

**ENVIRONMENTAL AND
NATURAL RESOURCE MANAGEMENT
IN DEVELOPING COUNTRIES**

A Report to Congress

VOLUME II: APPENDIX

United States Agency for International Development
Department of State
Washington, D.C. 20523
February 1979

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IN DEVELOPING COUNTRIES

- A Report to Congress -

Volume II: Appendix

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PREPATORY NOTE

This Appendix consists of two draft environmental reports -- on Sri Lanka and Mauritania, respectively -- prepared by the Science and Technology Division, Library of Congress, under contract* to the U. S. Man and the Biosphere Program. The two reports are examples of a number of similar documents being prepared for use by A.I.D. Mission personnel as a basis for dialogues with host country officials leading to a better mutual understanding of environmental needs.

The draft reports are reproduced in their original form, and are therefore paginated separately. Each report is preceded by its own table of contents.

*AID/DS/ST Contract No. SA/TOA 1-77.

**DRAFT ENVIRONMENTAL REPORT
ON SRI LANKA**

**Prepared by the Science and Technology
Division, Library of Congress
Washington, D.C.**

**AID/DS/ST Contract No. SA/TOA 1-77
With U.S. Man and the Biosphere Secretariat
•
Department of State
Washington, D.C.**

November 1978

Draft Environmental Report on SRI LANKA

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S R I L A N K A : ENVIRONMENT AND RESOURCES

0.0 INTRODUCTION AND SUMMARY

Located within the tropics and subject to monsoonal winds, the Republic of Sri Lanka has two sharply different climatic zones: the wet zone of the south-west of the island and the dry zone covering the remainder of its territory. The dry zone-wet zone distinction is essential for an understanding of Sri Lanka and its development potentialities and problems. The wet zone (about 100+ inches of rainfall per year) is the area of greatest population and industrial concentration, providing the soil and climatic conditions essential for Sri Lanka's major export crops: tea, rubber, and coconut. The wet zone is intensely utilized and apart from the possibility of land reclamation in coastal zones offers little opportunity for further agricultural expansion. The dry zone, on the other hand, until about the 13th century A.D. the center of a highly advanced civilization based on irrigated agriculture, receives less than 75 inches of rainfall per year, is relatively sparsely populated, has little industrial development, and offers the opportunity for agricultural expansion in conjunction with irrigation schemes.

With an economy based chiefly on tea, rubber and coconut, Sri Lanka, since receiving its independence from the British in 1948, has been able to raise significantly the living standard of its people, provide free education and health service, broaden the political base, and introduce land reform. Sri Lanka's economy has suffered, however, from several weaknesses: the inability to meet the food demands of its population and the rising cost of the food it must therefore import; a dependence for foreign exchange on crops which in recent years have suffered price declines on the world market; a decline in foreign investments; a high level of unemployment; inflation; and sharply rising prices for petroleum and other products essential for development. Drought through most of the first half of the 1970's aggravated Sri Lanka's weakened economic condition considerably, bringing about record low yields for rubber and other export crops.

The necessity of meeting the food requirements of its population, which has grown by about 96% since 1946, and of lowering its requirements for imported food and raw materials has resulted in several development emphases: the agricultural development of the dry zone, chiefly through the construction of major irrigation works; increased use of fertilizers, pesticides, and herbicides, with government subsidies to encourage their use; the diversification of "plantation" crops and the more efficient use of unproductive tea and rubber lands; the development of the forest industry to supply raw materials for local industry; the expansion of largely unexploited fisheries potential; and the increase of livestock numbers for meat and milk production. Mineral resources are limited but supply some foreign exchange as well as raw material for the production of cement and other construction materials such as bricks and tiles.

It is generally agreed that Sri Lanka's water, soil and forest resources offer opportunities for development, but such development must proceed rationally if environmental deterioration, already very much in evidence, is to be avoided. Although the government has established no central authority with responsibility for environmental protection, a wide range of government agencies have functions

involving the environment and natural resources (section 2), and legislation providing for protection of the environment is on the books (section 3). There are also indications that government agencies, despite some ill-advised development efforts, are willing to consider factors such as the protection of wildlife and forests in laying down development plans (section 2.2.1).

MAJOR ENVIRONMENTAL PROBLEMS

The major environmental problems of Sri Lanka, as touched on in this report, are, in descending order of importance: deforestation; problems involving water resources; soil erosion; dangers to coasts and coastal resources, especially coral reefs; wildlife protection; and industrial pollution. There are also problems involving administration and enforcement of environmental legislation.

1) DEFORESTATION:

Deforestation is identified as the chief environmental problem because it is reported to be proceeding at a rapid pace and because of its many ramifications, which include: loss of forests important for their waterholding capacity, with consequences for water flow in rivers, erosion, and local climate (section 4.2.3); increased danger of soil erosion, especially where forest land has been cleared in areas of high elevation; loss of unique rain forests (section 4.2.2.4); and loss of habitat for wild animals.

Deforestation has arisen from:

- land clearing for agriculture, either in conjunction with major development schemes or for traditional shifting agriculture (chena), which is said to account for more felled trees annually than the expansion of settled permanent agriculture (see 4.2.2.5); very frequently chena farmers encroach on land set aside as forest reserves;
- firewood collection: population growth has brought about an increased demand for this resource, leading in some cases to the looting of forest reserves (section 4.2.2.1); although most of the firewood is used domestically, tea plantations, because of recent high costs of petroleum fuels, have been burning valuable forest trees for tea-drying operations (section 4.2.2.6 and section 4.7.3.1); no regular programs presently exist to ensure the renewal of this valuable resource;
- development of the timber industry, which, in at least one instance, has led to the exploitation of a unique rainforest as a source of lumber for plywood manufacture (section 4.2.2.4).
- use of timber for construction needs (4.2.2.3).

2) WATER RESOURCES

Deforestation, already considered above, is reported to have had grave consequences for water resources, leading to reduced water flow in some rivers and to localized droughts (see 4.1.1).

Other problems related to water resources are:

- severe drought during the early and into the mid-70's have caused some speculation about the possible "dwindling of water resources," a development which could adversely affect plans for agricultural expansion through irrigation

- severe water shortages have existed in Colombo in recent years; these have been attributed not only to drought and the consequent reduction of the levels in the chief reservoir serving the city but also to deforestation around the catchment area, silting and evaporation;
- wide fluctuations in river flow, due principally to erratic or unreliable rainfall in dry zone areas; this creates problems for equalizing hydro-electric output (section 4.1.2.2.1);
- water quality is negatively affected by the presence of faecal matter in streams and canals (section 1.6.4); pollution from industrial activities (section 5.3); and the presence of pesticides in irrigation tanks and reservoirs (section 5.2.2.1.2);
- there are also problems of wasting of water in connection with major irrigation schemes (section 5.2.2.1.4).

3) SOIL EROSION

Serious soil erosion is another consequence of deforestation, especially where forests have been cleared on steep slopes and at high elevations (section 4.3.1). Other problems can be expected to arise from the growing practice of allowing a shorter fallow period in shifting agriculture and of converting such land for settled agriculture (section 5.2.2.3). Erosion is also leading to increasing siltation of both irrigation reservoirs and hydro-electric works (5.2.2.1.3). Increased soil erosion is expected to result from major development projects (section 5.2.2.1.2).

4) COASTS AND BEACHES

The quarrying of coral reefs for lime production, the most egregious example of which has been reported from the east coast (4.7.3.1), but which is also quite prevalent in the southwest, has serious consequence. In the Batticaloa area, rampant destruction has resulted in: severe shoreline erosion; loss of mangrove forests which serve as breeding areas for fish; destruction of small lagoons; decreased fish catch; loss of useful plants near the coast; and the salting of water in nearby coastal wells,

Coral reefs are also endangered by the crown of thorns starfish, which has proliferated in Sri Lanka's waters in recent years (section 4.7.3.2).

5) WILDLIFE RESOURCES

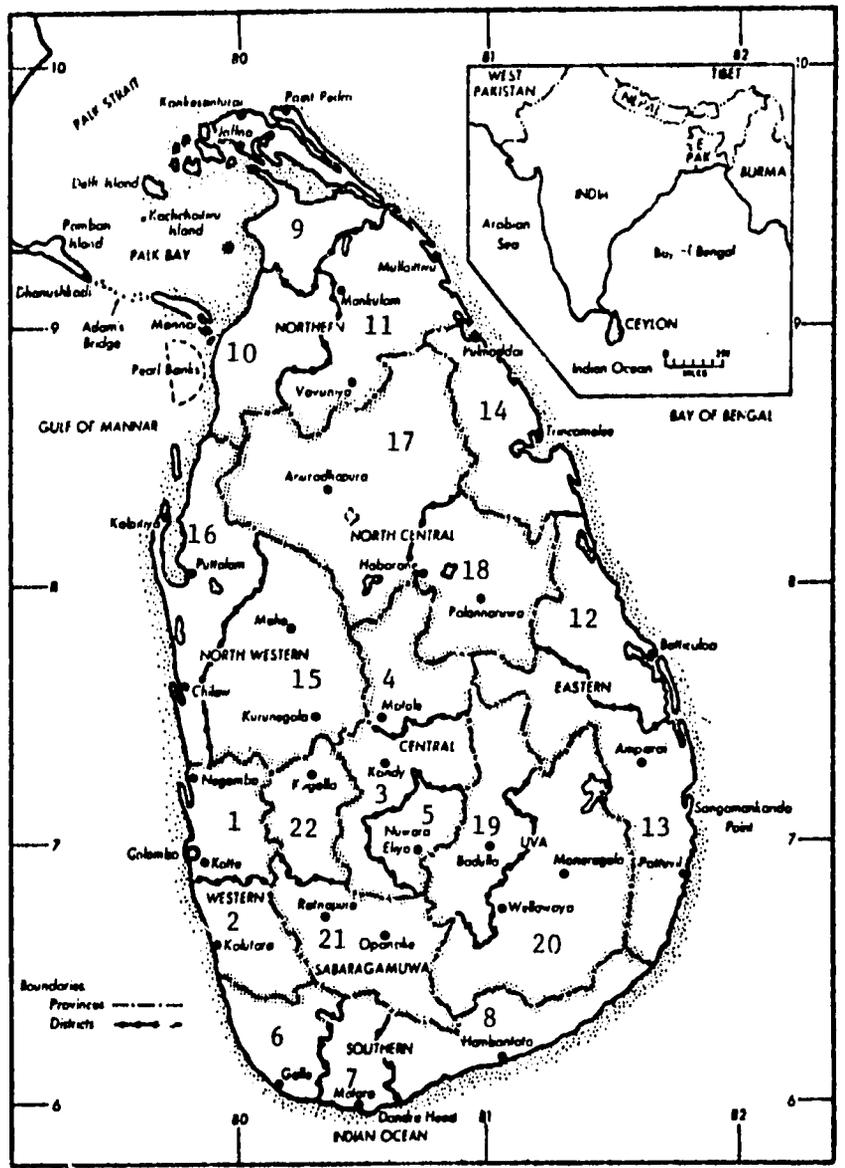
Sri Lanka's wildlife are adversely affected by increased human population and the agricultural development of lands formerly serving as wildlife habitat. Poaching and illegal capturing of wildlife is also a danger which enforcement officials are not equipped to control. The growing tourist trade in national parks, accompanied as it is by expansion of roads and tourist facilities, disturbs wildlife habitat in areas where they are under protection (section 4.4.6). The effect on wildlife of agrochemicals entering water supplies has not yet been calculated.

6) INDUSTRIAL POLLUTION

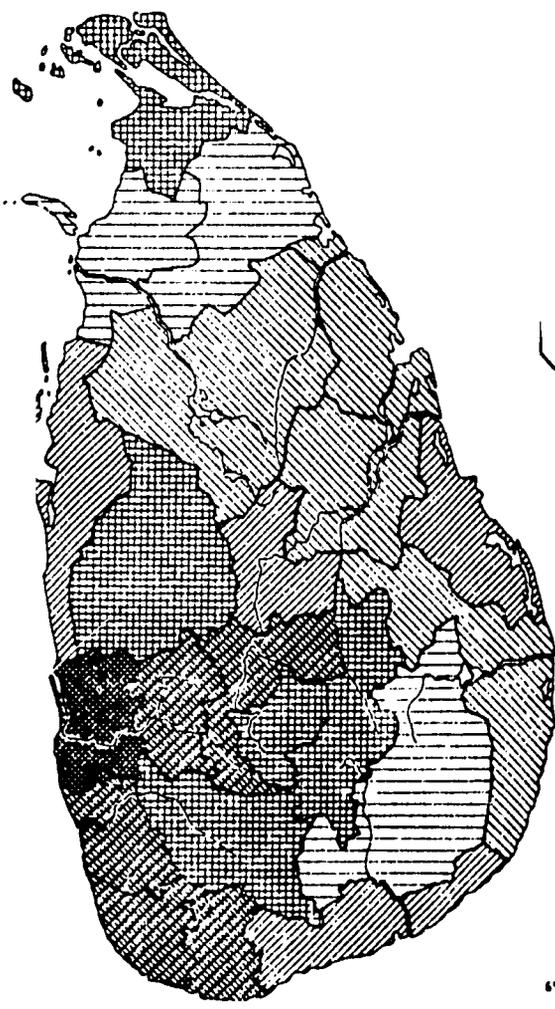
Industrial pollution arises from several sources: air pollution from chemical, petroleum and cement works and water pollution from paper production, textile mills, and food processing operation. The canal system in Colombo is reported to be heavily polluted by these sources as well as by human wastes. (Section 5.3.1) Air pollution in Colombo also arises from automobile exhausts.

7) ADMINISTRATION AND ENFORCEMENT

Although Sri Lanka has legislation covering environment and the development of resources, there is no central authority empowered to act in a coordinated fashion to control the many factors contributing to environmental deterioration. Furthermore, manpower shortages contribute to inadequate enforcement of laws dealing with areas such as wildlife protection and forest reserves (section 4.4.6.1).

