fabrics</td>
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<tr>
<td><strong>Total (incl. others)</strong></td>
<td>12,621</td>
<td>19,556</td>
<td>31,879</td>
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8. Principal Trading Partners

**(million francs CFA)**

<table>
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<tr>
<th>Imports</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
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<tbody>
<tr>
<td>Algeria</td>
<td>765</td>
<td>1,605</td>
<td>1,735</td>
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<tr>
<td>China, People's Republic</td>
<td>410</td>
<td>400</td>
<td>880</td>
</tr>
<tr>
<td>France</td>
<td>8,573</td>
<td>6,945</td>
<td>13,195</td>
</tr>
<tr>
<td>Germany, Federal Republic</td>
<td>1,205</td>
<td>1,080</td>
<td>2,060</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>765</td>
<td>935</td>
<td>2,400</td>
</tr>
<tr>
<td>Japan</td>
<td>180</td>
<td>200</td>
<td>905</td>
</tr>
<tr>
<td>Netherlands</td>
<td>735</td>
<td>675</td>
<td>805</td>
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<td>Nigeria</td>
<td>260</td>
<td>2,300</td>
<td>415</td>
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<tr>
<td>U.S.A.</td>
<td>2,033</td>
<td>2,675</td>
<td>3,950</td>
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<tr>
<td><strong>Total (incl. others)</strong></td>
<td>13,143</td>
<td>21,890</td>
<td>30,380</td>
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<table>
<thead>
<tr>
<th>Exports</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>300</td>
<td>470</td>
<td>1,100</td>
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<tr>
<td>France</td>
<td>6,875</td>
<td>12,420</td>
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</tr>
<tr>
<td>Germany, Federal Republic</td>
<td>935</td>
<td>1,430</td>
<td>2,111</td>
</tr>
<tr>
<td>Italy</td>
<td>125</td>
<td>225</td>
<td>437</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>135</td>
<td>225</td>
<td>352</td>
</tr>
<tr>
<td>Japan</td>
<td>16</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Nigeria</td>
<td>3,400</td>
<td>4,280</td>
<td>7,430</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>150</td>
<td>243</td>
<td>300</td>
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<tr>
<td>U.S.A.</td>
<td>95</td>
<td>505</td>
<td>555</td>
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<tr>
<td>Upper Volta</td>
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<td>490</td>
<td>980</td>
</tr>
<tr>
<td><strong>Total (incl. others)</strong></td>
<td>12,620</td>
<td>19,355</td>
<td>31,975</td>
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</tbody>
</table>

Appendix IV

List of U.S. AID Projects in Niger
PERIODIC REGIONAL MEETINGS TO DISCUSS POLICY ISSUES AND TRAINING LIVESTOCK CAO;

IMPLEMENTATION OF LIVESTOCK PROTOCOLS.

REVIEW AND SYNTHESIS INFORMATION OF SECTORAL DEVELOPMENT PROBLEMS;

FIELD RESEARCH PROVIDE CRITICAL INFORMATION RELATING TO DESIGN INTERVENTIONS TESTING VARIOUS MEANS TO ACHIEVE SECTORAL OBJECTIVES:

FUND, IMPLEMENT, EVALUATE INTERVENTIONS.

AUGMENT THE STANDARD OF THOSE RURAL POOR ASSOCIATED WITH ANIMAL PROTEIN FOR CONSUMPTION WITHIN THE REGION.

1. INCREASE THE AVAILABILITY OF REASONABLY-PRICED MEAT.

CAPITAL ASSISTANCE TO ENTENTE FUND TO PROVIDE CREDIT AND TECHNICAL ASSISTANCE TO SUB-PROJECTS, ASSIST LIVESTOCK SECTOR ADMINISTRATION TO IMPROVE DEVELOPMENT PLANNING CAPABILITY.

CAPITAL ASSISTANCE TO ENTENTE FUND TO PROVIDE CREDIT AND TECHNICAL ASSISTANCE TO SUB-PROJECTS, WHICH SUPPORT THE SECTORAL PROGRAMS TO INCREASE EFFICIENCY OF LIVESTOCK PRODUCTION AND ESTABLISH REGIONAL COOPERATION AND COORDINATION INSURING EFFECTIVE LIVESTOCK PRODUCTION AND MARKETING, ANALYSIS OF SECTORAL PROGRAMS THROUGH REGIONAL MEETINGS, SERVING AS CONTINUOUS BASIS FOR POLICY AND PROGRAM REINFORCEMENT.

DESIGN INTERVENTIONS TESTING VARIOUS MEANS TO ACHIEVE SECTORAL OBJECTIVES.

FUND IMPLEMENT, EVALUATE INTERVENTIONS.

REVIEW AND SYNTHESIZE INFORMATION OF SECTORAL DEVELOPMENT PROBLEMS;

FIELD RESEARCH PROVIDE CRITICAL INFORMATION RELATING TO DESIGN INTERVENTIONS TESTING VARIOUS MEANS TO ACHIEVE SECTORAL OBJECTIVES:

FUND, IMPLEMENT, EVALUATE INTERVENTIONS.

AUGMENT THE STANDARD OF THOSE RURAL POOR ASSOCIATED WITH ANIMAL PROTEIN FOR CONSUMPTION WITHIN THE REGION.

1. INCREASE THE AVAILABILITY OF REASONABLY-PRICED MEAT.
EVALUATION DOCUMENTATION

COUNTRY/BUREAU: NIGER
PROJECT: 6830201
TITLE: NIGER CEREALS PRODUCTION I
INITIAL FY: 74 FINAL FY: 80

ABSTRACT:

REGIONAL ROAD MAINTENANCE TRAINING CENTER (RMTC), also called CERFER, graduated 1370 students. Student cost per month was at a normal level for AID training, with minor exceptions. 1979 prop actions were achieved.

Bottlenecks which hindered or slowed project growth include: 1) lack of burden-sharing and self-help requirements in the grant agreements deterred initiative; 2) lack of participation of recipients at council of administration and director-general level reduced incentives to meet specified objectives; 3) lack of continuing contact with user-countries; hampers CERFER's ability to meet their needs; 4) requirement that equipment be from US origin; and decision to use (non-compatible) section 608 equipment, reduced training efficiency and diverted instruction; 5) desire of Entente states to keep experts at home generally restricts CERFER's staff to Togoese; 6) differences in donor philosophies resulted in divergent approaches to instructions; 7) Aero-Ford represented AID, but generally failed to meet contract objectives during first 4 years, e.g., (a) did not recruit on time; (b) had unusually high turnover of advisors (e.g., chiefs-of-party since 1979); (c) lacked specific objectives and procedures at the beginning; and (d) did not develop systems and counterparts until late in the contract, corresponding to AID's failure to hold contractor to the agreement; 8) service and rental of equipment adversely affected instruction.

CERFER should provide more administrative continuity. Better evaluation of grantees to provide feedback to training systems, home seminars and media publicity. However, despite failure to obtain maximum performance, CERFER represents a worthy aid achievement measured by prop objectives.

EVALUATION DOCUMENTATION

COUNTRY/BUREAU: NIGER
PROJECT: 6830201
TITLE: ROAD MAINTENANCE-NIGER
INITIAL FY: 65 FINAL FY: 79

ABSTRACT:

REGIONAL ROAD MAINTENANCE TRAINING CENTER (RMTC), also called CERFER, graduated 1370 students. Student cost per month was at a normal level for AID training, with minor exceptions. 1979 prop actions were achieved.

Bottlenecks which hindered or slowed project growth include: 1) lack of burden-sharing and self-help requirements in the grant agreements deterred initiative; 2) lack of participation of recipients at council of administration and director-general level reduced incentives to meet specified objectives; 3) lack of continuing contact with user-countries; hampers CERFER's ability to meet their needs; 4) requirement that equipment be from US origin; and decision to use (non-compatible) section 608 equipment, reduced training efficiency and diverted instruction; 5) desire of Entente states to keep experts at home generally restricts CERFER's staff to Togoese; 6) differences in donor philosophies resulted in divergent approaches to instructions; 7) Aero-Ford represented AID, but generally failed to meet contract objectives during first 4 years, e.g., (a) did not recruit on time; (b) had unusually high turnover of advisors (e.g., chiefs-of-party since 1979); (c) lacked specific objectives and procedures at the beginning; and (d) did not develop systems and counterparts until late in the contract, corresponding to AID's failure to hold contractor to the agreement; 8) service and rental of equipment adversely affected instruction.

CERFER should provide more administrative continuity. Better evaluation of grantees to provide feedback to training systems, home seminars and media publicity. However, despite failure to obtain maximum performance, CERFER represents a worthy aid achievement measured by prop objectives.

EVALUATION DOCUMENTATION

COUNTRY/BUREAU: NIGER
PROJECT: 6830180
TITLE: ROAD MAINTENANCE-NIGER
INITIAL FY: 65 FINAL FY: 79

ABSTRACT:

REGIONAL ROAD MAINTENANCE TRAINING CENTER (RMTC), also called CERFER, graduated 1370 students. Student cost per month was at a normal level for AID training, with minor exceptions. 1979 prop actions were achieved.