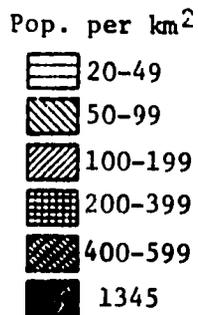


POPULATION DENSITY
1974
source: Domrös(1976)



Administrative Provinces and Districts

Source: Nyrop (1971)



1.0 POPULATION CHARACTERISTICS

1.1 Sri Lanka is an island roughly the size of West Virginia with a population more than seven times greater. The population of Sri Lanka has experienced rapid growth since the nation received its independence from Great Britain in 1948, rising from 6,657.3 million in 1946 to 12,711.1 million in 1971. (a growth of 91.8%), the date of the last official census.

| Population Growth by District: 1946-1974 | | | | | | | | | |
|--|-------------------|---------------------------|--------|----------|--------|------------------------|---------------------------|-------|-------|
| | Area in sq. miles | Population (in thousands) | | | | Increase 1946-1974 (%) | Pop. density per sq. mile | | |
| | | 1946 | 1963 | 1971 | 1974* | | 1946 | 1974 | |
| SRI LANKA | 25,332 | 6,657.3 | 10,582 | 12,711.1 | 13,393 | 14,283 | 91.8 | 263 | 528 |
| 1. Colombo (W) | 808 | 1,420.3 | 2,207 | 2,672.6 | 2,816 | | 98.2 | 1,758 | 3,485 |
| 2. Kalutara (W) | 624 | 456.6 | 631 | 731.8 | 771 | | 68.8 | 732 | 1,235 |
| 3. Kandy (W) | 914 | 711.4 | 1,044 | 1,187.2 | 1,251 | | 75.8 | 779 | 1,368 |
| 4. Matale (W) | 770 | 155.7 | 256 | 316.3 | 333 | | 113.9 | 173 | 432 |
| 5. Nuwara Eliya (W) | 474 | 268.1 | 398 | 453.2 | 478 | | 78.3 | 566 | 1,008 |
| 6. Galle (W) | 652 | 459.8 | 641 | 737.4 | 777 | | 69.0 | 705 | 1,191 |
| 7. Matara (W) | 481 | 351.9 | 542 | 558.2 | 662 | | 88.1 | 732 | 1,288 |
| 8. Hambantota | 1,013 | 149.7 | 274 | 341.0 | 359 | | 139.8 | 148 | 354 |
| 9. Jaffna | 998 | 474.8 | 613 | 704.3 | 742 | | 74.6 | 425 | 743 |
| 10. Mannar | 964 | 31.5 | 60 | 77.8 | 82 | | 160.3 | 33 | 85 |
| 11. Vavuniya | 1,467 | 23.2 | 69 | 95.5 | 101 | | 335.3 | 16 | 68 |
| 12. Batticaloa | 1,016 | 203.2 | 196 | 258.1 | 272 | | 175.1 | 73 | 267 |
| 13. Amparai | 1,048 | -- | 212 | 272.8 | 287 | | | | 273 |
| 14. Trincomalee | 1,177 | 75.9 | 139 | 191.9 | 202 | | 166.1 | 64 | 171 |
| 15. Kurunegala | 1,844 | 485.0 | 853 | 1,028.1 | 1,083 | | 123.3 | 263 | 587 |
| 16. Puttalam | | 43.1 | 303 | 379.8 | 400 | | 118.7 | 46 | 341 |
| Chilaw | 1,172 | 139.8 | | | | | | 533 | |
| 17. Anuradhapura | 2,808 | 139.5 | 280 | 389.2 | 401 | | 311.5 | 35 | 146 |
| 18. Polonnaruwa | 1,331 | -- | 114 | 163.8 | 173 | | | | 129 |
| 19. Badulla (W) | 1,089 | 372.2 | 522 | 616.3 | 649 | | 228.5 | 114 | 595 |
| 20. Moneragala | 2,785 | -- | 132 | 191.4 | 202 | | | | 72 |
| 21. Ratnapura (W) | 1,250 | 343.6 | 546 | 661.7 | 698 | | 103.1 | 275 | 558 |
| 22. Kegalla (W) | 642 | 401.8 | 579 | 652.1 | 687 | | 80.0 | 626 | 1,090 |

*mid-year estimates; (W)=wet zone.

Note: in 1946 and 1963 Badulla included Moneragala and Batticaloa included Amparai; in 1963 and 1971 Puttalam included Chilaw.

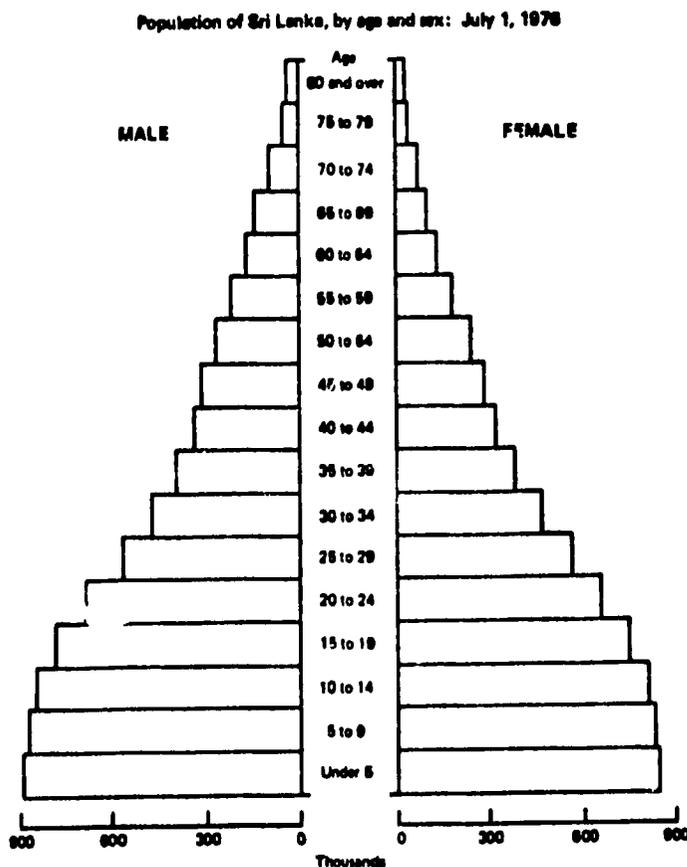
Present population
growth rate: 1.7.

Years to double
population: 41.

Percentage of pop-
ulation under 15: 39%.

Percentage of pop-
ulation over 64: 4%.

Projected population
for year 2000: 20.4 million



1.2 Population by ethnic membership:

Major ethnic groups of Sri Lanka

| GROUP | % of pop. | language | religion | geographic distribution |
|--|-----------|-------------------------------|------------------------|---|
| Sinhalese | 71% | Sinhala (Indo-European) | Buddhist | most heavily concentrated in the southern half of Sri Lanka, particularly in the southwest |
| Tamils | 22% | Tamil (Dravidian) | Hindu | eastern and northern districts, especially in Jaffna, where they comprise 90% of the population, and in Mannar and Vavuniya |
| Moors | 6% | Tamil | Islam | throughout Sri Lanka; largest concentrations on eastern coast, in Ampara, Batticaloa and Trincomalee |
| Others: Burghers (racial mixture); Malays | 1% | English, Sinhala, Malay | Islam, Christianity | throughout the country |

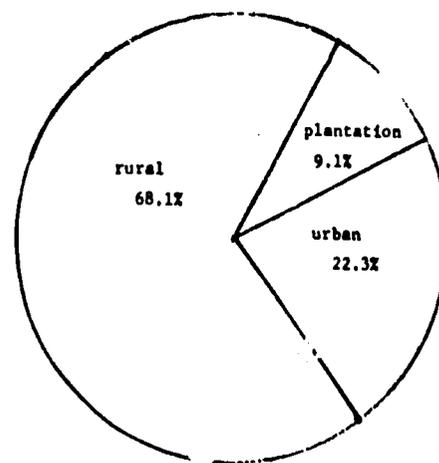
An important Tamil subgroup (about 45% of the total Tamil population in 1971) is formed by the "Indian" Tamils, descendants of workers brought in by the British to work the tea plantations. Since 1970, under an agreement with the Indian government, Sri Lanka has been implementing a program to repatriate 600,000 of these Tamils, most of whom live in the estate areas of the Central Highlands, to India. Relationships between the Sinhalese majority and the substantial Tamil majority, already somewhat on the sensitive side, have been considerably exacerbated by this program.

1.3 Rural-urban distribution of population

Population of major urban concentrations (in thousands)

| City | District | Zone | 1963 | 1971 | 1974 |
|----------------------|--------------|------|------|------|------|
| Colombo | Colombo | wet | 512 | 562 | 592 |
| Dehiwale-Mt. Lavinia | Colombo | wet | 111 | 155 | 162 |
| Jaffna | Jaffna | dry | 95 | 108 | 114 |
| Moratuwa | Colombo | wet | 78 | 96 | 100 |
| Kotte | Colombo | wet | 73 | 92 | 98 |
| Kandy | Kandy | wet | 68 | 94 | 98 |
| Galle | Galle | wet | 65 | 73 | 76 |
| Negombo | Negombo | wet | 47 | 57 | 60 |
| Trincomalee | Trincomalee | dry | 35 | 32 | 44 |
| Matara | Matara | wet | 33 | 37 | 37 |
| Batticaloa | Batticaloa | wet | 23 | 37 | 37 |
| Badulla | Badulla | dry | 27 | 35 | 36 |
| Anuradhapura | Anuradhapura | dry | 29 | 35 | 36 |
| Matale | Matale | wet | 26 | 31 | 32 |

RURAL-PLANTATION-URBAN POPULATION (1976)



Urban growth in relation to overall population growth has not been large. Between 1946 and 1971 urban population, counting all concentrations of 2,000 and above, grew from 20.3 to 22.1% of the population; growth for urban centers of over 20,000 population, went from 11.5 to 15.8% of population during the same period.

1.4 Wet zone-dry zone population distribution (see 4.1.1)

In 1946 only 12% of the population lived in the dry zone of Sri Lanka, the remainder being concentrated in the agriculturally more productive wet zone of the southwest of the island. Since that time, under government schemes to open up (colonize) the dry zone for extensive agricultural development, something of a shift of population has occurred: in 1977 the dry zone was estimated to contain about 20% of the population.

1.5 Educational characteristics of population:

Literacy: * 1963: 75.1%
1970: 82.6%

illiterates: 1963
total: 24.9%; men: 14.6%; women : 36.3%

1970
total: 17.4%; men: 10.3%; women : 24.9%

School enrollments:

| | <u>1973</u> |
|----------------------------|-------------|
| <u>Primary schools:</u> | 2,117,700 |
| <u>Middle and Sec.:</u> | 480,300 |
| <u>Teacher's schools:</u> | 9,300 |
| <u>University of S.L.:</u> | |
| Peradeniya | 4,578 |
| Colombo | 3,336 |
| Vidyalankara | 1,710 |
| Katubedde | 2,134 |
| Jaffna (1974) | 114 |

Expenditures for education:

| | <u>1973</u> |
|-----------------------------|-------------------|
| <u>Public expenditures:</u> | Rs. 614.9 million |
| <u>Share of gross</u> | |
| <u>domestic product:</u> | 4.1% |

Education is free and compulsory for all children between the ages of six and eleven. Secondary, college and university education are also free.

*Literacy is defined as the ability to read and write, with understanding, a simple paragraph pertaining to everyday life in Sri Lanka.

1.6 Health characteristics of the population:

- 1.6.1 Average annual birth rate: 26 per 1,000 population
Infant mortality rate: 47 per 1,000 live births (1975-76)
Crude death rate: 9 per 1,000 population
Expectation of life at birth: 68 years

Beginning in the late colonial era and continuing through the years since independence, Sri Lanka has provided its population with a level of health care far superior to that available in most lesser developed countries. Triggered by a severe malaria epidemic in the mid-1930's, health services were improved enormously: new hospitals were built in rural areas and there was an increased emphasis on preventive medical facilities throughout the country. At the same time a strong anti-malaria program involving massive spraying with DDT was responsible for a dramatic drop in the incidence of that disease.

Expanded and improved health care, which not only reduced the infant mortality rate but also led to a greater life expectancy for Sri Lankans, is the chief explanation for the rapid growth of population in Sri Lanka since the mid-1940's. It is only within the last few years that family planning programs have been successful in reducing the crude birth rate to a level which has been significant slowing population growth.

1.6.2 Medical facilities and health personnel

Hospitals and dispensaries are located throughout the country, and both out-patient and inpatient treatment is provided free in all these institutions. School children are monitored for both medical and dental problems; programs of vaccinations for paratyphoid, diphtheria and typhoid are carried out among school age and pre-school age children.

Medical facilities (1974):

Hospitals: 345/one for every 38,320 persons; this includes 30 hospitals specializing in diseases such as tuberculosis, mental illness and leprosy;
Hospital beds: 38,767/one per every 345 persons;
Central dispensaries: 356.

Medical personnel:

Doctors: 2,185/one per every 6,130 persons;
Pharmacists: 1,123/one per every 11,925 persons;
Trained nurses: 5,238/one per every 2,532 persons;
Midwives: 3,586 (1972).

Traditional "Ayurveda" Medicine:

Traditional Ayurveda medicine is still widely practiced in Sri Lanka. Ayurveda hospitals are located in Colombo, Anuradhapura, Ratnapura, Kurunegala, Beliatta and Jaffna; there are also an Ayurveda Research Institute and an Ayurvedic Medical College. The Ayurvedic Medical Council holds inquiries for the purpose of registering Ayurvedic physicians, and the Ayurvedic Pharmacopeia Board handles matters concerning traditional medicines.

Cases handled in Ayurvedic facilities include skin diseases, arthritis, asthma, wounds, snake bites, fractures, rickets, diarrhoeal diseases, gynaecological diseases, respiratory ailments, diabetic mellitus and hemorrhoids.

1.6.3 Health problems:

Despite improved medical care, severe health problems persist. Malnutrition is a widespread condition which was considerably aggravated in the mid-1970's when a combination of drought and economic difficulties reduced food supplies and pushed large numbers of the population to the edge of starvation.

Disease:

Medical statistics for 1974 list cases of: Typhoid and paratyphoid (8,014); bacillary dysentery (1,808); amoebic dysentery (1,808); tuberculosis (1,472); leprosy (418); whooping cough (525); acute polio (821); hepatitis (9,707); syphilis (1,421), and gonorrhoea (7,852). In addition, 1973-74 saw an outbreak of cholera in the Jaffna district in the northern part of the island; 4,405 cases of cholera were reported in 1974. Malaria, only twenty cases of which were reported in 1964, has experienced a resurgence within the past several years and is now prevalent throughout the island, particularly in the dry zone, where it is said to have reached epidemic proportions; over 500,000 cases are reported each year. Filariasis, an infestation of the lymph nodes by worms transmitted by mosquitoes, has been especially common along the coastal belt, but its incidence has been decreasing in recent years. Infestations with hook worms and whip worms are also common. Schistosomiasis, one of the most common tropical diseases, is presently not found in Sri Lanka; the snail which serves as the intermediate host for the disease is not present.

1.6.4 Sanitation and Water Supply:

Public health personnel, working with local authorities, are responsible for the provision of safe water supplies, disposal of human waste and refuse disposal. The National Water Supply and Drainage Board has major responsibilities in the treatment and supply of water.

Bacteriological examination of water supplies is carried out regularly for some urban water supplies, while some urban water supplies and some rural water supplies are monitored only occasionally. Sri Lanka's goal as reported by the World Health Organization in 1973 was to make safe water available to 6.85 million persons throughout the country by 1980. Examination of water supplies is undertaken by the National Water Supply and Drainage Board; water supplies to cities such as Colombo, which draws its water from several reservoirs, and Kandy, whose source of supply is the Mahaweli Ganga, is subjected to filtration and chemical treatment.

Domestic water supply: % of housing units supplied (total units: 2,217,478)[1971]

| Source | Sri Lanka | Urban | Rural | Estate |
|---|-----------|-------|-------|--------|
| <u>Piped water on tap</u> | | | | |
| Inside unit | 4.4% | 16.3% | 1.1% | 5.2% |
| Outside unit but within premises | 7.9% | 10.2% | 1.0% | 48.0% |
| Outside premises | 7.8% | 18.8% | 2.7% | 21.6% |
| <u>Water from well:</u> | 68.8% | 50.5% | 81.9% | 15.4% |
| <u>Other sources (stream, river, tanks)</u> | 8.9% | 2.0% | 11.0% | 7.3% |
| <u>Unspecified</u> | 2.3% | 2.1% | 2.3% | 2.5% |

1.6.4 (cont)

Bathing facilities: % of housing units (total units:2,217,478) [1971]

| Facility | Sri Lanka | Urban | Rural | Estate |
|------------------------------------|-----------|-------|-------|--------|
| <u>Bathroom</u> | | | | |
| inside | 4.0% | 15.8% | .8% | 3.7% |
| outside | 2.9% | 11.7% | .3% | 5.8% |
| <u>Well water</u> | 53.3% | 52.6% | 59.8% | 11.8% |
| <u>Other (river, stream, tank)</u> | 34.8% | 14.4% | 34.4% | 74.1% |
| <u>Unspecified</u> | 4.9% | 5.6% | 4.6% | 5.7% |

Toilet facilities :

There are government programs to improve facilities for the disposal of human waste in those parts of the island where they continue to be inadequate. Under the "aided scheme of latrine construction" financial assistance is provided for poor and needy households in rural areas to construct sanitary latrines. In 1973 Rs. 400,000 was allocated for this program and Rs. 224,345 actually expended. In the filaria endemic belt assistance is given to convert bucket systems to water seal latrines. Faecal pollution of streams continues to be a problem; in 1973 an outbreak of typhoid in the Badulla district was traced to faecal pollution of the stream used as a source of water supply for the affected area.

Latrine facilities: % of housing units (total units: 2,217,478) [1971]

| Facility | Sri Lanka | Urban | Rural | Estate |
|---------------------|-----------|-------|-------|--------|
| <u>Flush toilet</u> | | | | |
| inside unit | 3.7 | 12.9 | 1.2 | 3.7 |
| outside unit | 3.1 | 9.8 | 1.0 | 4.5 |
| <u>Water seal</u> | 14.3 | 19.2 | 9.9 | 33.9 |
| <u>Bucket type</u> | 4.8 | 19.4 | 1.9 | 4.1 |
| <u>Pit</u> | 38.8 | 18.3 | 44.4 | 38.2 |
| <u>None</u> | 34.3 | 19.1 | 41.5 | 13.4 |
| <u>Unspecified</u> | 1.2 | 1.3 | 1.0 | 2.2 |

Sewage treatment:

Information on sewage treatment was not available. It has been reported, however, that untreated sewage, including faecal matter, enters the canal system of Colombo, the nation's largest city, which, as a consequence has a high level of organic pollution. BOD (biochemical oxygen demand) levels of 80--296 p.p.m.* have been found (1971) in some parts of the system (the British Royal Commission for Sewage Disposal recommends a level of 4 p.p.m. for rivers capable of self-purification). BOD levels are especially high during drier weather. The canal system also receives untreated wastes from industrial plants.

*parts per million

1.7 Family planning and birth control

At least some degree of government support for family planning has been manifest since the 1950's, beginning with grants to the Family Planning Association, founded in 1953. Although the government later made its medical facilities and personnel available for family planning work, it was not until 1965 that such programs were incorporated into the agenda of the Ministry of Health. Under political fire, this National Family Planning Programme, which embraced child and maternal health care as well as birth control, was considerably subdued in 1969, but it received fresh impetus with the accession to power in 1970 of the United Front government, whose five year plan 1972-1976 stated that without a high priority for family planning programs, the strain on resources imposed by the high rate of population growth would be almost intolerable.

Family planning is said to be favored particularly by the middle classes, but birth control programs are politically unpopular among some groups, especially among certain Sinhalese, who fear a possible disruption of the present racial balance.

Statistics indicate that an increasing number of women are adopting some form of birth control each year; as of December 1973 an estimated 10% (or about 190,000) of married women were practicing birth control.

2.0 ORGANIZATIONS WITH INTEREST IN ENVIRONMENT AND NATURAL RESOURCES

2.1 GOVERNMENT AGENCIES

NOTE: The top level of the administrative structure of Sri Lanka is presently formed by 31 ministries, a large number of which have responsibilities impinging on environment and natural resources. It has been typical of Sri Lanka for government departments dealing with related and connected subjects to come under the aegis of different ministries and, conversely, for a ministry to be comprised of departments whose concerns may be difficult to coordinate or reconcile. In practice, departments tend to be the major units of administration, and because departments are organized in a self-contained fashion, inclining in many cases to act virtuously autonomously, strong ministerial direction is usually necessary to coordinate even the activities of departments within a single ministry. The strength of the department unit has frequently allowed departments to function in an almost unchanged manner even when, as frequently occurs in Sri Lanka, they are shifted from one ministry to another.

Departments whose functions reach down to the local level (agricultural irrigation, health, etc.) have regional headquarters at the administrative capitals of the districts into which Sri Lanka is organized. These officials and their subordinates interact, often in a very complex fashion, with local government authorities in the performance of their duties.

2.1.1 Department of Environment

Despite the entreaties of conservationists that a department concerned specifically with environmental management be established, no such agency has yet been established. The Ministry of Planning and Economic Affairs, which disappeared in a recent cabinet shuffle, had shown a marked interest in the inclusion of environmental concerns in economic planning. The Ministry worked in collaboration with former Australian cabinet minister Jack Beal on a report on measures for preventing further deterioration of the Sri Lankan environment. This report, begun in 1977 is to enumerate initiatives to be "considered by the Government to strengthen its efforts to prevent further environmental degradation, to control pollution and to manage the natural resources of the country."*

2.1.2 Ministry of Land and Land Development:

Established in mid-1978, this Ministry brings together under one ministerial cover departments earlier under other ministries, in an apparent effort to better coordinate development activities affecting water resources, forests, and land ownership.

2.1.2.1. Forest Department, Conservator of Forests Kew Road, Slave Island Colombo 2

The Department is headed by the Conservator of Forests; there are Assistant Conservators for the various sections of the country.

*It is not clear to which Ministry this report is now to be submitted: the new Ministry of Finance and Planning or the Ministry of Plan Implementation.

2.1.2.1. (cont).

Its functions include: the management and protection of all natural forests of Sri Lanka; the demarcation and preservation of the Man and the Biosphere Plot; responsibility for the reforestation of degraded forests.

The Conservator chairs the State Timber Corporation, which is responsible for harvesting and sale of timber.

The Department administers the Forest Ordinance
Felling of Trees (Control) Act.

Estimated expenditures (1975): Rs. 14,678,386/ 0.19% of total budget.

2.1.2.2 Water Resources Board

P.O. Box 34

Colombo

Established: May 1966 under the Water Resources Board Act, no. 29, of 1964.

The Board is basically responsible for the formulation of national policy on control and use of water resources.

The Board's mission specifically covers: the control, regulation, development, conservation and utilization of water resources; hydropower; irrigation; forestry; pollution; soil erosion; sewage; industrial waste; salinity ; and the coordination of related projects.

Examples of the subjects on which reports and advice were provided during 1973 are:

1. The impact on farmers under the Chandrikawewa Scheme of the drawing of water from the Chandrikawewa Reservoir for the Paper Factory at Embilipitiya; the undesirability of discharging untreated factory effluent into the Walawa Ganga;
2. Adverse effects on water resources resulting from the clearing of 300 acres of montane forest land over 5,000 feet in elevation by an apple growing association in Mahacoodugala Forest Reserve, Nuwara Eliya;
3. The inadequacy of existing controls to combat illicit felling of forest reserves and the need for adopting strong measures with deterrent penalties to prevent devastation of forests , especially those reserved for catchment basins of reservoirs.

Budget: not available.

2.1.2.3. Irrigation Department

Baudhaloka Mawatha, Colombo

The Department implements plans calling for the provision of irrigation to lands for cultivation; performs feasibility studies dealing with hydropower projects and works out details of their designs; provides irrigation facilities.

Implements the Irrigation Ordinance.

Estimated expenditures (1975): Rs. 55,486,290/ 0.75% of total budget.

2.1.2.4 Mahaweli Development Board

Responsible for the implementation of the Mahaweli Development Project, the Board consists of four members appointed by the minister responsible for irrigation and representatives of other pertinent ministries. The Mahaweli Development Scheme is the largest combination of water and land resources development ever undertaken in Sri Lanka.

Functions: promoting, operating and coördinating irrigation, drainage and water supply schemes in the Mahaweli development area, as well as the agricultural and economic development of "special areas" designated under the scheme.

2.1.2.5 Rivers Development Board

Functions: land preparation, provision of irrigation facilities, settlement and agriculture in connection with, among other things, the Uda Walawe Multi-purpose Project.

2.1.2.6 Land Commissioner's Department

Functions: the protection and administration of State Lands and the disposition and agricultural development of State Lands to peasants and others in settlement projects; instrumental in the promotion of schemes to "colonize" the dry zone of Sri Lanka.

Estimated expenditures(1975): Rs. 30,427,650/ 0.4% of total budget.

2.1.2.7 Land Settlement Department:

Functions: administers the Land Settlement Ordinance, under which claims to state lands are settled and investigated. This function is important in the light of the trend toward encroachment on State Land, since official certification as State Land is a pre-requisite for the eviction of encroachers.

Estimated expenditures (1975): Rs. 768,933/ 0.01% of total budget.

2.1.2.8 Land Reform Commission

Administers the Land Reform Act.

2.1.2.9 Survey Department

Functions: The department conducts: topographical surveys; engineering surveys; block topographical and demarcation surveys related to settlement of land disputes; air surveys for the crops diversification project; and various development projects; town surveys relative to assessment planning and town development, including water supply and drainage schemes; land development surveys; resources surveys designating "land capability"; and land reform surveys for the Land Reform Commission.

No land can be distributed in land reform schemes or otherwise dealt with by the Government unless first surveyed and demarcated by this Department.

Estimated expenditures(1975): Rs. 41,100,985/ 0.55% of total budget.

2.1.3 Ministry of Agricultural Development and Research

This Ministry was established in mid-1978. It contains the remnants of the previous Minister of Agriculture and Lands.

2.1.3.1 Department of Agriculture , Director of Agriculture Colombo

Functions: research; agricultural education and training; animal production and health; farms; agricultural economics; farm management; collection of farm statistics.

The Department operates several agricultural research organizations, including the Central Agricultural Research Institute at Peradeniya and agricultural research stations at several locations including Mahailuppallama and Nuwara Eliya.

The Department publishes Tropical Agriculturist, a journal of agricultural research.

Estimated expenditures(1975): Rs. 77,483,535/ .1% of total budget

2.1.3.2 Department of Agrarian Services:

The department is basically concerned with efficient use of agricultural land to promote increased production of agricultural products.

The Department administers the Agricultural Productivity Act and oversees the Agricultural Production Committees formed under this act to ensure maximal use of agricultural land; Agricultural Lands Act of 1973 and works with the Cultivation Committees formed under the Paddy Lands Act 1958, which this act superseded.

The Agrarian Research and Training Institute, Peradeniya, assists the land reform program with research on land settlement and farm planning.

2.1.4 Ministry of Fisheries

Mawatha, Galle Face,

Colombo

Established: June 1970

2.1.4.1 Department of Fisheries

Functions: administration of the Fisheries Ordinances and related Ordinances (pearl fishing, whaling and chanks ordinances); provision of welfare services to fishermen; development of fishery cooperatives; training and extension work; development of inland and brackish-water fisheries; provision of credit facilities to fishermen; fisheries research; head of Fisheries Inspectors.

Fisheries research carried out by the Fisheries Research Station, Colombo, and the Fisheries Research Station at Negombo.

Estimated expenditures for Ministry (1975): 76,013,119/ 1% of total budget

2.1.5 Minister of State [for Tourism, etc.]

This position was established in mid-1978 and very little information is available about it. Both the Department of Wildlife Conservation, which now comes under this Minister, and the Ceylon Tourist Board were previously under the now defunct Ministry of Shipping, Aviation and Tourism.

2.1.5.1 Department of Wildlife Conservation

29 Gregory's Road

Colombo 7

Established: October 1, 1949

Functions: principal agency for implementation of matters relating to the wild fauna and flora of Sri Lanka; maintenance of national parks, nature reserves and sanctuaries; protection of wild animals both in nature reserves and on the island as a whole; issuance of licenses for hunting of certain animals; responsibility for the slaughter of unwanted game. The Department is a member of the IUCN.

Implements the Fauna and Flora Protection Ordinance.

Estimated expenditures (1975): Rs. 2,403,932/ 0.03 % of total budget.