Bottlenecks which hindered or slowed project growth include: 1) lack of burden-sharing and self-help requirements in the grant agreements deterred initiative; 2) lack of participation of recipients at council of administration and director-general level reduced incentives to meet specified objectives; 3) lack of continuing contact with user-countries; hampers CERFER's ability to meet their needs; 4) requirement that equipment be from US origin; and decision to use (non-compatible) section 608 equipment, reduced training efficiency and diverted instruction; 5) desire of Entente states to keep experts at home generally restricts CERFER's staff to Togoese; 6) differences in donor philosophies resulted in divergent approaches to instructions; 7) Aero-Ford represented AID, but generally failed to meet contract objectives during first 4 years, e.g., (a) did not recruit on time; (b) had unusually high turnover of advisors (e.g., chiefs-of-party since 1979); (c) lacked specific objectives and procedures at the beginning; and (d) did not develop systems and counterparts until late in the contract, corresponding to AID's failure to hold contractor to the agreement; 8) service and rental of equipment adversely affected instruction.

CERFER should provide more administrative continuity. Better evaluation of grantees to provide feedback to training systems, home seminars and media publicity. However, despite failure to obtain maximum performance, CERFER represents a worthy aid achievement measured by prop objectives.
MAINTAIN TO IMPROVE THE CAPACITY
BENEFICIARIES WILL BE
REVISED PROP OF 3/21/75, EXTENDING
PROD 1 YEAR. 'LAMS TO
PUBLICATIONS AND SEMINARS ON COMMON ROAD MAINTENANCE
COURSES IN ENGLISH
CREW FOREMAN; ANO CLASSES
TRAINING WILL
RESPONSIBILITY FOR RRMTC THROUGH
RRMTC WILL BE COMPOSED OF 2 REPRESENTATIVES FROM EACH ENTENTE MEMBER STATE. WITH WELL-
RAINED MANAGEMENT, INSTRUCTIONAL ENGINEERING SERVICES INCLUDING THE PROCUREMENT AND INSTALLATION OF EQUIPMENT.
NIGER'S COMMERCIAL TRANSPORT COSTS ARE REDUCED.
PURPOSE: COMMERCIAL NAVIGATION OF THE NIGER RIVER IS EXTENDING FROM PORT MARCOURT TO NIAMEY, WESTERN NIGER.


PHASE I
PROJECT: 6839100 SUB-PROJECT 90
INITIAL FY 65 FINAL FY 79

TITLE: ROAD MAINTENANCE-NIGER

PHASE II
PROJECT: 6338925 SUB-PROJECT 88
INITIAL FY 74 FINAL FY 75

TITLE: NIGER RIVER BRIDGE

Although 5 AFRICAN COUNTRIES POSSESS A WELL-PLANNED ROAD NETWORK, THEY ARE PLAGUED BY COSTLY & DIFFICULT TRANSPORTATION BECAUSE OF POORLY MAINTAINED ROADS. LACK OF KNOWLEDGE, MACHINERY, AND SKILLED LABOR, THE POOR MAJORITY SUFFER ECONOMIC LOSSES AND HAS UNSATISFACTORY STANDARDS OF LIVING.

TECHNICAL ASSISTANCE (TA) PROVIDED TO FIVE AFRICAN ENTENTE STATES (IVORY COAST, TOGO, DAMOYEE, NIGER AND UPPER VOLTA) TO ESTABLISH A REGIONAL ROAD MAINTENANCE TRAINING CENTER (RRMTC) FOR ENTENTE ROAD MAINTENANCE PERSONNEL.

STRATEGY: A 3-YEAR PROJECT CONSISTS OF FUNDS FOR TECHNICAL ASSISTANCE FOR FIVE AFRICAN STATES TO ESTABLISH A REGIONAL TRAINING INSTITUTION (RRMTC) FOR ENTENTE ROAD MAINTENANCE PERSONNEL. USAID PROVIDES FUNDS FOR TECHNICAL SERVICES OF A REGIONAL TRAINING CENTER (RRMTC) INCLUDING THE ADMINISTRATION OF RECRUITMENT AND TRAINING PROGRAMS. THE CENTER WILL BE OPERATED AND MANAGED BY THE GOVT. OF NIGER.

PURPOSE: ESTABLISHMENT OF A VIABLE REGIONAL TRAINING INSTITUTION (RRMTC) FOR ENTENTE ROAD MAINTENANCE PERSONNEL.

1. WELL-TRAINED AND REFORMED TECHNICAL AND INSTRUCTIONAL STAFF;
2. STUDENTS TRAINED ANNUALLY;
3. PRACTICAL REGIONAL PROGRAM DEVELOPED AND IMPLEMENTED;
4. PERIODIC REGIONAL SEMINARS ON ROAD MAINTENANCE.

PUBLIC WORKS MID-TERM PERSONNEL.
NIGER'S PASTORAL ZONE REPRESENTS A MAJOR NATURAL RESOURCE-CONTAINING 20 MILLION HECTARES AND CARRYING CAPACITY OF OVER 5 MILLION LIVESTOCK UNITS IN DRY SEASON AND 2-3 TIMES THAT DURING WET SEASON. HOWEVER, THERE ARE MANY OBSTACLES TO ITS CONTINUED PRODUCTIVITY AND IMPROVES HAVE BEEN SERIOUSLY MISUSED AND ARE DEGENERATING UNDER PRESSURES OF MAN AND ANIMAL. PRODUCTIVITY IS LOW. ACQUISITION IS DIFFICULT AND COSTS OF MARKETING, DISTRIBUTION AND INSTALLATION OF FACILITIES ARE HIGH. ALSO POP IS POOR, LARGELY ILLITERATE & UNSCHOOL. NIGER IS PROVIDED WITH GRANT, TECHNICAL ASSISTANCE, AND TRAIN TO PRESERVE AND IMPROVE PRODUCTIVITY OF ASHERIANS RANGELAND. PROJ. WILL LAY BASIS FOR COMPREHENSIVE RANGE MANAGEMENT AND LIVESTOCK EXTENSION PROGRAMS. INTERVentions WILL BE UNDERTAKEN IN CENTRAL PASTORAL ZONE. US ADVISORS WILL WORK WITH GOV OFFICE OF PASTORAL ZONE.

DETAILED ASSESSMENT OF RANGE CONDITIONS WILL BE MADE. 30 RANGE TRANSECTS AND 16 ENCLOSURES WILL BE MONITORED. RANGE CONDITIONS WILL BE CORRELATED WITH RAINFALL PATTERNS AND AN OVERLAY MAP PREPARED SHOWING CHANGES IN VEGETATION FROM YR to YR. AERIAL PHOTOGRAPHY AND GROUND SURVEYS WILL BE USED FOR MAPPING AND TO DETERMINE MAJOR HABITAT TYPES AND EROSION PATTERNS. RESEEDING TRAILS WILL ALSO BE CONDUCTED.

3 EARTH WATER CATCHMENTS WILL BE CONSTRUCTED TO TEST RETENTION OF MET IN ZONE1S NORTHERN EXTREMITY FOR LONGER PERIODS FOR MORE EFFECTIVE USE OF FORAGE. 15 HAND-DUG Wells WILL BE IMPROVED. HERDER ASSOCIATIONS WILL BE FORMED TO PROMOTE RECOMMENDED GRAZING PRACTICES IN CATCHMENT AREAS. FIRE DAMAGE WILL BE MONITORED AND AN ON-GOING FIREBREAK CONSTRUCTION PROGRAM STUDIES. TRIAL BURNS WILL BE MADE ON SMALL PLOTS TO STUDY EFFECTS ON PLANT GROWTH AND CHANGE IN RANGE OF FORBAGE. LIVESTOCK ELEMENT OF PROJ. WILL INCLUDE: 1) COMPARATIVE COST-BENEFIT STUDY. 2) STRONGENING OF EXISTING LIVESTOCK PROS. PLOTS TO MEASURE EFFECTS ON FORAGE, RATE OF REGROWTH AND RESPONSE OF FORAGE. 3) CONSTRUCTION OF 10 HANDLING FACILITIES. LIVESTOCK STAND WILL INVOLVE 2 GROUPS OF HERDERS WITH HALF AS CONTROL GROUP AND HAVE WHEL WITH CARE/DISEASE CONTROL PROGRAM. EXISTING LIVESTOCK PROG WILL INCLUDE GREATER VACCINATION AND PARASITE CONTROL SERVICES. SOCIOLOGICAL STUDIES ARE PLANNED TO ENSURE THAT PROG WILL BE SOCIALLY FEASIBLE. LIVESTOCK INFO WILL BE DISSEMINATED TO HERDERS VIA OVER-THE-HOA LIVESTOCK RADIOPHONET WAYS OF MAN AND ANIMAL.

25 NIGERIANS WILL RECEIVE US TANG IN LIVESTOCK EATEN AND RANGE MANAGEMENT, US ADVISORS AND TECHNICAL CONSULTANTS WILL ASSIST LOCAL HERDERS IN LIVESTOCK PROG.

USAID WILL PROVIDE COUNTERPARTS, VACCINES & EVALUATION TEAM.

1. IMPLIMENTATION OF SYST OF RANGE MANAGEMENT IN THE PASTORAL ZONE, PURPOSE: 1. THE PREPARATION OF A COMPREHENSIVE, FEASIBLE RANGE MANAGEMENT PLAN AND LIVESTOCK EXTENSION TO OPTIMIZE ANIMAL PRODUCTION IN PASTORAL ZONE. 2. THE DEVELOPMENT OF GOV INSTITUTIONAL CAPACITY TO CARRY OUT THESE INTERVENTIONS.