2.1.5.2 Ceylon Tourist Board

Functions: promotion of tourism; maintenance of the National Zoological Gardens of Sri Lanka at Dehiwala, about six miles from Colombo (the zoological gardens features a world-wide selection of animals; its estimated expenditures for 1975 were Rs. 2,212,350 or about 0.029% of total budget).

2.1.6 Ministry of Industries and Scientific Affairs

2.1.6.1 Geological Survey Department
48 Sri Jinaratana Road, Colombo 2

Functions: systematic geological mapping of the country and preparation of geological maps; prospecting, exploration and appraisal of mineral resources; engineering geology and groundwater investigations; administration of mining enactments; supervision of mining and collection of mining statistics; fundamental research in earth sciences and applied research on mineral raw materials for industrial purposes. Administers the Mines and Mineral Development Act 1973. The Department's activities for 1973 included water supply investigations in various parts of the country.

Publications of the Department deal, among other things, with industrial clays, gems and semi-precious stones, and groundwater.

Estimated expenditures(1975): Rs. 2,080,575/ 0.02% of total budget.

2.1.6.2 Ceylon Institute of Scientific and Industrial Research (CISIR):
362 Baudhaloka Mawata, P.O. Box 787
Colombo 7

Established: 1955 Status: state-funded but autonomous non-profit industrial research institute.

Functions: scientific and industrial research with particular respect to utilization of Sri Lanka's raw materials. The industrial microbiology section has been studying the treatment of industrial effluents.

Note: In mid-1978, the Acting Director of the CISIR denounced state-owned institutions as being the chief polluters of the environment of Sri Lanka.

2.1.6.3 National Science Council
Established: 1968

Functions: the Council was established as an executive body to coordinate scientific activity in Sri Lanka; to advise the Minister responsible for science on matters pertaining to the application of science and technology; and to formulate a policy for science and technology.

The research priorities of the Council are: natural resources, health, agriculture, industry and social overheads.

The Council, in collaboration with the Planning Ministry, has produced a report on environmental management in Sri Lanka, published in the Bulletin of the National Science Council of Sri Lanka in December 1976 as Environmental Problems in Sri Lanka.*

*This report could not be obtained for use in the preparation of the present report.

2.1.6.4 Atomic Energy Authority

Functions: the Authority has a wide range of functions touching most part on atomic energy but also on energy resources in general. It has developed Atomic Energy Regulations covering the import, storage, use and handling of radioactive materials and all forms of ionizing radiation including X-rays, as well as the use of irradiating apparatus.

The Hydrology Committee has formulated an Isotope Hydrology Programme, which includes studies on groundwater estimation and sediment transport.

The Committee on Energy, has representatives from the Ceylon Electricity Board, the Faculties of Engineering, University of Sri Lanka (Peradeniya and Katubedde Campuses); the Ministry of Plan Implementation; the Department of Irrigation; and the Radioisotope Center, Colombo Campus, University of Sri Lanka.

The Committee is preparing a report covering: present and future demand for power in S.L.; a comprehensive survey of the hydropower potential; suggestions for bridging possible energy gaps; and alternative sources of energy to back up hydroelectric power, including the feasibility of using nuclear power.

2.1.6.5 State Corporations: most heavy industry in Sri Lanka, some of which is reported to be among the heaviest polluters of Sri Lanka's environment, comes under the control of the Ministry of Industry and Scientific Affairs:

- National Textile Corporation
- Ceylon Oils and Fats Corporation
- Ceylon Ceramics Corporation
- Paranthan Chemicals Corporation
- Jute Industries Corporation
- National Salt Corporation
- Ceylon Mineral Sands Corporation
- National Paper Corporation
- Ceylon Cement Corporation
- Ceylon Plywood Corporation
- Ceylon Leather Products Corporation
- Ceylon Tyre Corporation
- Ceylon State Hardware Corporation
- Sri Lanka State Flour Milling Corporation
- State Fertilizer Manufacturing Corporation
- Ceylon Petroleum Corporation.

2.1.6.6 Department of Meteorology 383 Bullers Rd., Colombo 7

Estimated expenditures (1975): Rs. 3,027,545/ 0.04% of total budget.

2.1.6.7 Bureau of Ceylon Standards

Established in 1966, the Bureau prepares standard specifications and codes of practice, administers compulsory standards, and works on the adoption of the metric system. There is no indication that it has worked on environmental standards for industrial operations.

2.1.7 Ministry of Plantation Industries

This ministry deals with matters pertaining to conduct and development of Sri Lanka's plantation industries: tea, rubber, coconut and minor export crops such as cinnamon, cashew, mulberry and silk. Since the government takeover of large tea and rubber estates, completed in 1975, this ministry has become responsible for their administration as well as for the agricultural diversification of tea and rubber lands.

Several of the departments or organizations subordinate to the Ministry are concerned with research which has implications for the more rational exploitation of natural resources. The Tea Research Institute, for example, was reported in 1977 to have established the possibility of usefully recycling waste tea leaves from instant tea factories for use in cattle fodder and for extracting the high protein content of these leaves for possible use as a protein supplement.

The organizations subordinate to the Ministry are:

- Tea Research Institute of Ceylon
- Rubber Research Institute of Ceylon
- Coconut Research Institute of Ceylon
- Sri Lanka Tea Board
- Rubber Control Department
- Coconut Cultivation Board
- Coconut Marketing Board
- Sri Lanka State Plantations Corporation.

Estimated expenditures (1975): Rs. 191,451,100/ 2.6% of total budget.

2.1.8 Ministry of Local Government, Housing and Construction

This Ministry has general supervision of the some 600 local authorities on the village, town, urban and municipal level; these authorities, whose activities are regulated by a group of central government local-authority ordinances and who are empowered to issue local bylaws, are responsible for matters such as water supply, sewerage, public health and the control of nuisances.

2.1.8.1 National Water Supply and Drainage Board

P.O. Box 14, Mt. Lavinia

Established: 1974

Functions: the development, provision, operation and control of efficient, and coordinated water supply and sewerage systems; the Board is authorized to assume the water supply and sewerage functions of local authorities, either on their own request or by a compulsory transfer order.

The Board is empowered to purchase and sell water and has exclusive control of water supply in the areas of its authority.

The daily business of the Board is under a General Manager.

2.1.8.2 Department of Town and Country Planning

2.1.8.3 Department of Local Government

2.1.9. Ministry of Health
Box 500, Secretariat Bldg.
Galle Face, Colombo 1

The Ministry of Health has control over the planning and financing of Public Health and Medical Services in Sri Lanka. It works in close cooperation with local authorities.

2.1.9.1 Department of Health

Functions: Administers the national health services; conducts a program of family health services and education, including birth control clinics; public health division is responsible, in active cooperation with local authorities and voluntary organizations, for environmental sanitation, including measures taken for disposal of human waste, provision of safe water supplies, refuse disposal, housing, food and food sanitation.

The Department conducts specialized campaigns for the control of: tuberculosis, malaria, filariasis, leprosy and venereal diseases.

Estimated expenditures (1975): Rs. 331,171,487/ 4.5% of total budget.

2.1.9.2 Department of Ayurveda

Functions: Administers hospitals and programs utilizing traditional Sri Lankan medical practices.

Estimated expenditures (1975): Rs. 11,306,655/0.14% of total budget.

2.2 NON-GOVERNMENT ORGANIZATIONS INVOLVED IN ENVIRONMENT AND NATURAL RESOURCES

2.2.1 Wildlife and Nature Protection Society

Chaitiya Road, Marine Drive, Fort, Colombo 1

Established: 1894

Membership: about 3,000 members

Purpose: to assist in protection of nature in all its forms: landscape, soil, water, flora, fauna, marine habitats, and to conserve it for future generations.

Activities: The Wildlife and Nature Protection Society has been the most active force in Sri Lanka for the development of programs aimed at wildlife conservation and the creations of a favorable public opinion for wildlife conservation. A former Director has said that "practically all major and minor conservation achievements in this area during the current century have their origin in our Society."

In promoting its aims, the Society works closely with not only the Department of Wildlife Conservation, the existence of which may be largely attributed to pressure by the Society for the creation of such a government department, but also with other ministries dealing with natural resources development. The advice of the Society was solicited by the Ministry of Irrigation, Power and Highways regarding the consequence for wildlife and forest reserves of the Heda Oya Development Scheme; comments and suggestions of the Society were subsequently incorporated into revisions of the plans.

The Society publishes Loris, a journal covering not only developments affecting the wildlife resources of Sri Lanka but also environmental deterioration and the development and enforcement of legislation dealing with wildlife and natural resources.

2.2.2 The Soil Association of Ceylon

Activities: The Association has assisted the government of Sri Lanka in developing more environmentally-sound agriculture by improving traditional practices abandoned after the adoption of important pesticides and fertilizers.

2.2.3 The Soil Conservation Society of Ceylon

47/1 Flower Road, Colombo 7

Activities: Among other things, the Society presents the Samaraweera Conservation Award of the year for soil conservation. In 1971 this award went to the Wildlife and Nature Protection Society.

2.2.4 Ceylon Bird Club and Ceylon Section, International Council for Bird Preservation

P.O. Box 11, Colombo

Activities: Publishes Bird Notes, a monthly.

2.2.5 Sri Lankan Environmental Federation

Established: 1977

Co-sponsored by the All Ceylon Public Transport Travellers' Federation and the Sri Lankan Consumers Users' Federation, the organization's goals are:

- 1) to acquire a knowledge of the psychological and environmental factors influencing the family and community;
- 2) to identify significant environmental pollution directly affecting the health of the nation and visitors to Sri Lanka.

2.2.6 Ceylon Environmental Society

7-13th Lane, Colombo 3

[no details available]

2.2.7 Institute of Social Research

Colombo

The Institute, about which no further details were available, sent a representative as consultant to the SCOPE/UNEP Symposium on Environmental Sciences in Developing Countries, held in Nairobi in 1974.

2.3. ENVIRONMENTAL RESEARCH AND EDUCATION

2.3.1 Education

Courses in biology at general degree levels are given at four campuses of the University of Sri Lanka, and special courses in botany and zoology, with ecology, are offered at two campuses. As of 1975, no integrated courses in environmental studies were available, but it was proposed to start such a course in the near future. *

2.3.2 Research

2.3.2.1 University of Sri Lanka--Vidyalankara Campus Kelaniya, Sri Lanka

Department of Zoology: studies on the effects of pollutants on the behavior of fish and other invertebrates; the distribution of fauna in polluted environments.

2.3.2.2 Research Institutes under Government Agencies

- Agrarian Research and Training Institute (see 2.1.3.2)
- Central Agricultural Research Institute (see 2.2.3.1)
- Ceylon Institute of Scientific and Industrial Research (see 2.1.6.2)
- Coconut Research Institute, Bandirippuwa Estate, Lunuwila (see 5.2.1.2)
- Fisheries Research Station (see 2.1.4)
- Geological Survey Department (see 2.1.6.1)
- National Science Council of Sri Lanka (see 2.1.6.3)
- Rubber Research Institute, Agalawatta and Colombo (see 5.2.1.2)
- Tea Research Institute, St. Coombs, Talawakelle (see 5.2.1.2)
- Veterinary Research Institute, Gannoruwa, Peradeniya:
 - concerned with research and investigations into health and production problems of livestock and poultry.

* The undergraduate course in Architecture at the University of Sri Lanka is reported to offer a B.S. in Built Environment, a curriculum which includes a very strong element of training in environmental studies. A post-graduate training curriculum in Town & Country Planning was scheduled to commence at the Katubedde Campus of the University in 1974. The overall training thus provided is designed to make the graduate suited for responsibilities involving the management and control of environmental issues in the context of overall development plans.

3. OVERVIEW OF MAJOR ENVIRONMENTAL AND RESOURCES LEGISLATION AND MAJOR AGENCIES RESPONSIBLE FOR ITS IMPLEMENTATION

Coverage: P=protection; R=establishment of reserves; O=ownership; U=utilisation; C=control; M=Marketing

| RESOURCE/AREA OF CONCERN | Legislation | Coverage | Implementing Agency: Department, Authority, etc. | Ministry | sub. section of report | | |
|--------------------------|--|--|---|---|---|---|---------|
| Renewable Resources | WATER resources | | | | | | |
| | | Water Resources Board Act, no. 29, 1964 | P/U | Water Resources Board | Ministry of Land and Land Development | 3.1.1.1 | |
| | | supply | National Water Supply & Drainage Board Law, no. 2 of 1974 | U/P | National Water Supply and Drainage Board | Ministry of Local Government, Housing, and Construction | 3.1.1.3 |
| | | | Colombo Municipal Council Waterworks Ord., Chapter 208 | U/P | Colombo Municipal Council | | 3.1.1.4 |
| | | | Local government laws | U/P | Municipal, Urban, Town and Village Councils | | 3.1.1.5 |
| | | irrigation | Irrigation Ordinance, Chapter 453 | U/P | Irrigation Department | Ministry of Land and Land Development | 3.1.1.2 |
| | | pollution | Nuisances Ordinance, Chapter 230 | P | Boards of Health, local councils | Ministry of Health | |
| | | FORESTS | Forest Ordinance, Chapter 451 | P/U/O/R | Forest Department | Ministry of Land and Land Development | 3.1.2.1 |
| | | | Felling of Trees (Control) Act, Chapt. 452 | P/U | | | 3.1.2.1 |
| | | WILDLIFE | Fauna and Flora Protection Ordinance, Chapter 469 | P/R/U | Department of Wildlife Conservation | Minister of State | 3.1.3.1 |
| FISH AND MARINE LIFE | Fisheries Ordinance Chapter 212 | U/P | Fisheries Division | Ministry of Fisheries | 3.1.4.1 | | |
| | Pearl Fisheries Ordinance, Chapter 214 | U/P | | | 3.1.4.2 | | |
| | Whaling Ordinance, Chapter 215 | U/P | | | 3.1.4.3 | | |
| | Chank Fisheries Ordinance, Chapter 213 | U/P | | | 3.1.4.4 | | |
| AIR | Nuisances Ordinance (offensive smells) Chapter 230 | P | Boards of Health, local councils | Ministry of Health | 3.1.5.1 | | |
| Non-Renewable Resources | | | | | | | |
| MINERALS | Mines and Minerals Development Act, 1973 | U/O | Geological Survey Department | Ministry of Industries and Scientific Affairs | 3.2.1.1 | | |
| SOIL | Soil Conservation Act, Chapter 450 | P | Department of Agriculture | Ministry of Agricultural Development and Research | 3.2.2.1 | | |
| COASTS AND BEACHES | Crown Lands Ordinance, Chapter 254 | P/O/U | Land Commissioner's Dept. | Ministry of Land and Land Development | 3.3.1 | | |
| Land Use and Agriculture | AG. LAND | Crown Lands Ordinance Chapt. 454 | P/U/O/R | Land Commissioner's Dept. | Ministry of Land and Land Development | 3.3.1. | |
| | | Land Reform Law, no.1 of 1972 | O | Land Reform Commission | | 3.3.2.1 | |
| | | Agricultural Productivity Law, no. 2 of 1972 | U/O | Agrarian Services Dept. | Ministry of Agricultural Development and Research | 3.3.2.2 | |
| | | Land Development Ordinance, Chapter 464 | O/U | Land Commissioner's Dept. | Ministry of Land and Land Development | 3.3.2.3 | |
| | | Agricultural Lands Law, no. 42 of 1973 | O/U | Agrarian Services Department | Ministry of Agricultural Development and Research | 3.3.2.4 | |
| PESTICIDES | Plant Protection Ordinance, Chapt. 447 | U | Director of Agriculture | Ministry of Agricultural Development and Research | 3.3.3.1 | | |
| FERTILIZERS | Fertilizers Ordinance, Chapter 445 | P/M | Director of Agriculture | Ministry of Agricultural Development and Research | 3.3.4.1 | | |

3.0 LEGISLATION DEALING WITH ENVIRONMENT AND NATURAL RESOURCES

3.1 Renewable Resources

3.1.1 Water Resources (see also 3.3.1.1)

3.1.1.1. Water Resources Board Act, no. 29, of 1964

Provisions: provides for a central organization, the Water Resources Board, to advise the Minister [of Land and Land Development] on all matters relating to water resources of the island and utilization of such resources to provide for the proper distribution of water resources to meet the claims of agriculture, domestic consumption, hydropower, etc.