RANGE RESOURCE STUDIES: A. CARRYING CAPACITY OF RANGE WILL BE DETERMINED AND SYST OF RANGE ASSESSMENT DEVELOPED FOR CONTROL OF GRAZING PATTERNS. B. CHANGES IN THE RANGE BETWEEN 1955-97 DETERMINED BY AERIAL PHOTO ANALYSIS. EROSION PATTERNS AND MAJOR HABITAT TYPES MAPPED. CLIMATOLOGY TRAILS CONDUCTED IN 20 LOCATIONS. 3) FEASIBILITY OF IMPROVING PRIVATE Wells & CONSTRUCTION OF WATER CATCHMENTS DETERMINED. 4) FEARS DAMAGE MONITORED. 5) LIVESTOCK MANAGEMENT STRENGTHENED. 6) A PACKAGE OF INTERVENTIONS TESTED. 7) VACCINES HANdLED. 8) LIVESTOCK AND 10 LIVESTOCK HANDLING FACILITIES INSTALLED. 9) MARKETING STUDY CONDUCTED. 10) TRAINING/INSTITUTIONAL DEVELOPMENT PROGRAM ESTABLISHED.

NIGER IS A NET EXPORTER OF CEREALS PRIOR TO SANH. W.AFRICA HAS BEEN FORCED TO ACCEPT EMERGENCY DONATED CEREAL SUPPLIES AND ABLE TO PROVIDE WHEAT ALTHOUGH THROUGH WHICH AID CAN MAKE CONSTRUCTIVE CONTRIBUTIONS TO AGRICULTURAL AND ECONOMIC RELATIONSHIP NIGER THROUGH WHICH AID CAN MAKE CONSTRUCTIVE CONTRIBUTIONS TO AGRICULTURAL AND ECONOMIC RELATIONSHIP.
THE 35,000 SMALL FARMERS IN THE DEPARTMENT OF NIAMEY (A SAHELIAN REGION IN NIGER) HAVE A PER CAPITA INCOME OF $50/YEAR. 90% OF THEIR CROP PRODUCTION IS LIMITED TO MILLET. THE AREA BECAME FOOD DEFICIENT IN 1975-76 DUE PRIMARILY TO LACK OF RAINFALL. PROJECT AREA IS SUBJECT TO EROSION, DECLINING SOIL FERTILITY, CROP PESTS, AND PLANT DISEASE. AGRICULTURAL PRODUCTION IS ALSO LIMITED BY TRADITIONAL CULTIVATION METHODS, ABSENCE OF COOP AND FARM CREDIT SYSTEMS, VIRTUALLY NON-EXISTENT ANIMAL TRACTION, AND WEAK MARKETING & EXTENSION SERVICES.

THREE-YEAR PROJECT PROVIDES GRANT FOR CONTRACT TECHNICAL ASSISTANCE, LOCAL PERSONNEL, LOCAL TRAINING, COMMODITIES (VEHICLES, OFFICE EQUIPMENT, AGRICULTURAL EQUIPMENT, FERTILIZER, ANIMALS, VACCINES), CONSTRUCTION OF FACILITIES, AND OPERATIONAL COSTS FOR THE INTEGRATED RURAL DEVELOPMENT OF THE NIAMEY DEPARTMENT, NIGER. MOST COUNTRY PROVIDES 25% OF PROJECT COSTS AND PROJECT MANAGEMENT.

GRANT FOR THE INTEGRATED RURAL DEVELOPMENT OF THE DEPARTMENT OF NIAMEY IN THE NIGER REPUBLIC. PROJECT HAS 6 COMPONENTS:
1) AGRICULTURAL SERVICES: DON WILL INITIALLY SUPPLY 16 FIELD AGENTS; ANOTHER 42 AUXILIARY FIELD AGENTS WILL BE TRAINED. EACH CLUSTER OF 5 VILLAGES WILL HAVE AN OFFICE COMPLEX AND A TRAINING CENTER. THE DEMONSTRATION/EXPERIMENTATION PROGRAM WILL INCLUDE IMPROVED PRACTICES OF MILLET PRODUCTION, CULTIVATION OF COMPOSS IN ROTATION WITH MILLET, ANIMAL TRACTION, LIVESTOCK PRODUCTION, AND SOIL AND WATER CONSERVATION TECHNIQUES. A CREDIT AND COOPERATIVE UNION OF NIGER (UNCCI) WILL TRAIN 42 CO-OP MONITORS TO WORK WITH THE 42 CO-OPs AND 210 LOCAL FARMER ASSOCIATIONS (MUTUALs) THAT ARE TO BE ESTABLISHED. 252 CO-OP LEADERS WILL BE TRAINED AT THE AGRICULTURAL SERVICE TRAINING CENTERS. A CO-OP MARKETING SYSTEM AND AN AGRICULTURAL CREDIT SYSTEM WILL BE DEVELOPED. A UNCC OFFICE/WAREHOUSE COMPLEX WILL BE BUILT IN EACH OF THE 3 APRODISSEMENTS. 10 MILLET GRINDING MILLS AND 4 SMALL TAPIOCA/MANIOC FLOUR MILLS WILL BE TESTED AND EVALUATED. VARIOUS STUDIES OF RURAL PROBLEMS WILL LEAD TO A SECOND PHASE, COMPREHENSIVE AREA DEVELOPMENT PLAN.

2) CREDIT AND COOPERATIVE SERVICES: THE CREDIT AND COOPERATIVE UNION OF NIGER (UNCCI) WILL TRAIN 42 CO-OP MONITORS TO WORK WITH THE 42 CO-OPs AND 210 LOCAL FARMER ASSOCIATIONS (MUTUALs) THAT ARE TO BE ESTABLISHED. 252 CO-OP LEADERS AND 2100 mutual leaders will be trained at the agricultural service training centers. A co-op marketing system and an agricultural credit system will be developed. A UNCC office/warehouse complex will be built in each of the 3 appronisements. 10 millet grinding mills and 4 small tapioca/manioc flour mills will be tested and evaluated at the co-op level.

3) LIVESTOCK SERVICES: TRIAL/DEMONSTRATION PROGRAMS WILL BE CARRIED OUT FOR: A) ON-FARM FATTENING OF CATTLE; B) COTTAGE POULTRY-HAUSINGS; C) THE MARADI GOAT PROGRAM; AND D) ANIMAL HEALTH PROGRAM. A VILLAGE-LEVEL LAND USE AND SOIL CONSERVATION PROGRAMS WILL DEVELOP VILLAGE SOIL CONSERVATION PLANS INCLUDING TREE NURSERIES AND EXPERIMENTAL FISH PONDS. A) A PROVINCE WIDE SOIL CONSERVATION PROGRAM WILL BE CARRIED OUT FOR: A) ON-FARM FATTENING OF CATTLE; B) COTTAGE POULTRY-HAUSINGS; C) THE MARADI GOAT PROGRAM; AND D) ANIMAL HEALTH PROGRAM. A VILLAGE-LEVEL LAND USE AND SOIL CONSERVATION PROGRAMS WILL DEVELOP VILLAGE SOIL CONSERVATION PLANS INCLUDING TREE NURSERIES AND EXPERIMENTAL FISH PONDS. A PROVINCE WIDE SOIL CONSERVATION PROGRAM WILL BE CARRIED OUT FOR: A) ON-FARM FATTENING OF CATTLE; B) COTTAGE POULTRY-HAUSINGS; C) THE MARADI GOAT PROGRAM; AND D) ANIMAL HEALTH PROGRAM.

4) STUDY PROGRAM: VARIOUS STUDIES OF RURAL PROBLEMS WILL LEAD TO A SECOND PHASE, COMPREHENSIVE AREA DEVELOPMENT PLAN.

5) TO INCREASE FOOD PRODUCTION, RURAL INCOMES AND IMPROVE RURAL STANDARDS OF LIVING WITHIN THE DEPT OF NIAMEY, NIGER.

6) STRENGTHENED THRU INFRASTRUCTURE & TRAINING PROGRAMS 1) CREDIT & COOP UNION OF NIGER - COOP SERVICES 2) LIVESTOCK SERVICE PROGRAMS 3) VILLAGE-LEVEL LANDUSE & CONSERVATION PROGRAMS 4) TRIAL IRRIGATION SCHEMES INSTALLED & EVALUATED 5) COMPLETE LAWN DATA GATHERED. STUDIES COMPLETED 7) COMPREHENSIVE AREA DEVELOPMENT PLAN PREPARED 8) PROJECT MANAGEMENT UNIT ESTABLISHED IN CONJUNCTION WITH THE NIAMEY DEPT DEVELOPMENT COMMITTEE.
ABSTRACT: EVALUATES PERFORMANCE OF CONSORTIUM FOR INTERNATIONAL DEVELOPMENT (CID) IN ASSISTING NIGER CEREALS PROJECT (NCP) FROM 7/1/75 TO 12/11/76, CID HIRED TO HELP PROVIDE GOVT OF NIGER (GON) WITH A NATIONAL CAPABILITY IN THE PRODUCTION, DISTRIBUTION, AND MARKETING OF SORGHUM & MILLET. CID EVAL TEAM HELD DISCUSSIONS WITH GON OFFICIALS & STAFF MEMBERS OF USAID & NCP, NATL AGR RESEARCH INSTITUTE (INRAN) IS RESPONSIBLE FOR THE DEVELOPMENT OF A PROVEN SET OF PRODUCT INCREASING PRACTICES THROUGH VARIETAL IMPROVEMENT, AGRONOMIC RESEARCH & RELATED TO SORGHUM & MILLET, WORKABLE SYSTEMS FOR DELIVERY OF VEHICLES TO FARMERS, EVALUATORS EXPRESSED A NEED FOR BETTER LIBRARY & LAB FACILITIES TO SUPPORT CEREALS RESEARCH & TESTING & ANALYSIS FOR THE CONSTRUCTION OF SEED RESEARCH & PRODUCT CENTER, A PARTICULAR EMPHASIS ON WATER CONSERVATION & IRRIGATION SYSTEMS DESIGNED TO ENHANCE PRODUCTION, PERSONNEL NEED TRAIN IN LAB TECHNIQUES & IN DEMONSTRATION, MAINTENANCE & REPAIR OF ANIMAL TRACTORS & OTHER TYPES OF FARM EQUIP. A LACK OF TRAINED MANPOWER IS A CRUCIAL PROBLEM IN THE SEED MULTIPLICTION & DISTRIBUTION COMPONENT. ACQUISITION OF EQUIP HAS BEEN DELAYED & DEVEL OF SEED MULTIPLICATION CTRS HAS BEEN HAMPERED BY INCREASED SHIPPING COSTS, INADEQUATE IRRIGATION SYSTEM & DIFFICULTIES IN PROCURING INSECTICIDE. REQUIRES TO PROJECT SUCCESS IS THE ESTABLISHMENT OF A SOUND NATL SEED POLICY. THE TEAM BELIEVES THAT DEVEL OF EFFECTIVE DELIVERY SYSTEMS DEPENDS ON COORDINATN AMONG CONCERNED AGENCIES, QUANTIFIED TARGETS & A COMPREHENSIVE APPROACH BY THE CID ADVISOR. THE NIGERIEN COOP & CREDIT ORGANIZATION (UNC) HAS SEVERAL NEEDS: READILY AVAILABLE TRANSPORT APPROPRIATE FACILITIES, PERSONNEL UPGRADING THROUGH IN-SERVICE SEMINARS, ECONOMIC VIABILITY STUDY, MORE FLEXIBLE FISCAL CONTROL FOR USAID-GON POLICIES ASSURING NECESSARY INPUTS OF FERTILIZER, SEED MATERIALS & EQUIP. AFTER REVIEWING SEVERAL MEMORANDA, TEAM RECOMMENDS THAT USAID PURSUE PROPOSAL TO ORGANIZE VILLAGE DIESEL MILLS TO GRIND MILLET & EXTRACT PEANUT OIL, FREEING WOMEN TO PARTICIPATE IN VILLAGE INDIGO-DYE INDUSTRIES.