Areas for which the Board's advise may be required by the Minister include:

- promotion, construction, operation and maintenance of schemes of irrigation, drainage, flood control and hydraulic power;
- the promotion of afforestation;
- the control of soil erosion;
- the prevention of the pollution of rivers, streams, and other water courses.

Areas for which the Board may be asked to formulate national policy include:

- the multi-purpose development and use of water resources;
- the short-term and long-term provision fo water resources for domestic supplies, industrial supplies, hydraulic power, hydro-electric power, irrigation, reclamation of land, flood control, navigation, development of fisheries, protection of wild life, and control of soil erosion;
- the disposal of sewage and industrial wastes;
- afforestation;
- the control of salinity.

The law in effect provides the mechanism for the establishment of an integrated national water policy and for the protection of water resources without, however, giving that policy the force of law. The Minister is under no obligation to solicit the advice of the Board on matters within its purview. Article 16 provides, however, that: "The Board may make rules for the purpose of carrying out and giving effect to the principles and provisions of this Act and for all matters connected with the functions and duties of the Board."

Implementation:By the Water Resources Board, which is now under the aegis of the Minister of Land and Land Development.

3.1.1.2 Irrigation Ordinance , Chapter 453 of Statutes [November 1, 1946]

Provisions: provides for the establishment of rates for irrigation water supplied from major irrigation works; provides for the issuance of regulations pertaining to the protection of irrigation works and the conservation of irrigation water.

Implementation: The Irrigation Department of the Ministry of Land and Land Development.

3.1.1.3 National Water Supply and Drainage Board Law, no. 2, of 1974

Provisions: Establishes the National Water Supply and Drainage Board, with powers to develop, provide, operate and control an efficient and coordinated water supply and to distribute water for public, domestic or industrial purposes; and to develop and control an efficient and coordinated sewerage system.

The Board is authorized to assume the water supply and sewerage functions of local authorities either at the request of those authorities or by a compulsory order.

Provides for the protection of waters belonging to the Board:

- penalties for the fouling of water, throwing objects into water, allowing drains or sewers to flow into water belonging to the Board;
- penalties for wasting water;
- penalties for discharging, without the sanction in writing of the Board, "any sullage, foul liquids or faecal matter into any drain or other place which is not suitable or intended to receive such discharge or into any land or place in such manner as to cause a nuisance or willfully discharge ...any rain water into any sewer which is intended to carry foul water."

Implementation: The National Water Supply and Drainage Board under the aegis of the Ministry of Local Government, Housing and Construction.

3.1.1.4 Colombo Municipal Council Waterworks Ordinance, Chapter 208 [January 2, 1908]

Provisions: provides for water supply for Colombo and, in a manner similar to the National Water Supply and Drainage Board Law, provides for penalties for pollution of water intended for public water supply.

Implementation: Colombo Municipal Council under the ultimate aegis of the Ministry of Local Government, Housing and Construction.

3.1.1.5 Local government laws and ordinances : Laws establishing and stating the functions of municipal, urban, town and village councils are found in Chapters 252, 255, 256 and 257, respectively, of the Legislative Enactments of Ceylon.

Provisions: Local authorities laws assign to local authorities responsibilities in the area of water supply, public health, the control of nuisances, etc. With regard to water supply, such authorities are empowered to prevent "pollution of streams which flow into reservoirs or waterworks."

Implementation: Local authorities under the ultimate aegis of the Ministry of Local Government, Housing and Construction.

3.1.2. Forests

3.1.2.1 Forest Ordinance: An Ordinance to Consolidate and Amend the Law Relating to Forests and the Felling and Transport of Timber. Chapter 451. [January 2, 1908]

Provisions: -provides for the establishment of forest reserves on which certain activities, such as felling of trees, clearing of land, stripping of bark from trees, etc. may be carried out only with a permit;
-provides for the establishment of village forests for the benefit of a village community or a group of village communities;
-provides for the restriction of activities on other forest lands without permit or except under rules made by the Minister;
-certain trees are listed as reserved trees and land on which they stand may not be exploited in certain ways except under regulations;
-government land: all forest, waste, land used for shifting agriculture, uncultivated or unoccupied land unless proof of ownership can be produced;
(definition)
-penalties detailed.

Implementation: Forest Department of the Ministry of Land and Land Development. The Forest Conservator (head of the Forest Department) is the head of a hierarchy of implementing officers which include Assistant Forest Conservators and Forest Wardens on the lower levels. Police officers are responsible for apprehending violators.

3.1.2.2 Felling of Trees (Control) Act, Chapter 452 [March 15, 1951]

Provisions: Empowers the Minister [of Land and Land Development] to issue Orders providing for the prohibition, regulation or control of the felling of specific varieties of trees.

Implementation: same as for Forest Ordinance (3.1.2.1)

3.1.2.3 Enforcement of forest legislation:

Forest legislation has been difficult to enforce because of the lack of personnel necessary to prevent the damage inflicted by squatters, encroachers and illegal woodcutters. Furthermore, it is reported that the Forest Department itself has indulged in the felling of trees in restricted areas.

3.1.3. Wildlife

3.1.3.1 Fauna and Flora Protection Ordinance, Chapter 469 [March 1, 1938]

Provisions:-provides for the establishment of national reserves and sanctuaries (with protection generally more stringent in reserves), boundaries of which may not be changed without parliamentary consent;

-reserves: hunting, killing and wounding of wild animals prohibited as well as acts tending to destroy or damage their habitats such as clearing of land or destruction of vegetation; no destruction of reptile or bird eggs; no removal or plants;

-sanctuaries: no hunting or carrying of firearms without a permit;

-protection outside of reserves and sanctuaries: absolute for elephants except for certain stated exceptions (all elephants killed become the property of the government);

-close season: no hunting, killing or taking of deer or fowl;

-open season: license required for capturing buffalo or hunting, killing or taking of deer or fowl;

-protected species (see Appendix A for a complete listing)

-birds: except for 40 listed species, all are protected (about 340 species);

-mammals and reptiles:-27 species absolutely protected during both closed and open season;

-4 species may not be shot without a special license at any time of the year;

-plants:-8 absolutely protected species of herbaceous plants; -4 protected trees.

-export of animals: prohibits export of wild birds, beast and reptiles without a permit;

-marketing:prohibits sale or purchase of animals or parts thereof;

-special penalties listed for offences against elephants in nature reserves or sanctuaries: Rs. 3,000 and/or up to 3 years in prison;

-prescribed animals cannot be killed to protect crops.

Implementation: Department of Wildlife Conservation, now under a Minister of State. The Director of Wildlife Conservation heads the Department. Police and other local authorities are responsible for the apprehension of violators.

3.1.4 Fisheries

3.1.4.1. Fisheries Ordinance , Chapter 212 [June 1, 1941]

Provisions: -covers both inland fisheries and coastal fisheries;
-licensing required for fishing for profit by non-Ceylonese or Ceylonese employed by foreign interests;
-prohibits the use of poisonous, explosive or stupefying substances for the purposes of catching fish;
-provides for seasonal fishing restrictions;
-provides for the inspection of fishing boats by Inspectors;
-provides for the protection of certain fish, which may not, without a permit, be exported as live fish, egg, roe or spawn.

Implementation: Director of Fisheries of the Fisheries Division of the Ministry of Fisheries.

3.1.4.2 Pearl Fisheries Ordinance , Chapter 214 [February 12, 1925]

Provisions: -vests the exclusive right of fishing and taking pearl oysters in Sri Lankan waters in the State;
-requires a license for pearl fishing;
-the Ministry of Fisheries declares dates for pearl fishing.

Implementation: Director of Fisheries of the Fisheries Division of the Ministry of Fisheries, supported by customs officers, police officers and peace officers acting as pearl fishery guards and by the Inspector of Pearl Banks.

3.1.4.3 Whaling Ordinance, Chapter 215 [July 4, 1936]

Provisions: -requires licensing for whaling operations;
-provides protection for certain categories of whales (right whales, immature whales, females accompanied by a calf).

Implementation: Director of Fisheries of the Fisheries Division of the Ministry of Fisheries; the Marine Biologist; the Whale Fishery Inspector.

3.1.4.4 Chank Fishery Ordinance , Chapter 213 [March 14, 1953]

Provisions: -requires licenses for chank fishing, both for vessels and divers;
-limits licenses to Sri Lankan citizens or those holding valid residency permits.
-Article 10 states: "Regulations may be made for the prohibition or the regulation, supervision and control, of the export and taking of beche-de-mer, coral or shells, whether generally or in any specified area."

Implementation: Director of Fisheries under the Ministry of Fisheries.

3.1.5 Air and the Atmosphere

Note: No legislation clearly provides for the limitation of air pollution, although it is possible that the Nuisances Ordinance could provide the legal basis for restriction of polluting installations.

3.1.5.1 Nuisances Ordinance, Chapter 230 [January 1, 1863]

Provisions: Article 5 requires a license for "any manufactory or place of business from which offensive or unwholesome smells arise; Article 2(10) provides for fines for persons operating such businesses without a license.

Implementation: Boards of Health, Urban or Town Councils, under the ultimate aegis of the Ministry of Health.

3.2 NON-RENEWABLE RESOURCES

3.2.1 Mineral Resources

3.2.1.1 Mines and Minerals Law, no. 4, 1973

Provisions: A law to provide for the vesting of the absolute ownership of certain minerals in the Republic, to regulate the mining of, prospecting for, collection, processing, sale and export of minerals; to provide for the health, safety and welfare of workers in mines; to enable the compulsory acquisition or requisition of immovable or movable property for any Corporation established to develop the mineral industry; and to make provision for other matters connected with or incidental to the matters aforesaid. [This description is simply the full title of the law; no further details were available.]

Implementation: Geological Survey Department of the Ministry of Industries and Scientific Affairs.

3.2.2 Soil

3.2.2.1 Soil Conservation Act, Chapter 450 [August 13, 1951]

Provisions: -provides for surveys and investigations as to the extent of soil erosion;
-provides for the issuance of regulations covering land use in erodible areas; including restriction of the use of land for agricultural or pastoral purposes;
-provides for the prohibition or control of the exploitation of forest and grassland resources in the interests of soil conservation;
-provides for regulations controlling grazing or agricultural practices conducive to soil erosion;
-permits the Director of Agriculture to step in and take action if a landowner fails to do so.

Implementation: The Director of Agriculture under the Ministry of Agricultural Development and Research.

Note: As of 1976, no regulations of implementing legislation had been issued under this Act, which in effect means that the law has never been enforced.

3.2.3 Coasts and Beaches (see 3.3.1.1-Crown Lands Ordinance)

3.2.3.1 Proposed law: Bill to consolidate the law relating to coast conservation and the administration, control and management of the coastal zone.

Provisions: Proposes the establishment of the position of Director of Coast Conservation with the power, among other things, to implement measures for coastal conservation and the control of sea erosion in terms of national policies; provides for prohibitions on the excavation or removal of sand, stone, coral, etc. from the coastal zone.

Implementation: A proposed Director of Coast Conservation; not certain under which ministry.

3.3 Land Use and Agriculture

3.3.1 State Lands

3.3.1.1 Crown Lands Ordinance, Chapter 254 (Sept. 1, 1949)

Provisions: -deals with state lands, prescribing how they may be sold, granted, and occupied or exploited for mineral or other wealth;

-state lands may be declared as reservations, among other things, for:

- the protection of the source, course or bed of any public stream;
- the protection of springs, tanks or reservoirs;
- the protection of the foreshore;
- the prevention of soil erosion;
- the preservation of water supplies;

-foreshores: -the control, custody and management of foreshores is vested in the state (foreshore is defined as the shore of the island between the high and low water marks);

-regulations may be issued to limit public use of the foreshore;

-any part of the foreshore may be declared as an area from which no sand, stone, coral or other substance is to be removed without a permit;

-the Government Agent may prohibit the removal of sand, stone or coral, etc. from any part of the foreshore if such removal is judged detrimental;

-waters of public lakes and streams (including public irrigation tanks and reservoirs):

- vests the right for the use of such water in the state and enables the state and its officers to take measures to provide for the conservation and supply of such waters, to provide for its more equal distribution and beneficial use, to protect it from pollution, and to prevent the unauthorized obstruction of public streams;
- public waters may not be diverted without a permit.

Implementation: Land Commissioner's Department of the Ministry of Land and Land Development.