ABSTRACT: PAR EVALUATES PERFORMANCE OF NIGER CEREALS PRODUCTION (NCP) PROJECT FROM 9/1/75 TO 2/15/77, PURPOSE OF PROJECT IS TO PROVIDE THE GOVT OF NIGER (GON) WITH AN ECOLOGICALLY SUSTAINABLE AND REASONABLE PRICE FOR CEREALS PRODUCTION AND DISTRIBUTION SYSTEM TO SERVE A LARGE POPULATION AT A SMALLER RATE PER CAPITA THAN CULTIVATION. EVALUATION RECOMMENDS THAT CONSORTIUM FOR INTERNATIONAL DEVELOPMENT (CID) TEAM CONCEPT BE REDEFINED, LEAVING PROJECT COORDINATION TO AID AND GON TO ALLOW TEAM MEMBERS TO BECOME MORE FULLY INTEGRATED INTO THEIR RESPECTIVE ORGANIZATIONAL ASSIGNMENTS, TRAINING OF SOME NIGERIEN COUNTERPARTS IS BEING CARRIED OUT, BUT QUALITY OR LOW-LEVEL PERSONNEL IS LOW ASSIGNMENT OF FULL-TIME AGRICULTURAL ENGINEER, AGRONOMIST, EXTENSION ADVISOR, & SEED SPECIALIST COUNTERPARTS ARE PROPOSED. THERE IS A LACK OF COORDINATION AMONG GOVERNMENT AGENCIES AND RURAL DEVELOPMENT PROGRAMS CONCERNED WITH EXTENSION PLANS INCLUDING QUANTIFIED TARGETS. THE CID EXTENSION ADVISOR SHOULD BE CONCERNED WITH ALL ASPECTS OF NCP EXTENSION, AND SHOULD BE GIVEN AN EXPERIENCED ADMINISTRATIVE ASSISTANT TO ASSUME PAPERWORK AND LOGISTIC CHORES. THE NATIONAL AGRICULTURAL RESEARCH INSTITUTE (INRAN) WILL ASSUM A FULL-TIME ADMINISTRATOR TO COORDINATE RESEARCH WITH NCP REQUIREMENTS. THE ACQUISITION OF COMMODITIES HAS BEEN DIFFICULT BECAUSE OF DELAYS IN GETTING GON APPROVAL OF SPECIFICATIONS AND IN GETTING PAPERWORK PROCESSED THROUGH AID / AN THE AFRICAN PURCHASING CENTER. PLANNED CONSTRUCTION IS PROCEEDING ON SCHEDULE, FINALLY, EVALUATION RECOMMENDS 1) THE CREATION OF A NIGERIEN COOPERATIVE AND CREDIT ORGANIZATION (UNC) CENTER, 2) THE DEVELOPMENT OF PLANS TO MEET RISING FINANCIAL REQUIREMENTS & 3) ACCEPTANCE OF A NATIONAL SEED POLICY WHICH HAS BEEN DEVELOPED.
APPENDIX V

Water Resources

1. Periods of Runoff/Drainage
2. Stream Gauging Network
3. Annual Stream Flow on the Niger
4. Flow of the Niger River in Niger
   a. Flow of the Niger at Niamey Gauging Station
   b. Flow of the Niger at Gaya Gauging Station
5. Flow of Selected Niger Tributaries in Niger
   a. Flow of the Goronol River Alconqui Gauging Station
   b. Flow of the Dargol River at Kakassi Gauging Station
   c. Flow of the Diamangou River at Tamou Gauging Station
   d. Flow of the Medrou River at Barou Gauging Station
6. Flow of Streams in South-Central Niger
   a. Flow of the G. Maradi at Madarounta Gauging Station
   b. Flow of the Maggia at Tsernaoua Gauging Station
7. Hydrogeologic Sketchmap
8. Well Yields in Southern Niger
   a. Shallow Wells
   b. Deep Aquifers
   a. Shallow Aquifers
   b. Deep Aquifers
10. Groundwater Storage and Safe Yields in Southern Niger
    a. Storage
    b. Safe Yield
11. Groundwater Quality
12. Irhazer Valley Location Map
13. Discharge, Drawdown, and Specific Capacity of Irhazer Valley Wells
14. Water Quality of Irhazer Valley Wells
15. Proposed and Existing Dams
16. Location Map for Dams
1. Periods of Runoff/Drainage

ISOLINE OF THE DURATION (DAYS) OF RUNOFF/DRAINAGE AT THE 0.5 PROBABILITY LEVEL

TENTATIVE ISOLINE

LENGTH OF PERIOD OF RUNOFF/DRAINAGE OBSERVED (DAYS)

RAINFALL STATION

TOTAL RUNOFF/DRAINAGE DURING PERIOD CONCERNED (IN mm)

INTERNATIONAL BOUNDARIES

LIMITS OF PROJECT

CAPITAL OF COUNTRY

OTHER CITIES

RIVERS

2. Stream Gauging Network

Gauging Station

Installation Date (number of complete years of record)
Date Abandoned

International Boundaries

Limits of Project

Capital of Country

Other Cities

Rivers

Limits of Main Basins

Limits of Secondary Basins

3. Annual Stream Flow

Period of reference for Niger stations:
Right bank tributaries
1952-1975
Others
1907-1973

Values of Annual, 10-Year Dry, Mean, and 10-Year Wet Flows in m³/s

Limits of Main Basins
Limits of Secondary Basins
International Boundaries

4a. Flow of the Niger at Niamey Gauging Station (70,000 sq. km. watershed)

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<th>Year</th>
<th>Annual Volume (cubic meters)</th>
<th>Specific Discharge (cubic meters per second)</th>
<th>Instantaneous Peak (cubic meters per second)</th>
<th>Total Daily Flood (cubic meters per second)</th>
<th>Specific Flood (cubic meters per square kilometer)</th>
<th>Mean Flood (cubic meters per square kilometer)</th>
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<td>1930-31</td>
<td>20,000,000</td>
<td>48.0</td>
<td>1.46</td>
<td>1,460.0</td>
<td>2.1</td>
<td>100.0</td>
</tr>
<tr>
<td>1931-32</td>
<td>10,000,000</td>
<td>42.0</td>
<td>1.39</td>
<td>1,390.0</td>
<td>2.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1932-33</td>
<td>15,000,000</td>
<td>46.0</td>
<td>1.59</td>
<td>1,590.0</td>
<td>2.3</td>
<td>150.0</td>
</tr>
<tr>
<td>1933-34</td>
<td>20,000,000</td>
<td>50.0</td>
<td>1.77</td>
<td>1,770.0</td>
<td>2.5</td>
<td>170.0</td>
</tr>
<tr>
<td>1934-35</td>
<td>25,000,000</td>
<td>54.0</td>
<td>1.99</td>
<td>1,990.0</td>
<td>2.9</td>
<td>190.0</td>
</tr>
<tr>
<td>1935-36</td>
<td>30,000,000</td>
<td>58.0</td>
<td>2.23</td>
<td>2,230.0</td>
<td>2.7</td>
<td>220.0</td>
</tr>
</tbody>
</table>

4b. Flow of the Niger at Gaya Gauging Station (1,000,000 sq. km. watershed)

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Volume (cubic meters)</th>
<th>Specific Discharge (cubic meters per second)</th>
<th>Instantaneous Peak (cubic meters per second)</th>
<th>Total Daily Flood (cubic meters per second)</th>
<th>Specific Flood (cubic meters per square kilometer)</th>
<th>Mean Flood (cubic meters per square kilometer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1926-27</td>
<td>40,000,000</td>
<td>58.0</td>
<td>1.83</td>
<td>2,060.0</td>
<td>2.9</td>
<td>200.0</td>
</tr>
<tr>
<td>1927-28</td>
<td>50,000,000</td>
<td>60.0</td>
<td>1.77</td>
<td>1,765.0</td>
<td>2.5</td>
<td>200.0</td>
</tr>
<tr>
<td>1928-29</td>
<td>40,000,000</td>
<td>58.0</td>
<td>1.76</td>
<td>1,765.0</td>
<td>2.5</td>
<td>200.0</td>
</tr>
<tr>
<td>1929-30</td>
<td>30,000,000</td>
<td>54.0</td>
<td>1.59</td>
<td>1,590.0</td>
<td>2.3</td>
<td>150.0</td>
</tr>
<tr>
<td>1930-31</td>
<td>20,000,000</td>
<td>48.0</td>
<td>1.46</td>
<td>1,460.0</td>
<td>2.1</td>
<td>100.0</td>
</tr>
<tr>
<td>1931-32</td>
<td>10,000,000</td>
<td>42.0</td>
<td>1.39</td>
<td>1,390.0</td>
<td>2.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1932-33</td>
<td>15,000,000</td>
<td>46.0</td>
<td>1.59</td>
<td>1,590.0</td>
<td>2.3</td>
<td>150.0</td>
</tr>
<tr>
<td>1933-34</td>
<td>20,000,000</td>
<td>50.0</td>
<td>1.77</td>
<td>1,770.0</td>
<td>2.5</td>
<td>170.0</td>
</tr>
<tr>
<td>1934-35</td>
<td>25,000,000</td>
<td>54.0</td>
<td>1.99</td>
<td>1,990.0</td>
<td>2.9</td>
<td>190.0</td>
</tr>
<tr>
<td>1935-36</td>
<td>30,000,000</td>
<td>58.0</td>
<td>2.23</td>
<td>2,230.0</td>
<td>2.7</td>
<td>220.0</td>
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5. Flow of Selected Niger Tributaries in Niger

5a. Flow of the Goromol River Alcongu Gauging Station (44850 sq. km. watershed)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DAILY FLOW</th>
<th>ANNUAL VOLUME</th>
<th>DISTRIBUTION</th>
<th>SPECIFIC DENSITY</th>
<th>HIGHEST FLOOD</th>
<th>LATEST FLOOD</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>MAX FLOOD</th>
<th>A.D. FLOOD</th>
<th>BASED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1504.3</td>
<td>2579.8</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1978</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1977</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
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</table>

5b. Flow of the Dargol River at Kakassi Gauging Station (6940 sq. km. watershed)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DAILY FLOW</th>
<th>ANNUAL VOLUME</th>
<th>DISTRIBUTION</th>
<th>SPECIFIC DENSITY</th>
<th>HIGHEST FLOOD</th>
<th>LATEST FLOOD</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>MAX FLOOD</th>
<th>A.D. FLOOD</th>
<th>BASED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1504.3</td>
<td>2579.8</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1978</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1977</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
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</table>

5c. Flow of the Diamangou River at Tamou Gauging Station (4030 sq. km. watershed)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DAILY FLOW</th>
<th>ANNUAL VOLUME</th>
<th>DISTRIBUTION</th>
<th>SPECIFIC DENSITY</th>
<th>HIGHEST FLOOD</th>
<th>LATEST FLOOD</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>MAX FLOOD</th>
<th>A.D. FLOOD</th>
<th>BASED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1504.3</td>
<td>2579.8</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1978</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1977</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
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5d. Flow of the Medrou River at Barou Gauging Station (10,500 sq. km. watershed)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DAILY FLOW</th>
<th>ANNUAL VOLUME</th>
<th>DISTRIBUTION</th>
<th>SPECIFIC DENSITY</th>
<th>HIGHEST FLOOD</th>
<th>LATEST FLOOD</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>MAX FLOOD</th>
<th>A.D. FLOOD</th>
<th>BASED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1504.3</td>
<td>2579.8</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1978</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
</tr>
<tr>
<td>1977</td>
<td>1473.6</td>
<td>2550.7</td>
<td>18.0%</td>
<td>74.00</td>
<td>2512.4</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
<td>74.00</td>
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6. Flow of Streams in South-Central Niger

6a. Flow of the G. Maradi at Madarounta Gauging Station (5400 sq. km. watershed)

<table>
<thead>
<tr>
<th>WATER YEAR</th>
<th>AVG. AN. DISCH.</th>
<th>ANNUAL VOLUME</th>
<th>RUNOFF</th>
<th>SPECIFIC RUNOFF</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>AVG MIN. DISCH.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-61</td>
<td>3.3</td>
<td>106.0</td>
<td>19.0</td>
<td>0.61</td>
<td>110.0</td>
<td>17.6</td>
<td>0.0</td>
</tr>
<tr>
<td>1961-62</td>
<td>4.0</td>
<td>107.0</td>
<td>23.0</td>
<td>1.12</td>
<td>220.0</td>
<td>40.7</td>
<td>0.0</td>
</tr>
<tr>
<td>1962-63</td>
<td>5.3</td>
<td>122.0</td>
<td>27.0</td>
<td>1.85</td>
<td>260.0</td>
<td>47.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1963-64</td>
<td>6.2</td>
<td>131.0</td>
<td>27.0</td>
<td>1.79</td>
<td>300.0</td>
<td>57.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1964-65</td>
<td>6.9</td>
<td>157.0</td>
<td>35.0</td>
<td>2.57</td>
<td>450.0</td>
<td>66.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1965-66</td>
<td>7.6</td>
<td>207.0</td>
<td>44.0</td>
<td>3.43</td>
<td>600.0</td>
<td>75.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1966-67</td>
<td>11.3</td>
<td>327.0</td>
<td>79.0</td>
<td>6.05</td>
<td>950.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1967-68</td>
<td>2.2</td>
<td>75.0</td>
<td>13.0</td>
<td>0.57</td>
<td>130.0</td>
<td>15.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1968-69</td>
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<td>336.0</td>
<td>63.0</td>
<td>2.32</td>
<td>435.0</td>
<td>47.0</td>
<td>0.0</td>
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<tr>
<td>1969-70</td>
<td>4.2</td>
<td>153.0</td>
<td>29.0</td>
<td>0.50</td>
<td>270.0</td>
<td>50.0</td>
<td>0.0</td>
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<tr>
<td>1970-71</td>
<td>11.3</td>
<td>765.0</td>
<td>75.0</td>
<td>1.00</td>
<td>500.0</td>
<td>60.0</td>
<td>0.0</td>
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</table>


6b. Flow of the Maggia at Tsernaoua Gauging Station (2525 sq. km. watershed)

<table>
<thead>
<tr>
<th>WATER YEAR</th>
<th>AVG. AN. DISCH.</th>
<th>ANNUAL VOLUME</th>
<th>RUNOFF</th>
<th>SPECIFIC RUNOFF</th>
<th>MAX DAILY FLOOD</th>
<th>SPECIFIC FLOOD</th>
<th>AVG MIN. DISCH.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-61</td>
<td>0.8</td>
<td>7.3</td>
<td>3.0</td>
<td>0.30</td>
<td>7.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1961-62</td>
<td>0.2</td>
<td>3.3</td>
<td>1.0</td>
<td>0.50</td>
<td>6.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1962-63</td>
<td>0.4</td>
<td>14.4</td>
<td>4.0</td>
<td>0.24</td>
<td>13.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1963-64</td>
<td>0.3</td>
<td>15.0</td>
<td>4.0</td>
<td>0.25</td>
<td>13.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1964-65</td>
<td>0.8</td>
<td>26.0</td>
<td>8.0</td>
<td>0.50</td>
<td>17.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1965-66</td>
<td>0.8</td>
<td>26.0</td>
<td>8.0</td>
<td>0.50</td>
<td>17.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

quaternary and continental terminal, and cretaceous

maestrichtian (and paleocene) b.m, bp

cretaceous (b)

continental intercalaire (2cm)

paleozoic cover (s, o)

quaternary: mediocre to good aquifer
2.3-150 m³/h (50-90)
10-100 m (10-90)

continental terminal: fair to good aquifer
10-150 m³/h (50-100)
25-150 m (50-over 100)

good aquifer
10-300 m³/h (50-150)
20-500 m (50-250)

 mediocre aquifer in tadojeni and niger basins 0-100 m³/h (5-50)

fair to good aquifer in nigeria basins 10-200 m³/h (50-100)
10-500 m (50-250)

poor to mediocre aquifer
0-100 m³/h (5-10)
20-70 m (25-40)

### Well Yields - Shallow Wells

<table>
<thead>
<tr>
<th>m/HOUR</th>
<th>m/DAY</th>
<th>LITER/SECOND</th>
<th>GALLON/MINUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>0-25</td>
<td>0-0.3</td>
<td>0-45</td>
</tr>
<tr>
<td>1-2</td>
<td>25-50</td>
<td>0.3-0.6</td>
<td>45-10</td>
</tr>
<tr>
<td>2-6</td>
<td>50-150</td>
<td>0.6-1.8</td>
<td>10-30</td>
</tr>
<tr>
<td>6-25</td>
<td>150-650</td>
<td>1.8-7.5</td>
<td>30-120</td>
</tr>
<tr>
<td>25-90</td>
<td>650-2200</td>
<td>7.5-25</td>
<td>120-400</td>
</tr>
<tr>
<td>&gt;90</td>
<td>&gt;2200</td>
<td>&gt;25</td>
<td>&gt;400</td>
</tr>
<tr>
<td>0-6</td>
<td>0-150</td>
<td>0-1.8</td>
<td>0-30</td>
</tr>
<tr>
<td>2-25</td>
<td>50-650</td>
<td>0.6-7.5</td>
<td>10-120</td>
</tr>
</tbody>
</table>

DEVELOPABLE ACCORDING TO BRGM/BURGEAP (SEE SECTION 6.4.4. OF THE REPORT
ACTUAL GROUNDWATER STORAGE IS PROBABLY TWICE AS MUCH IN THE BASEMENT,
AND SEVERAL TIMES HIGHER IN THE SEDIMENTARY BASINS)

Source: Inter African Committee for Hydraulic Studies (CIFEA). 1979, Vol. 2
9b. Ground Water Storage - Deep Aquifers

Groundwater Storage (m³/ha)

- 0,000 - 100,000
- 100,000 - 500,000
- 500,000 - 1,000,000
- 1,000,000 - 5,000,000
- Poorly known, or no deep aquifers except if mapped otherwise.