3.3.2 Agricultural Land

3.3.2.1 Land Reform Law, no. 1 of 1972

Provisions: -creates the Land Reform Commission;
-imposes a ceiling on agricultural land owned by individuals* and vests the excess land in the Land Reform Commission for redistribution to peasant farmers or state corporations;
-this is the legislation under which the large tea and rubber estates have been taken over by government of Sri Lanka.

Implementation: Land Reform Commission under the Ministry of Land and Land Development.

3.3.2.2 Agricultural Productivity Act, no. 2, of 1972

Provisions: -defines the objectives and duties incumbent on owners of agricultural land;
-gives the State considerable power to confiscate land which fails to conform to government production norms;
-defines the powers of Agricultural Productivity Councils as a means of achieving production regarding land which comes into the hands of the State.

3.3.2.3 Land Development Ordinance , Chapter 464 [October 15, 1935]

Provisions: under this and under the subsequent Land Development (Amendment Act) 16 of 1969 and the Sale of State Lands (Special Provisions) Law No. 43 of 1973 provision is made for the alienation of State Lands to peasants and middle class allottees in Settlement Projects and for agricultural development of these projects. This is the legislation under which much of the effort to "colonize" the agriculturally underdeveloped dry zone of Sri Lanka has taken place.

Implementation: Land Commissioner's Department of the Ministry of Land and Land Development.

3.3.2.4 Agricultural Lands Law no. 42 of 1973

Provisions: concerned chiefly with the development of rice (paddy) lands, this law is designed to provide for the security of tenant cultivators of paddy lands; to specify the rent payable by tenant cultivators to landlords; and to make provisions for the establishment of Cultivation Committees, which are concerned, among other things, with the supply of agricultural equipment, implements and machinery for paddy cultivation.

Implementation : Agrarian Services Department of the Ministry of Agricultural Development and Research.

25 acres for paddy (rice) lands, 50 acres for plantation crops.

3.3.3 Plant Protection and Pesticide Use

3.3.3.1 Plant Protection Ordinance, Chapter 447 [June 27, 1924]

Provisions: -provides for the issuance of Ministerial regulations for prohibiting the importation of certain plants, for quarantining other plants, and for the spraying or other treatment of any plants within Sri Lanka affected with any pest or disease; -empowers the Director of Agriculture to prescribe the manner in which weeds or plants attacked by a declared pest or disease are to be treated; owner or occupier of land is obliged to conform;

Note: There are no provisions which directly apply to the control of pesticides or their use; as of March 1976 none of the implementing legislation under this Ordinance had contained such regulations.

Implementation: The Director of Agriculture under the Ministry of Agricultural Development and Research.

3.3.4 Fertilizers

3.3.4.1 Fertilizers Ordinance, Chapter 445 [January 1, 1902]

Provisions: regulates the sale of fertilizers and provides against the adulteration of fertilizers.

Implementation: Director of Agriculture under the Ministry of Agricultural Development and Research.

4.0 RESOURCES

4.1 WATER RESOURCES

4.1.1 RAINFALL AND CLIMATE

Sri Lanka has a relatively uniform tropical climate with generally high temperature and humidity levels. Mean temperatures range from 80 to 82°F with little seasonal variation in lower lying areas, gradually decreasing in higher elevations in the central highlands; in Nuwara Eliya (6,200 ft.), where the mean average temperature is 60° F, ground frost occurs on a few days of the year in January and February.

Relative humidity is generally high throughout the country, varying generally from about 70-75% during the day to about 90-95% at night; in the driest areas, however, daytime humidity may drop as low as about 60%.

The pattern of rainfall is generally determined by Sri Lanka's tropical location and by the monsoon winds to which it is exposed, while the central highland region (see relief map) is the principal factor in influencing rainfall variations within the country, dividing Sri Lanka into the wet zone of the southwest and the dry zone of the eastern and northern parts of the country.* The monsoon winds, blowing from the southwest from late May to late September and from the northeast from December to February bring the heaviest periods of rainfall to the southwest and northeast areas of Sri Lanka respectively. Two fairly distinct inter-monsoonal periods occur: the first (April-May) is characterized by almost daily thunderstorms, especially in the southwest, the second (October-November) by tropical cyclones, which bring heavy, often extremely intense rains to most parts of the island.

The wet zone is favored by rainfall well distributed through the year, seldom falling below 5 inches per month; here rainfall is reliable in its occurrence and is generally effective in maintaining the moisture level of the surface soil above the wilting point. This zone covers about 25% of the land mass of Sri Lanka.

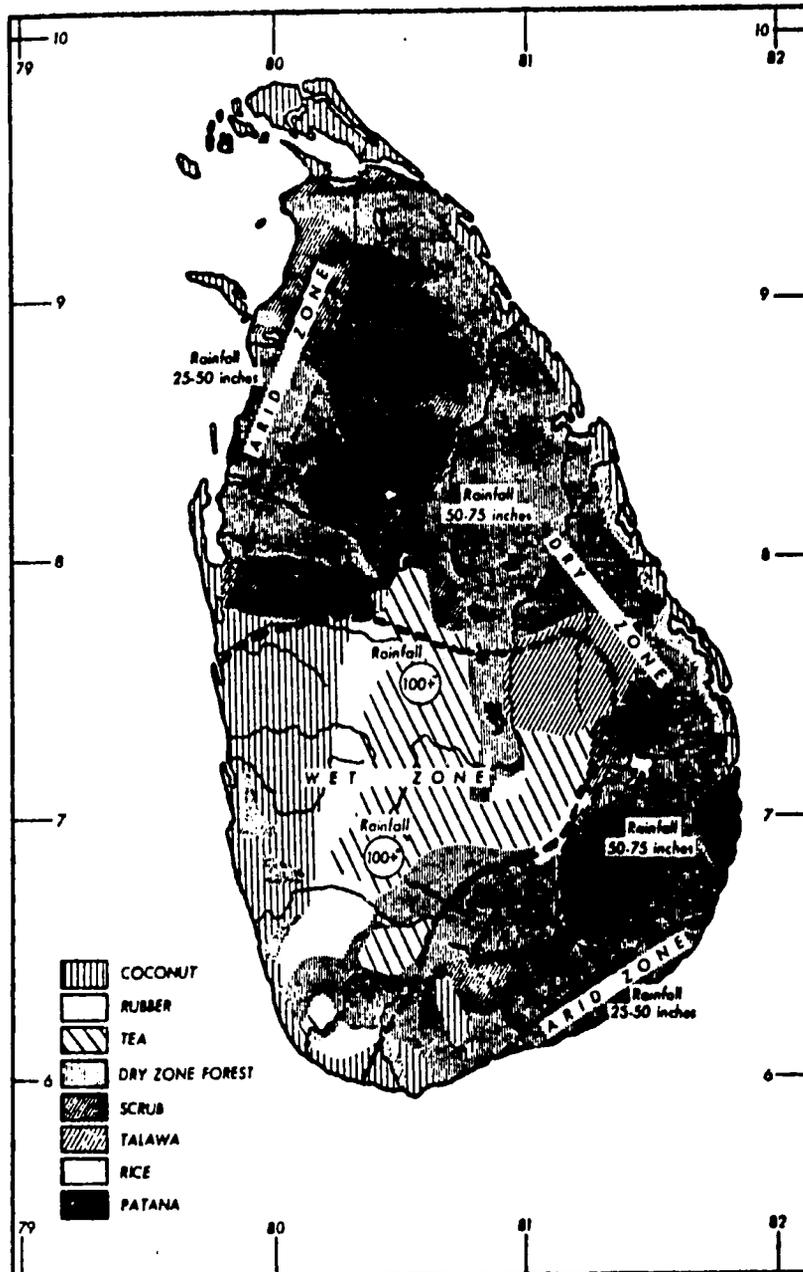
The dry zone experiences a wet season, generally running from October to January, and a dry season covering the rest of the year. This zone generally receives less than 75 inches of rain per year, although in the areas of lowest rainfall (the southeastern and northwestern parts of the coastal plains--sometimes identified as the "Arid Zone"), mean annual rainfall is below 50 inches, and drought prevails during most of the year. The dry zone covers about 75% of the land mass of Sri Lanka.

In the wet zone and areas bordering it, the frequency and intensity of heavy storms varies with altitude, higher elevations (those of 3,000 feet or more) tend to have longer and gentler rains, while lower and intermediate elevations are exposed to intense rainstorms with a high erosion potential.

RECENT RAINFALL PATTERNS:

Severe droughts have occurred in recent years with the failure of the monsoon rains. This has caused lowered agricultural production and necessitated water rationing in urban areas such as Colombo. Localized droughts occurring during the intermonsoonal periods have been attributed, among other things, to deforestation.

*Without questioning the validity of the basic wet zone-dry zone classification, some sources also identify an intermediate zone (between the wet and dry zones) and an arid zone.



Rainfall and Vegetation Zones Source; Nyrop (1971)

RAINFALL: Averages from 1931-1960 (in inches)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|-----------------|-----|-----|-----|------|------|------|------|------|------|------|------|------|-------|
| <u>WET ZONE</u> | | | | | | | | | | | | | |
| Colombo | 3.5 | 3.8 | 4.7 | 10.4 | 14.1 | 8.5 | 5.6 | 4.9 | 6.1 | 14.1 | 12.9 | 7.0 | 95.8 |
| Wattawala | 4.5 | 4.4 | 7.9 | 11.8 | 28.1 | 36.4 | 28.5 | 26.2 | 20.6 | 25.8 | 14.6 | 8.7 | 218.0 |
| Ratnapura | 6.0 | 7.2 | 9.8 | 13.6 | 19.8 | 18.5 | 12.3 | 13.1 | 12.6 | 19.9 | 14.2 | 8.6 | 155.5 |
| <u>DRY ZONE</u> | | | | | | | | | | | | | |
| Badulla | 9.2 | 4.8 | 4.4 | 7.9 | 4.6 | 1.0 | 2.0 | 3.8 | 3.7 | 8.6 | 10.7 | 11.0 | 71.6 |
| Hambantota | 4.0 | 2.3 | 2.6 | 4.4 | 4.8 | 2.2 | 1.7 | 1.7 | 1.8 | 5.0 | 7.5 | 4.8 | 43.0 |
| Mannar | 3.5 | 1.4 | 1.8 | 3.5 | 2.0 | .2 | .3 | .6 | 1.0 | 6.7 | 9.7 | 9.8 | 38.7 |
| Trincomalee | 8.4 | 3.8 | 1.9 | 3.1 | 2.7 | .8 | 2.2 | 4.1 | 3.6 | 9.4 | 14.2 | 15.0 | 69.1 |

4.1.1.2 Rainwater utilization

In the wet zone, where rainfall is plentiful and regular, in some areas in fact in excess of actual needs, cultivation of tea, rubber and coconuts, as well as of other minor crops, takes place under rainfall conditions.

In the dry zone shifting agriculture (chena), including some rice production, takes place strictly with reliance on the rains, but most agriculture relies on tanks (reservoirs) of various sizes, which accumulate runoff from small streams and depend only to a small extent on direct collection of rainwater.

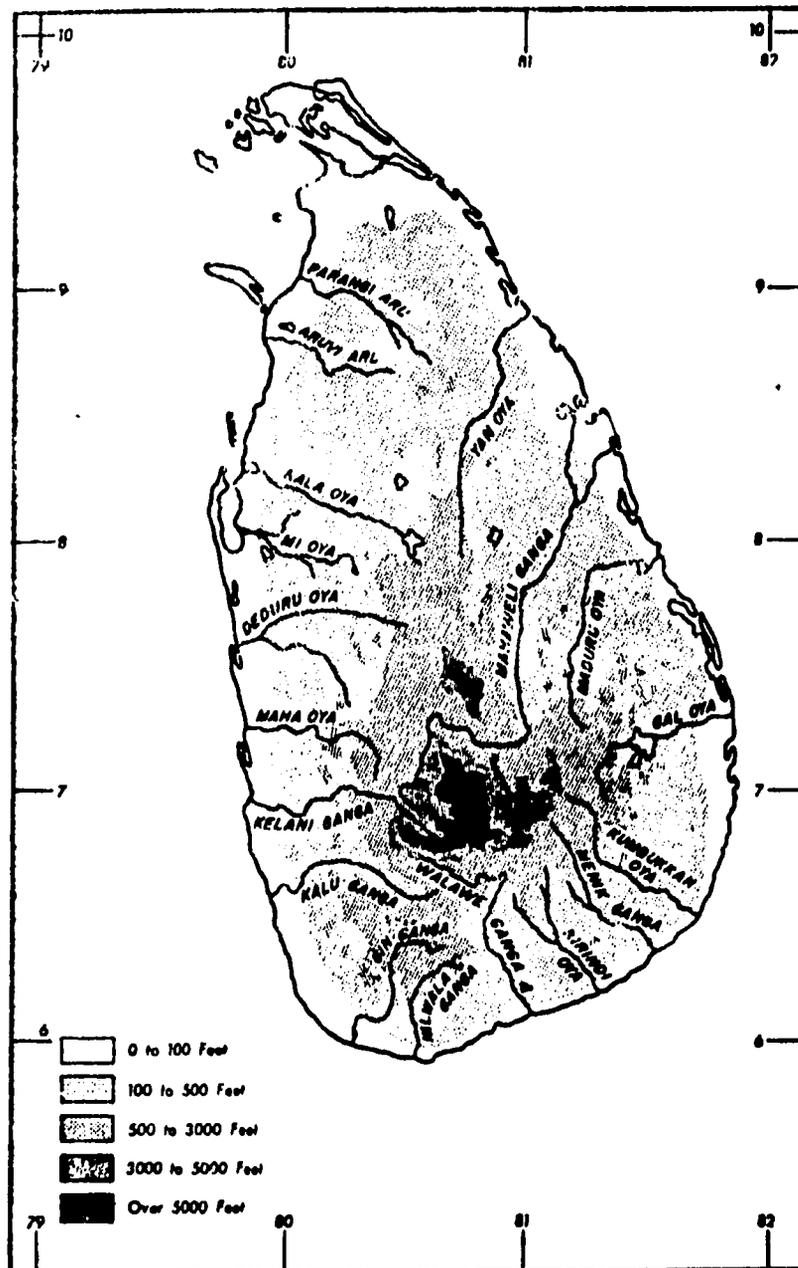
4.1.2 SURFACE WATERS

4.1.2.1 Rivers

Although there are over a hundred rivers in Sri Lanka, many of these are only small or seasonal streams. Twelve rivers account for over 75% of the total river discharge, and about 50% of these flow through the approximately one-fourth of the country which is the wet zone. Of about 89 million acre feet of rainfall per year, the average annual run-off in rivers, according to a 1969 estimate, was about 41.6 million acre feet.