Note:

- In the Lake Chad Basin, only semi-deep aquifers are mapped. Deep aquifers (Continental Intercalaire) are not well known but should have a good storage.

10. Groundwater Storage and Safe Yield in Southern Niger

10a. Groundwater Storage - Sedimentary Basins

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>FORMATION</th>
<th>(10^-2) STORAGE COEFFICIENT</th>
<th>Drawdown</th>
<th>(Million m^3/km^2) DEVELOPABLE GROUNDWATER STORAGE</th>
<th>MAPPED AREA</th>
<th>VOLUME OF DEVELOPABLE GROUNDWATER STORAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIGER</td>
<td>Continental Terminal</td>
<td>1.8</td>
<td>1/3 épaisseur saturée</td>
<td>0.4-0.95</td>
<td>96 100</td>
<td>39 770-91 510</td>
</tr>
<tr>
<td></td>
<td>Continental Intercalaire</td>
<td>5-10</td>
<td>10</td>
<td>0.5-1</td>
<td>86 700</td>
<td>43 350-86 700</td>
</tr>
<tr>
<td></td>
<td>Plio-Quaternaire</td>
<td>1-10</td>
<td>1/3 épaisseur saturée</td>
<td>0.25-0.55</td>
<td>50 000</td>
<td>12 500-27 500</td>
</tr>
<tr>
<td></td>
<td>Quaternaire</td>
<td>1-2.5</td>
<td>10</td>
<td>0.10-0.25</td>
<td>14 850</td>
<td>1 480-3 710</td>
</tr>
<tr>
<td></td>
<td>Pliocène</td>
<td>0.2-0.8</td>
<td>100 m sous le sol</td>
<td>0.25-0.50</td>
<td>17 500</td>
<td>4 375-8 750</td>
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<tr>
<td></td>
<td>Continental Intercalaire</td>
<td>0.1-0.5</td>
<td>100 m sous le sol</td>
<td>0.17-0.37</td>
<td>30 000</td>
<td>22 100-48 100</td>
</tr>
</tbody>
</table>

Groundwater Storage - Basement

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>MAPPED AREA</th>
<th>DEVELOPABLE GROUNDWATER STORAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIGER, Liptako</td>
<td>50 000</td>
<td>5 000</td>
</tr>
<tr>
<td>ZINDER</td>
<td>10 000</td>
<td>1 000</td>
</tr>
</tbody>
</table>

### Safe Yield - Sedimentary Basins

<table>
<thead>
<tr>
<th>BASIN</th>
<th>COUNTRY</th>
<th>FORMATION</th>
<th>AVERAGE INFILTRATION (mm/yr)</th>
<th>MAPPED AREA</th>
<th>SAFE YIELD (Million m$^3$/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIGER</td>
<td>Niger</td>
<td>Continental Terminal</td>
<td>13</td>
<td>96 100</td>
<td>1 220</td>
</tr>
<tr>
<td></td>
<td>Tagara, Damagou, Mango</td>
<td>Continental intercalaire, Terminal et Plio-Quaternaire</td>
<td>3</td>
<td>136 000</td>
<td>408</td>
</tr>
<tr>
<td></td>
<td>Koramga</td>
<td>Quaternaire</td>
<td>127</td>
<td>14 850</td>
<td>1 890</td>
</tr>
</tbody>
</table>

### Safe Yield - Basement

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>INFILTRATION (mm/yr)</th>
<th>MAPPED AREA</th>
<th>SAFE YIELD (Million m$^3$/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIGER, LIPTAKO</td>
<td>3</td>
<td>50 000</td>
<td>160</td>
</tr>
<tr>
<td>ZINDER</td>
<td>3</td>
<td>10 000</td>
<td>30</td>
</tr>
</tbody>
</table>

## Groundwater Quality in Selected Sedimentary Aquifers (mg/l)

<table>
<thead>
<tr>
<th>Aquifer</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>Cl</th>
<th>SO4</th>
<th>CaCO3</th>
<th>Nitrate</th>
<th>Iron</th>
<th>TDS</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Chad Basin</td>
<td>16-200</td>
<td>2.67-13.36</td>
<td>10.1-655</td>
<td>3.5-66</td>
<td>1.8-155</td>
<td>64.8-1860</td>
<td>92.7-361</td>
<td>85-3121</td>
<td>6.5-7.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Continental Terminal, Lake Chad Basin</td>
<td>2-26</td>
<td>1.2-10.9</td>
<td>126.5-266</td>
<td>2.8-10.5</td>
<td>17.7-73.4</td>
<td>4.8-218</td>
<td>238-549</td>
<td>269-748</td>
<td>7-8.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Continental Terminal, Niger Basin (Bokoto)</td>
<td>4.1-136</td>
<td>0.4-55.8</td>
<td>2.4-98</td>
<td>0.2-22.8</td>
<td>2-15.3</td>
<td>3-508</td>
<td>3-246</td>
<td>0.3-99</td>
<td>6.4-7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creaceous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niger Basin (Bokoto)</td>
<td>0-137</td>
<td>0-12</td>
<td>2-200</td>
<td>7.2-38</td>
<td>1-37</td>
<td>3-167</td>
<td>1.5-110</td>
<td>0.04-3.2</td>
<td>151-628</td>
<td>4.9-7.6</td>
<td></td>
</tr>
<tr>
<td>-Continental Intercalaine, Lake Chad Basin</td>
<td>58</td>
<td>1</td>
<td>449</td>
<td>10</td>
<td>748</td>
<td>152</td>
<td>1339</td>
<td>7.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. Inhazer Valley Location

Drainage Channel
Crystalline Bedrock
Road
Town
Village
Settlement

13. Discharge, Draw down, and Specific Capacity of Inhazer Valley Wells

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Discharge (m³/hr)</th>
<th>Drawdown (m)</th>
<th>Specific Capacity (gpm/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR1</td>
<td>5.9</td>
<td>56.46</td>
<td>0.10</td>
</tr>
<tr>
<td>IR2</td>
<td>11.3</td>
<td>27.61</td>
<td>0.41</td>
</tr>
<tr>
<td>IR3</td>
<td>52.8</td>
<td>2.51</td>
<td>21.04</td>
</tr>
<tr>
<td>IR4</td>
<td>17.6</td>
<td>6.56</td>
<td>2.68</td>
</tr>
<tr>
<td>IR5</td>
<td>30.4</td>
<td>6.68</td>
<td>4.55</td>
</tr>
<tr>
<td>IR6</td>
<td>11.8</td>
<td>46.48</td>
<td>0.25</td>
</tr>
<tr>
<td>IR7</td>
<td>11.3</td>
<td>1.2</td>
<td>9.42</td>
</tr>
<tr>
<td>IR8</td>
<td>11.3</td>
<td>24.83</td>
<td>0.46</td>
</tr>
<tr>
<td>Absok</td>
<td>3.2</td>
<td>39.00</td>
<td>0.08</td>
</tr>
<tr>
<td>Anouar</td>
<td>80.0</td>
<td>16.42</td>
<td>4.87</td>
</tr>
<tr>
<td>Assouas</td>
<td>21.4</td>
<td>28.00</td>
<td>0.76</td>
</tr>
<tr>
<td>Azal</td>
<td>76.6</td>
<td>7.07</td>
<td>10.83</td>
</tr>
<tr>
<td>In Gitene</td>
<td>20.30</td>
<td>6.80</td>
<td>2.98</td>
</tr>
<tr>
<td>Isakanan</td>
<td>4.8</td>
<td>27.12</td>
<td>0.18</td>
</tr>
<tr>
<td>N'Takouha</td>
<td>76.0</td>
<td>21.22</td>
<td>3.58</td>
</tr>
<tr>
<td>Takoutout</td>
<td>65.4</td>
<td>26.50</td>
<td>2.47</td>
</tr>
<tr>
<td>Tamerat</td>
<td>46.60</td>
<td>14.00</td>
<td>3.33</td>
</tr>
</tbody>
</table>

\(^a\)After 48 hours of pumping.