All of Sri Lanka's rivers originate in the central highlands (see map), and with the exception of the Mahaweli Ganga flow directly to the Indian Ocean, often forming spectacular waterfalls as the drop to lower elevations. Most rivers have short courses: the Mahaweli Ganga, with a length of 206 miles, is the longest; the remaining major rivers are no more than 62-97 miles long. These rivers effectively drain the highlands of the country, but in the lowlands they tend to spread out on the plains, often blocking land development and communications.

Major Rivers of Sri Lanka Source; Nyrop (1971)



4.1.2.2 River utilization

Irrigation and hydropower are the two chief uses of rivers in Sri Lanka. Most of the rivers are too wild in the highlands and too shallow in the lowlands for effective navigation; only about 249 miles of river are navigable. A canal system, now largely in disrepair, has provided a water route to the interior of the country.

4.1.2.2.1 Hydroelectric power

The overall hydro-power potential of Sri Lanka, taking account of projected hydropower schemes, is estimated to be around 700-800 megawatts. The actual capacity of hydropower plants in 1975 was about 192 megawatts, with 100 megawatts expected to be added with the completion of the Laksapana hydro-power plant. In 1975, hydropower accounted for about 73% of electric power produced.

Problems: The major difficulty with hydroelectric schemes is the wide fluctuation in the flow of local rivers, which creates problems in equalizing power outputs. This necessitates large-storage reservoirs demanding large capital outlays to harness rivers for power generation.

4.1.2.2.2 Irrigation (see 5.2.2.1.2)

4.1.2.2.3 Other uses of river water:

Rivers, streams and tanks all serve as fishing grounds.

Rivers, streams and tanks continue to serve as a source of water for domestic uses and for bathing, principally in the rural and estate sector.

4.1.2.2 Lakes

There are few natural lakes; there are, however, a large number of man-made reservoirs, called tanks, formed mainly by damming rivers and streams. Many of these are as large as a mile across.

4.1.3. GROUNDWATER

Most of Sri Lanka is underlain by crystalline rocks which, because they are practically impermeable, cannot serve as groundwater aquifers. In those areas of the wet zone where the crystalline rocks are overlain by thick lateritic soils, these soils act as a sponge to hold water, while in the valley tracts and deltaic lowlands, alluvial deposits store considerable quantities of groundwater. While deep groundwater is in rare supply throughout the dry zone, it has been argued that considerable supplies of shallow groundwater are present, especially in lowland areas; such groundwater presently supplies wells, sometimes on a year-round basis, throughout much of the dry zone.

In the north of Sri Lanka, particularly in the Jaffna area, considerable groundwater is held in limestone sedimentary rock. Here, 3-6 feet of freshwater is present about 30-35 feet below ground; this aquifer, which is underlain by brackish water, has been estimated to yield from 15,000 to 100,000 gallons of freshwater per day.

Along the coastal tracts of the rest of the island, where sands and sandstone gravels have been deposited, fresh water occurs in convex formations resting on salty seawater. Supplies ranging from 20,000 to 200,000 gallons per day have been drawn from groups of wells in these formation, while the towns of Batticaloa, Mannar, and Hambantota have obtained their water supplies from such deposits underlying sand dunes.

4.1.3.2 Groundwater utilization

Wells tapping shallow groundwater supplies serve as the major source of domestic water supply throughout the country, particularly in rural areas.

Groundwater has traditionally not been used for irrigation purposes; the major exception to this pattern occurs in the Jaffna peninsula where lift irrigation taps groundwater for extensive agricultural endeavors. Increasing interest is being shown in the possible use of both deeper groundwater and shallow groundwater for irrigation in the dry zone.

4.2 FORESTS

4.2.1 The Resource

Estimates of the extent of forest land in Sri Lanka vary considerably. Ceylon Forest Department estimates for 1972 place it at 53.1% of total land area, while the FAO's 1975 estimate shows 2,899,000 acres of forest land, or about 44% of the area of Sri Lanka. About 2.3 million acres of this are forest reserves or proposed forest reserves under the control of the Forest Department; about 150,000 acres are planted or enriched forests.

Because of the intensive use of land, little primary forest area remains in Sri Lanka.

dry zone forests

Most of the dry zone is covered by secondary vegetation that has developed after centuries of repeated clearing for both sedentary and shifting cultivation.

In the most arid sections along the coast in the extreme northwest and south-east, tropical thorn forests with varieties of acacias and euphorbia predominate, while in the tropical dry mixed evergreen (monsoon) forest that covers most of the zone, trees seldom exceed 65 feet in height and do not form a canopy; these include, in scattered occurrence, such valuable trees as satinwood (Chloroxylon swietenia), ebony (Diospyros ebenum), mahogany (Swietenia mycrophylla), and halmilla (Berrya cordifolia).

wet zone forests

In this zone great quantities of land have been cleared and planted with commercial trees such as coconut and rubber. There also occur, mostly in forest reserves, such evergreen forest species as Doona congestiflora (local name: tiniya), Dipterocarpus zeylanicus (hora), Cullenia ceylonica and Cullenia rosayroana (kataboda) and Cyathocalyx zeylonicus (kekila); these are native species, all of which are found in quantities suitable for large scale commercial extraction. A few valuable hardwoods such as Periscopis mooniana (nedun) also occur.

rain forest

The wet zone was once covered by rain forests. Today only about 20,000 acres of such forest remain, most of it spread out over the two Sinharaja Reserves in the highlands of the southwestern interior; smaller remnants are found in the Peak Wilderness. These forests are prized by Sri Lankan conservationists as "richer in plant and animal species than all other forests of the island."

coastal zone forests

In the swampy areas of the coastal plains mangroves and the animal life associated with them occur.

4.2.2 Utilization of forest resource

| Roundwood removals (1,000's cubic meters: all non coniferous) | | | |
|---|-------|-------|-------|
| | 1969 | 1973 | 1975* |
| Sawlogs, veneer logs, logs for railway ties | 345 | 504 | 375 |
| Other industrial wood | 370 | 400 | 426 |
| Fuel wood | 3,880 | 4,150 | 4,225 |

*FAO estimates

4.2.2.1 Firewood

Firewood remains the principal use of wood in Sri Lanka; Dyptes separia, the trees which accounts for about 25% of forest growth in the dry zone, is said to be unsuitable for any other purpose.

Population pressures have brought increasing demands for firewood, and the looting of forest reserves for this ever scarcer resource has increased during recent years. This problems has been aggravated by the rise in the cost of other forms of energy, and recently even tea plantations, faced with rising energy costs, are reported to be stripping the forests of such valuable trees as satinwood in order to provide energy for tea drying.

Whereas in the past a large percentage of the nation's firewood needs was provided by wood which became available because of the replanting of old seedling rubber trees with new varieties, a recent decrease in the area of rubber replanted annually has led to a reduction in this source of firewood, putting increasing pressure on natural forests.

4.2.2.2 Industrial uses:

Because valuable commercial trees occur only in scattered stands in Sri Lankan forests and because many forests have been too dense for extensive logging, commercial exploitation of this resource has been slow in developing. In recent years, however, the government has made an effort to increase production in this sector of the economy; this has involve growing use of modern machinery and techniques.

In 1973, timber produced by the State Timber Coporation, apart from firewood, consisted of: softwood and non-softwood logs; ebony logs; railway ties; telegraph and transmission poles; and sawn timber. Some of this wood was exported: ebony, teak, satin and flowered satin wood, palu, vellam, neralu, panakka, halmilla and cyprus logs. Much wood was also supplied to local industry, particularly the State-run Ceylon Plywoods Corporation, which produces plywood for tea chests and furniture. Conservations have complained that valuable woods such ebony are being used for cheap furniture.

4.2.2.3 Construction

Sri Lanka dwellings are for the most part mud and plaster in construction with wood used for wall support, doors and windows. A recent article estimates that the wood needed for these purposes as well as for such implements as spoons and furniture in the form of benches and tables would possibly require one tree of 3-4 foot in girth. At the present rate of 53,000 new housing units per year, an equal number of trees are required to meet construction needs.

4.2.2.4 Negative effects of the development of the forest industry: the case of Sinharaja

The development of the forest industry has been accompanied, according to conservationists, by unforgiveable and nearly irremediable encroachments on unique primary forest land. The most notorious example has been the selective logging of Sri Lanka's last extensive tract of tropical rain forest, the Sinharaja, to provide input for the production of furniture at a branch installation of the Ceylon Plywood Corporation. Removal of wood, begun in 1972 and originally planned to extend to the entire forest, was later, in response to increasing protest by conservationists, restricted somewhat and a small tract (4,200 acres) was set aside for scientific purposes. Shortly after the change of governments in 1977, it was announced that exploitation of the forest would cease completely. Although logging has been halted, a great deal of harm has been done to the natural ecology of the area, not only by the removal of trees but also by the cutting of roads through the forest, the encroachment of alien weeds, and the reforestation of certain cleared areas with mahogany, a tree alien to the habitat of the Sinharaja.

4.2.2.5 Clearing of land for agricultural development

Clearing of land to provide the acreage so desperately needed to meet the food needs of Sri Lanka's population is responsible for the loss of a good deal of forest land. As a part of the Mahaweli Ganga Project, the second phase of which entails the irrigation and agricultural development of approximately 106,000 acres, most of the scrub jungle now covering this area will be removed. Also responsible for the clearing of forest land is the traditional practice of chena (shifting) agriculture, which has become more widespread as population increases. Chena is said to account for more felled trees than the expansion of settled permanent agriculture.

4.2.2.6 Encroachment on forest reserves

Despite legal restrictions and the presence of enforcement authorities in the form of police and wardens, forest reserves are subject to the encroachments of squatters, poachers and illegal woodcutters. Such practices seem to be prevalent throughout the country, but a particularly egregious case is that of the Forest Reserve at Udawattekelle in the Kandy District, where as of 1975 squatters and illegal timber fellers had reduced this reserve from 256 to about 100 acres. Similar cases are reported in Loris, the publication of the Nature and Wildlife Conservation Society of Ceylon.

4.2.3. Forests as hydrological reserves and as influences on climate

Apart from their economic value as sources of timber and firewood, certain forests play an important role in influencing the water resources and climate of the island. Forests, most notably in the higher altitudes of the wet zone, perform the vital function of soaking up and holding rain water, which is then slowly released into catchment areas; in the absence of this important water-holding function, rainwater is more likely to be immediately lost to rivers as runoff, causing flooding and soil loss as it flows to the sea. Conservationists consequently argue that loss of forest cover through overdevelopment in the Horton Plains and Peak Wilderness areas of the Central Highlands could result in the drying up of the main sources of supply of major rivers such as the Mahaweli, Kalani, and Walawe Gangas, reducing them to streams and drastically damaging the agricultural development dependent on their waters.

It has also been maintained that hot air rising from deforested areas in higher areas has been responsible for local droughts during intermonsoon¹ periods.

4.2.4 Forests as animal habitat

The forests and grasslands of Sri Lanka serve as the habitat for a wide range of wildlife.

4.2.5 Reforestation

Reforestation in Sri Lanka, conducted by the Forest Department, has entailed chiefly the planting of species of trees suitable for commercial exploitation. In 1973, for example, under the long-term Forest Development Plan of 1970, there were plantings of extents of teak (10,902 acres), eucalyptus (1,107 acres), bamboo (480 acres), various pines (2,234 acres) and albizzia (504 acres). In addition mahogany "enriching" was carried out in 2,235 acres of natural forest. Other types of reforestation involve intercultivation with food crops (teak, eucalyptus and bamboo) and reforestation of unproductive tea and rubber lands, principally with Albizzia species.

4.2.6 Emergency measures for the protection of forests

Under the constant pressure exerted by conservationists, the government of Sri Lanka is becoming increasingly aware of the actual and potential consequences of deforestation on water supply, soils, wildlife, climate and the general ecology of the island.

Measures recently undertaken by the government to retard deforestation include:

- a total ban on the felling of forests over 5,000 feet;
- a national tree planting campaign under the personal direction of the former Prime Minister;
- a complete ban on the export of timber (1977);
- the halting of logging of the Sinharaja rain forest (1977).

4.3 SOILS

4.3.1 Major Soil Types*

Soil types in Sri Lanka coincide with the major climatic zones: the soils of the wet zone are generally lateritic, while red earths are the predominant soil type of the dry zone. Soil types do not occur uniformly throughout these zones, however, but rather interspersed with minor soil types, dependent on factors such as local rainfall and proximity to rivers and coastlines.

4.3.1. Lateritic soils

The soils of the wet zone are lateritic: generally mottled-red in color; clayey in texture; rich in iron and aluminum oxides; poor in silica and nutrients; low in pH; deep; and with a humus content of about 3%. These features are intensified as one moves from the weakly lateritic highlands above 3,000 feet through the strongly lateritic upland areas below 3,000 feet to the very strong lateritic soils of the wet lowland savannas.

vegetation

The natural vegetation of these soils ranges from the massive trees of the lowland rain forests to the stunted forests (about 20 feet) of the evergreen montane rain forests above 5,000 feet; this vegetation is replaced by lowland wet savanna and montane savanna respectively as areas are burned and cleared.

utilization

The lateritic soils of the wet zone have been intensely utilized. Only a small portion of the natural vegetation remains. Coconut is grown in the lowlands, rubber in the lowlands and intermediate elevations and tea in the hilly regions. In the semi-dry uplands of Uva, much of the land has been terraced and brought under highly productive market crops.

The very strongly lateritic soils of the southwest lowlands, which have a very high iron content, are in some areas cut out in blocks, dried and used as construction materials (cabook).

Lateritic soils have demonstrated greatly increased production when fertilizer is used. Tea production, for example, increased by 35% over a ten-year period in response to correctly used fertilizers.

problems

These soils are subject to erosion, especially on the steep slopes which are now coming under cultivation.

*The soil classification followed here is that of Fernando (1969) as followed in Domros (1976); another frequently cited classification is that of Moorman (1961).