## 15. Proposed and Existing Dams

<table>
<thead>
<tr>
<th>Stage</th>
<th>Purpose</th>
<th>Capacity $\times 10^6$ m³</th>
<th>Irrigation (ha)</th>
<th>Height (m)</th>
<th>Power (MW)</th>
<th>Annual Production (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>I</td>
<td>11</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>30</td>
<td>(included with Zango) 10,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I</td>
<td>6.5</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I</td>
<td>6</td>
<td>900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>E</td>
<td>1,040</td>
<td>26-43</td>
<td>26</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>E</td>
<td></td>
<td>10-15</td>
<td>84</td>
<td>526</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>5.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>15</td>
<td>230</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I,E</td>
<td>12,000</td>
<td>80,000</td>
<td>30</td>
<td>200</td>
<td>1,000</td>
</tr>
</tbody>
</table>

1=existing
2=under study
I=Irrigation
E=Hydroelectric

16. Location Map for Dams

APPENDIX VI

Environmental Legislation

A. Water
B. Soils
C. Flora
D. Fauna
E. Minerals
F. Hazardous Substances
G. Public Health

Sources: Caponera, D. A. 1978.
         U. S. Environmental Protection Agency. 1976.
Appendix VI

Environmental Legislation

A. Water

1. Colonial legislation for former French West Africa is still in force unless specifically superceded by more recent legislation.

a. The Civil Code (Articles 640-645) governs use of non-public water.

b. The Decree of 14 April 1904 concerns the protection of public health.

c. The Decree of 5 March 1921 concerns the status of water. Users of public water must apply to the proper administrative agency. Discharge of refuse, domestic wastes, etc. into any public water is prohibited.

d. The Decree of 21 March 1928 concerns the status of water.

e. The Decree of 29 September 1928 governs the public domain and compulsory servitutes and defines public domain of surface waters as including navigable waterways and their overflow; springs and non-navigable watercourses and overflow area; ponds, lakes to highwater mark, and artificial water courses (canals, etc.) if built with public money.

f. The Decree of 4 July 1935 (Article 30) concerns the status of forests.

g. The Decree of 30 October 1935 concerns the protection of drinking water.

h. Decree No. 52-679 of 3 June 1952 amends Articles 1 and 2 of the Decree of 29 September 1928, defining all groundwater as part of public domain.

i. Decree No. 55-490 of 5 May 1955 supplements the Decree of 29 September 1928.

j. Order No. 9929 of 15 December 1955 of the Ministry of Public Works concerns conditions of implementation of Decree No. 55-490 of 5 May 1955 supplementing the Decree of 29 September 1928. Protected areas are established around urban drinking water supplies. Groundwater use may be regulated or prohibited for any reason of public interest.

2. Agreement of 5 February 1952 concerns the management of the Electricity, Water and Ice Service at Niamey.

3. Law No. 61-8 of 29 May 1961 concerns the prospecting, exploration, exploitation, possession, movement, trade and processing of mineral and fossil substances, including water, in the territory of the Republic of the Niger.

4. Law No. 63-31 of 7 May 1963 creates a public institution for the exploitation of underground water in the Republic of the Niger (OFEDES).
5. Law No. 63-37 of 10 July 1963 amends Article 7 of Law No. 63-31 of 7 May 1963 (OFEDES).

6. Decree No. 64-019 MER/MTP/MFAE of 3 January 1964 concerns the statute of the Underground Water Board (OFEDES).

7. Convention and statute of 21 May 1964 concerns the development of the Chad Basin. Signatory states undertake to refrain from taking measures which will adversely affect the size of water loss, the shape of the annual hydrograph and limnograph, or the biological characteristics of fauna or flora of the Chad Basin. Land use projects which can affect these factors are covered, as are domestic and agricultural water use.


11. Agreement made concerning the Niger River Commission and navigation and transport on the Niger River, Niamey, 25 November 1964, forbidding the pollution of water of the Niger or any tributaries or alteration of the biological characteristics of fauna or flora without prior warning and consultation with the Niger River Commission.

12. Decree No. 67-143 PRN/MER of 25 September 1967 regulates the opening of pumping stations situated in grazing areas.

13. Decree No. 69-43 MTP/T/M/U of 2 January 1969 sets up a Water and Electricity Committee.

14. Cahier des charges of 9 July 1971 concerns the operation on a concession basis of public drinking-water supply facilities by the Electricity Company of the Niger. Water must be of such quality to satisfy the public health service and hygiene and environmental health regulations.

15. Decree No. 70-281 institutes a commission to study regulations on river navigation.

16. Decree No. 72-130 PRN of 26 September 1972 defines the functions of the Minister of Mines, Geology and Water.
B. Soils

1. Colonial Decree of 7 July 1935 (Article 30) on the status of forests regulates forest clearance so as to control soil erosion.


C. Flora

1. Colonial Decree of 4 July, 1935 (Article 30) on the status of forests denies private owners of forest and woodland the right to clear the land if it would jeopardize protection of soils against erosion and flooding.

2. Decree 206 of 1960 sets the conditions for importation into Niger of any vegetable or other matter which could introduce organisms detrimental to agricultural crops.


D. Fauna


2. Colonial Decree of 27 April, 1954 concerns protection of wildlife reserves and National Parks.


4. Decree 122 of 1964 prohibits marketing or export of products from wild animals.

5. Decree 101 of 1966 restricts hunting of birds to use of traditional weapons only.


7. Law 17 of 1971 regulates fishing and protects fisheries and fish.

E. Minerals

1. Law No. 61-8 of 29 May 1961 is the Mining Law.

3. Decree 63 of 1969 grants a type "A" permit to the French commission of atomic energy.


5. Decree 134 of 1969 amends Decree 23 of 1968 pertaining to the institution of a fiscal scheme of enterprises for research and exploitation of physical or chemical minerals of uranium.

F. Hazardous Substances

1. Law No. 66-033 of 24 May 1966 concerns dangerous, unhealthy or troublesome establishments. Manufacturing establishments, workshops, factories, warehouses, construction sites and any other industrial or commercial establishments constituting a source of danger or inconvenience, whether to the safety, hygiene or amenity of the neighbourhood or to public health, or to agriculture, are placed under the surveillance of the administrative authorities under the conditions laid down by this Law.


3. Decree No. 69-99/MER of 30 May 1969 prescribes additional provisions governing the possession and use of poisons for plant protection purposes. The manufacture, conversion, extraction, preparation, possession, offer, distribution, brokerage, purchase, sale, import and export of substances classified in Schedule C annexed to the Decree of 2 April 1951 (laying down the composition of Part II of the Poisons Schedules) and, in general, all agricultural, industrial and commercial operations involving these substances, are prohibited, except if a licence is held. The latter is non-transferable and is issued by the Minister of Rural Economy.

4. Order No. 005 MER/AG of 19 May 1970 of the Ministry of Rural Economy, pursuant to the provisions of Decree No. 69-99/MER of 30 May 1969, establishes the list of plant protection products and specialities recognized as necessary for use in the control of crop pests. These products and specialities are classified as follows: I. insecticides and acaricides; II. fungicides; III. herbicides, defoliants and shrub control agents; IV. miscellaneous pesticides (rodenticides, nematocides, wetting agents).

5. Decree 98 of 1970 relates to transport by land and management of dangerous or infectious materials.
1. Order No. 11/MS/AS of 11 June 1969 prescribes the duties of the physicians in charge of departmental hygiene and mobile medical units.

2. Decree No. 74-8 PRN of 4 January 1974 establishes and organizes a National Committee for the Coordination of the Onchocerciasis Control Activities.

3. Decree No. 74-81 PCMS/MSP/AS of 10 May 1974 prescribes the duties of the Minister of Public Health and Social Affairs.
Appendix VII

Governmental and Other Organizations

1. Principal Government Officials and U. S. Officials in Niger

2. Ministry of Rural Development Organization

3. Functions of Selected Ministry of Rural Development

4. Functions of other Governmental Organizations

5. International Organizations

6. Selected U. S. Non-Governmental Non-Profit Organizations Involved in Niger

Sources:  Arid Lands Natural Resources Committee. 1979.
         CILSS. undated.
         Committee on Environment and Development. 1980.
         Quan, C. 1976.
         Sierra Club. 1976.
         UNESCO. 1966.

A. Principal Government Officials

President of the Republic, Head of the Supreme Military Council-Lt. Col. Seyni Kountche

Ministers
Finance-Intendent Lt. Col. Militaire Moussa Tondi
Postal Affairs and Telecommunications-Lt. Col. Sory Mamadou Diallo
National Education-Major Moussa Sala
Youth, Sports, and Culture-Major Moumouni Djermakozye Adamou
Interior-Capt. Tandja Mamadou
Plan-Dr. Annou Mahamane
Mines and Hydraulics-Mounkeila Arouna
Economic Affairs, Commerce, and Industry-Mai Maigana
Justice-Alou Harouna
Public Works, Transport and Urbanism-Moussa Bako
Rural Development-Brah Mamane
Public Health and Social Affairs-Yahaya Toundara
Higher Education and Research-Garba Sidikou
Foreign Affairs and Cooperation-Daouda Diallo
Information-Mahamadou Halilou
Civil Service and Labor-Mayaki Issoufou
Secretary of State for Foreign Affairs and Cooperation-Hamid Algabit
Secretary of State for the Interior-Abdou Mallam Moussa
Director General of President's Cabinet-Jean Poisson
Secretary General of the Government-Boubadar Abdou Adamou
Rector of the University-Dr. Abdou Moumouni Dioffo

Prefectorial Assignments
Niamey-Maigary Amballam
Maradi-Capt. Amadou Seyni
Tahoua-Major Adamou Arouna
Agadez-Major Abdou Ide
Zinder-Major Bagnou Beido
Dosso-Major Ibrahim Hassane
Diffa-Capt. Dandi Abarchi
Ambassador to the United States-Andre Wright
Ambassador to the United Nations-Ide Oumarou

B. Principal U. S. Officials

Ambassador-James K. Bishop
Deputy Chief of Mission-Peter R. Chaveas
Director, U. S. AID-Jay P. Johnson
Economic/Commercial Officer-David Thatcher
Director, Joint Administrative Office-Edward Pohl
Public Affairs Officer (USICA)-William R. Barr
Peace Corps Director-Phyllis Dichter

The mailing address of the U. S. Embassy in Niger is B. P. 201, Niamey.

2. Ministry of Rural Development Organization

Ministry

- Composit Societies
- Cabinet of the Ministry
- Public Organizations

SONITRAN
(Nigerien Tanning Organization)

SONERAN
(Nigerien Organization for Development of Animal Resources)

SNCP
(Organization for Collection of Skins and Hides)

Secretariat of State

- Cabinet of the Secretariat of State

Secretary General

- National Directorate of Rural Engineering
- National Directorate of Administrative and Financial Affairs
- Water and Forestry Directorate
- Livestock Service
- Agriculture Service
- Research and Planning Department

UNCC
(Union Nigerien de Credit et Cooperatives)

INRAN
(Institut National de Recherche Agronomique du Niger)

IPDR Kolo

OLANI
(Office du Lait du Niger - Dairy Office)

refrigerated slaughterhouse

various projects

3. Functions of Selected Ministry of Rural Development Departments.*

A. Union Nigerien de Credit et Cooperatives (UNCC)

1. Goals and duties:
   to promote establishment of cooperatives
   to assist coops in marketing
   to provide farming inputs and technical assistance
   to manage irrigation schemes

2. UNCC Organization Chart

Source: Quan, C. 1976.

*if a director is stated, the source is Europa Publications, 1979. 
A governmental reorganization was carried out in late 1979, so that directors may have changed.
B. Institute National de Recherche Agronomique du Niger
B. P. 150
Niamey

also:

INRAN—Forestry
B. P. 225
Niamey


C. Water and Forestry Directorate
goals and duties: to protect the natural habitat in the areas of forestry, hunting, fishing

D. Livestock Service

1. Goals and duties: control of animal diseases; supervision of sales and inspections of meat, hides; compile statistics on the livestock sector

2. Station Sahelienne Experimentale de Toukounous
Service d'Elevage du Niger
Toukounous/Filingue

Goals and duties: selection and breeding of Zebu Azaouak cattle and distribution of selected bulls to improve the local heterogeneous breed

E. Agriculture Service
Goals and duties: to improve agricultural methods, provide protection against disease and pests, carry out agricultural research, aid in implementation of research, and compile agricultural statistics.
4. Functions of Other Governmental Organizations*

A. Ministry of Mines and Hydrology

1. Office des Eaux du Sous-Sol (OFEDES)
   B.P. 734
   Niamey
   government office for the maintenance and development of wells and boreholes in the country

2. Service of Mines and Hydrology
   conducts minerals research

3. Office National des Ressources Minieres (ONAREM)
   B.P. 210
   Niamey
   government office for the prospecting, exploitation and development of trade in all minerals

B. Ministry of Public Works, Transport, and Urbanism

1. The Water Commission
   responsible for determining water policy, coordinating projects of various government offices, evaluating projects and legislation concerning water
   a. The Technical Water Committee
      evaluate implementation problems regarding water and electricity in urban, industrial, and mining zones.

C. Ministry of Planning

1. Provincial Planning Service SDP
   elaborates and coordinates planning on departmental level
   collection and organization of data and information on natural resources, the economy, and social conditions for use by other services to assist their activities

2. Animation Service
   supports other services, especially the health service; demonstrates principles of hygiene, sanitation, and nutrition in villages.

*see note on part 3 of this appendix
D. **Ministry of Finance**

1. Direction du Service Topographique et du Cadastre  
   B. P. 250  
   Niamey

E. **Independent or undetermined agencies**

1. Bureau de Recherches Geologiques et Minieres  
   B. P. 458  
   Niamey

2. Institut de Recherches d'Agronomie et Cultures Viviers (IRAT)  
   Part of a wider network of French sponsored research stations in West Africa, in Niger IRAT is one of the main agents of agricultural research. A station at Tarna (near Maradi) focuses on dryland farming; one at Kolo (near Niamey) on irrigated agriculture.

major fields of research:

- climatology  
- soils and soil fertility  
- irrigation  
- plant breeding  
- cultural practices for a number of crops

3. Institut de Recherches sur les Fruits et Agrumes (IRFA)  
   B. P. 886  
   Niamey

4. Laboratoire Veterinaire de Niamey

5. Office de la Recherche Scientifique et Technique OutreMer  
   B. P. 11416  
   Niamey

   hydrology, archaeology, geophysics

6. Office des Produits Vivriers du Niger OPVN  
   B. P. 474  
   Niamey

   government office for developing agricultural and food production

7. Office National de L'Energie Solaire ONERSOL  
   B. P. 614  
   Niamey

   gouvernement office for building and commercial exploitation of solar-powered machinery

8. Societe Nationale des Grands Travaux du Niger  
   B. P. 625  
   Niamey
public building and engineering projects; cap. 529m. francs CFA

9. Station Avicole et Centre d'Elevage Caprin

F. Universities and Colleges

1. Universite De Niamey
   B. P. 237
   Niamey

   Constituent Institutes:
   Ecole des Sciences
   Ecole des Lettres
   Ecole de Pedagogie
   Institut de Recherche pour l'Enseignement des Mathematiques
   Ecole Superieure d'Agronomie
   Ecole des Sciences de la Sante
   Institut de Recherches en Sciences Humanies

   Institut de Recherches en Sciences Humaines IRSH
   B. P. 318
   Universite de Niamey
   Niamey

   f. 1976 as successor to Centre Nigerien de Recherches en Sciences
   Humaines

   library of 8,000 vols.

   5 sections: archaeology, history, sociology, linguistics, audio-visual

   publs. Etudes Nigeriennes, Mu Kaara Sani (3 a year)

2. Ecole Nationale d'Administration du Niger
   B. P. 542
   Niamey

   library of 18,000 vols.
5. International Organizations

Niger is a member of several organizations which are directly concerned with various environmental problems.

A. CILSS (Comite Inter-Etats de lutte contre la Secheresse au Sahel) and its support organization, Club du Sahel

CILSS members: Cape Verde Islands, Chad, Gambia, Mali, Mauritania, Niger, Senegal, Upper Volta

Club de Sahel: not statutory membership. Open to all countries and organizations interested in development of the region encompassed by CILSS states.

Source: CILSS. Undated.
B. Lake Chad Basin Commission  
(Cameroon, Chad, Niger, Nigeria)  
(of section 2.2.4)

C. Liptako-Gourma Region Integrated Development Authority (Mali, Niger, Upper Volta)

The Authority is charged with promoting regional development of mineral, energy, water, agricultural, grazing, and fishery resources in the contiguous parts of these three states.

D. Niger River Commission  
(Cameroon, Chad, Benin, Guinea, Ivory Coast, Mali, Niger, Nigeria, Upper Volta)

E. Organization commune de lette antiacridienne et de lutte antiaviaire  
(Cameroon, Chad, Benin, Ivory Coast, Mali, Mauritania, Niger, Senegal, Upper Volta)

The organization is charged with control of insect pests and granivorous birds (particularly the desert locust and Quelea quelea) and with carryingout supporting research.

F. Organization International contre de Criquet Migrateur African  
(21 African states including Niger)

OICMA is charged with control of and research on the African migratory locust. It focuses on, but is not limited to, the major outbreak area on the Niger River.

G. Organization de coordination et de cooperation pour la lutte contre les granches endemies  
(Benin, Ivory Coast, Mali, Mauritania, Niger, Senegal, Togo, Upper Volta)

This West African organization is responsible for research on and implementation of programs to control the major endemic diseases of the area.

H. Inter African Committee for Hydraulic Studies  
(most African states including Niger)

I. Mission permanente de cooperation  
B. P. 494  
Niamey

Center for administering bilateral aid from France according to the co-operation agreements signed in 1961 and re-negotiated in 1977

J. Mission ORSTOM au Niger (ORSTOM Mission in Niger)  
B. P. 223  
Niamey, Niger

In addition, numerous other countries and organizations provide assistance to Niger and/or maintain offices or projects in the Niger, including:

African Development Bank
EEC
FAO
IBRD
OPEC
UNDP
Algeria
Belgium
Canada
China
Germany (West)
Japan
Netherlands
Saudi Arabia
Switzerland
USA

Africare
works in areas of development planning, drought relief, agricultural and livestock projects, health programs

Care, Inc
work in agricultural production, improving water sources, fisheries

Catholic Relief Services
technical training projects, small scale water storage projects

Church World Service
date palm production in Air, fisheries, well restoration projects. Participates in reforestation, dune control, projects, health programs

Sudan Interior Mission, Inc.
maintains a farm center at Maradi which aids farmers, offers training, carries out rural development projects (particularly well construction, irrigation, water conservation). Health programs

United Methodist Committee on Relief.
agricultural projects, reforestation, health programs
Appendix VIII

Bibliography

1. General Bibliographic Sources for Africa
2. Geography and Climate
3. Geology, Minerals, and Soils
4. Agriculture and Agricultural Land Use
5. Pastoralism and Range Use
6. Water Resources and Management
7. Flora and Fauna
8. Public Health and Nutrition
9. Social Aspects
10. Development
1. General Bibliographic Sources for Africa


Forestry Abstracts. Slough, UK: Commonwealth Agricultural Bureaux.


A: geomorphology.
B: biogeography and climatology.
C: economic geography.
D: social geography and cartography.
E: sedimentology.
F: regional and community planning.
G: remote sensing and cartography.


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2. Geography and Climate


4. Agriculture and Agricultural Land Use


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5. Pastoralism and Range Use


6. Water Resources and Management


7. Flora and Fauna


9. Social Aspects