4.3.1.2 Red earths

The red earths, the predominant soils of the dry zone, occur at varying levels of elevation but especially in the better drained upper slopes. They are characterized by: a generally loamy texture; a humus content of 2% or less; only partial leaching; a pH of 7-8; a good depth; and a low silica and high iron oxide content. They have a low waterholding capacity and tend to dry up soon after the rains cease. The red earths are relatively fertile as tropical soils go.

An important subgroup of these soils, the chalky red earths, occur in northern and northwest Sri Lanka

natural vegetation

The natural growth of these soils in the wetter parts of the dry zone is mixed evergreen forest, characterized by an admixture of deciduous species; this "monsoon" forest is replaced by dry grassland when areas have been cleared by burning. The drier areas bear a natural growth of thorn forest, which is replaced by arid grasslands after extensive burning and clearing.

utilization:

The red earths have been exploited chiefly for shifting cultivation, although some rubber and coconut are grown in areas closer to the wet zone. With irrigation these soils, which once supported an extensive irrigated agriculture, are being increasingly brought under rice cultivation.

The chalky red earths of the Jaffna peninsula of the north are intensely cultivated with the help of bulky organic fertilizer and lift irrigation.

4.3.2. Minor soil groupings

4.3.2.1 Alluvial soils are found on the flood plains, in the deltas and on the banks of rivers throughout Sri Lanka. These soils, which are generally crumbly, loamy and very deep, have a high level of fertility, consisting as they do of eroded topsoils of higher elevations that have been washed downstream.

The natural vegetation of such soils consists of lofty riverine forests, bamboo and tall grasses; however, little natural vegetation remains because of intensive agricultural utilization.

utilization :

Alluvial soils are the main rice-producing soils of Sri Lanka. Coconut has also been grown on them. In the area of river estuaries such soils are usually too brackish to support agriculture.

4.3.2.2 Saline soils occur in the most arid sections of the extreme northwest and south-east of the island, where the dry season is prolonged and very heavy evaporation brings salts to the soil surface. These soils are shallow, light in color, low in humus content and high in salts, especially sodium chloride and sodium sulphate.

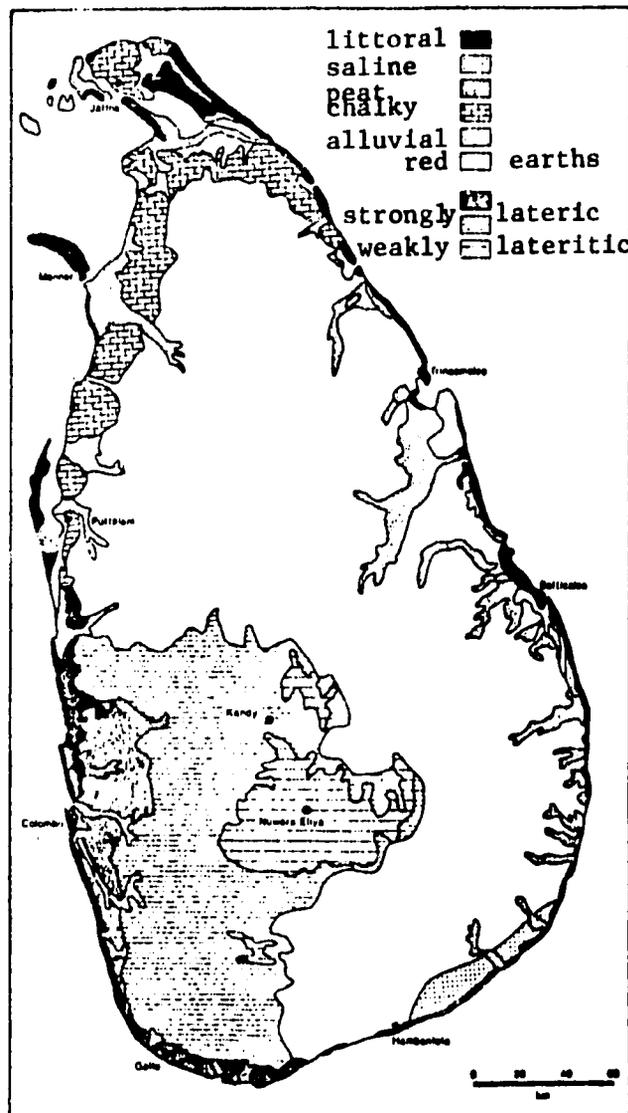
The natural vegetation of these soils is monsoon scrub jungle, dominated by stunted acacias, euphorbias, and tamarinds. In areas where this growth has been subjected to prolonged drought or burning, short annual grasses occur. Utilization: Saline soils are poor for agriculture, except where irrigation can be used to lower their salt content. The Ruhunu National Park occupies an extensive area of saline soils in the southwest.

4.3.2.3 Bog soils (peats) occur throughout the country with greatest concentration in the Colombo area. These soils are waterlogged and contain large quantities of organic matter (humus).

Swamp vegetation occurs naturally on peat soils in the lowlands; in the highlands they support wet grassland.

Most of these soils are now economically unproductive, but boggy areas can be reclaimed through draining; gardens on such drained soils near Colombo demonstrate that they could be used for truck-farming crops.

4.3.2.4 Littoral soils are the beach sands, dunes and other materials deposited by the sea; they contain very little humus, are very infertile, bear only creeping beach vegetation, and are subject to almost no agricultural utilization.



GENERALIZED SOIL MAP

Source: Domros (1976)

4.4 WILDLIFE

4.4.1 The resource

Sri Lanka has a rich variety of wildlife. Birds include cuckoos, owls, hawks, eagles, kingfishers, peacocks, hummingbirds, flamingoes, and many unusual species, including the seven sisters bird, which is said always to flock in groups of seven. Smaller mammals include grey flying squirrels, five varieties of monkeys, and the "flying fox" bat. Among the larger mammals are the asiatic elephant, leopards, jungle bears, jackals, wild swine, buffaloes, and several varieties of wild deer. In the great rivers of the lowlands and in the brackish waters of the lagoons are reptiles such as the crocodile species known as the Ceylon mugger; the monitor lizard inhabits the banks of swampy rivers, and chameleons live in the crowns of rain forest trees. There are many varieties of insects, including spectacularly large and colorful butterflies. The rain forests abound in rare and unusual species of plants, and rivers, reservoirs, and coastal water contain a rich variety of fish and marine life.

4.4.2 Exploitation

Both elephants and buffaloes have traditionally been captured and tamed for use as farm and draught animals, a practice which still continues, although the capture of elephants has been restricted in recent years; in 1973 conservationists urged that permits to capture buffaloes as agricultural animals be issued to cover the Yala complex of parks, where large numbers of buffalo were threatening the habitat of other park animals. Animals continue to be hunted for meat, ivory, and skins.

4.4.3 Protection of wildlife

Unrestrained hunting and trapping of wildlife have led to the extinction of many species of Sri Lankan wildlife and threatened the continued existence of many others, while the increasing growth of human population and the consequent extension of land devoted to agriculture and settlement have led to a severe limitation of the areas available for wildlife habitat. Growing realization of the danger to wildlife led, beginning in 1937, to the establishment of a series of national parks and sanctuaries, which today cover 2,366.14 square miles, about ten percent of the total area of Sri Lanka.

Protected areas, almost all of which are in the dry zone, fall into three basic groups:

- 1) strict natural reserves(four with a total area of 234.40 sq. miles):
entry permitted only for scientific purposes;
- 2) national parks and intermediate zones(four: total of 1,172,68 square miles): absolute protection provided for plant and animal life; felling of trees, clearing of land and construction of roads prohibited; entry permit required; borders may not be changed without parliamentary approval;
- 3) sanctuaries (40 covering a total of 767 square miles):
hunting and firing of weapons prohibited; borders may not be changed without parliamentary approval; freely accessible to public; persons exercising rights such as cultivation of land before the sanctuary was declared may continue that practice; sanctuaries frequently serve as buffers to national parks and strict natural reserves.

4.4.3 (cont)

The Fauna and Flora Protection Ordinance (see 3.1.3.1), under which these areas were established also provides absolute protection outside such areas to a large number of animals of all varieties (see appendix 1) and provides for hunting or capturing of others only with a license. Orders issued under this law in recent years have considerably strengthened legal protection for wildlife by suspending the issuance of all game licenses, and prohibiting both the capture of elephants and the export of wild animals or parts thereof in commercial quantities. At the present time, therefore, only the following animals can be hunted: wild boar, hare, porcupine, jackal, takgoya, some squirrels and monkeys, civet cats, and game birds during the open season, which runs from November 1 to April 30.

Despite apparent official concern with wildlife and its protection, Sri Lanka had, as of mid-1977, not yet signed the Convention on International Trade in Endangered Species, which came into force on July 1, 1975.

4.4.4 National parks **

4.4.4.1 Wilpattu National Park (no. 1 on map)

date established: 1938

area: 508.5 square miles

terrain: sandy region with a string of natural lakes on the west surrounded by sand dunes, thickets and forest patches; in the eastern and central sectors traces of old fields gradually invaded by thicket and dry secondary forest.

animals: asian elephant (Elephas maximus)*; axis deer; sambhar; buffalo; sloth bear; leopard (Panthera pardus)*; hornbills; bee-eaters, flycatchers, ibises, pelicans, eagles.



4.4.4.2 Ruhunu (Yala) National Park (no. 2 on map)

date established: 1958

area: 447.57 square miles

landscape: a coastal zone with lagoons and dunes, rocks scrub and thorn jungle; traces of ancient civilization on the plain;

animals: elephant (Elephas maximus)*; sambhar and other deer; leopard (Panthera pardus)*; crocodile; birds: peafowl, cormorants, plovers, grey heron, imperial pigeon.

4.4.4.3 Gala Oya National Park (no. 7 on map)

date established: 1954

area: 100 square miles

landscape: reservoir lake situated in flat country but dominated by gneissic hills 150 m high; dry evergreen forest occupies about a quarter of the area; the remainder is scattered tree-grassland savannah;

wildlife: elephant (Elephas maximus)*; buffalo; muntjac; axis deer; leopard (Panthera pardus)*; jackal; python (P. molurus)*; cobra; many birds

4.4.4.4 Uda Walawe National Park

date established: 1972

area: 119 square miles

animals: elephant (Elephas maximus)*; leopard (Panthera pardus)*; golden palm civet; mouse deer; jackals; grey langurs.

note: little attention has been paid to the development of this park.

4.4.5 Strict natural reserves

4.4.5.1 Yala Strict Natural Reserve (no. 4 on map)

date established: 1937

area: 116.6 square miles

landscape: flat, sandy, some sand dunes; jungle is low and thicker inland

animals: sloth bear, buffalo, deer, sambhar, elephant (Elephas maximus)*; monkeys, leopard (Panthera pardus)*; many birds.

*Animals on the U.S. Fish and Wildlife Service List of Endangered and Threatened Species

**The administration of all national parks (except Gala Oya), strict natural reserves and sanctuaries is the responsibility of the Wildlife Conservation Department (see 2.1.5.1). (1977).

4.4.5.2 Wasgomuwa Strict Natural Reserve (no. 3 on map)

established: 1937

area: 112.56 square miles

landscape: the central part is a narrow valley between two steep ridges of the Sudukanda hills; vegetation varies from thick forests at lower levels to open forests and scrub.

animals: elephant (Elephas maximus)*; sambhar; buffalo; axis deer; sloth bear; leopard (Panthera pardus)*

4.4.5.3 Other strict natural reserves are the Hakgala Strict Natural Reserve (no. 6 on map) and the Ritigala Strict Natural Reserve (no. 5 on map), both of which are rich in flora, and the Horton Plains Natural Reserve.

4.4.6 Continuing danger to wildlife:

4.4.6.1 Inadequate enforcement of nature protection laws

Personnel and equipment are in insufficient supply to enforce effectively the laws prohibiting the hunting of wildlife. In national parks, for example, there are inadequate numbers of vehicles for anti-poaching patrols, and poaching is therefore rampant. There is said to be an active illicit trade in leopard skins, and despite strictures against the killing of deer, venison is said to appear on hotel menus. Slaughter of protected species of crocodiles continues, and this, in combination with loss of crocodile habitat due to human pressure, has drastically reduced their numbers and bringing about their complete disappearance from areas in which they formerly thrived.**

It is also reported that penalties for the illegal slaughter of animals are too small to provide sufficient discouragement for poachers. In 1977, for example, a penalty imposed for the illegal possession of a leopard skin was only Rs. 15 (about \$.93), and other penalties were equally as low.

4.4.6.2 The tourist trade

The influx of tourists into Sri Lanka's national parks has been increasing recently, and it is feared that the consequent expansion of roads in parks and the construction of tourist facilities may have a negative effect on animal habitats. Furthermore, tourists have supplied a ready market for illegally obtained items derived from wildlife such as ivory, leopard skins and claws, bear's teeth, feathers, fur, skin and shell.

4.4.6.3 Agricultural encroachment on wildlife protection areas and habitat

4.4.6.3.1 Shifting cultivation

Encroachments on wildlife reserves by peasant chena farmers are very common; cultivation has been reported, for example, on the edge of the Yala (Ruhunu) National Park as well as in other parks and sanctuaries.

4.4.6.3.2 Major agricultural development schemes

The head of the Wildlife and Nature Protection Society of Ceylon has noted that "technocrats and administrators" tend to ignore legislation providing for the inviolability of national parks, in the preparation of extensive agricultural development schemes. Plans for the development of

4.4.6.3.2(cont)

the Heda Oya basin in the southeastern part of the island, as originally proposed by the Department of Irrigation, took no account of the effect of the project on important elephant reserves and also called for the complete elimination of a forest reserve. These plans were altered somewhat under pressure from conservationists, but other development projects, such as the Kumbukkan Oya basin development scheme are expected to result in the loss of large areas of the Yala complex of national reserves. Furthermore, it is expected that the gigantic Mahaweli Ganga Development Project, the second stage of which will open up land on the edge of Wilpattu National Park, apart from bringing into its immediate area large human populations likely to encroach on the park for firewood, will also eliminate from the surrounding area much of the scrub jungle which park animals have depended on for food in times of stress, such as prolonged drought.

4.5 Fish and Marine Life

4.5.1. Fish resource

The inland and coastal waters of Sri Lanka abound in fish, an estimated 856 varieties, about half of which are percoids (perches). The most-valued commercial marine fish are mackerel, mullet, indian salmon, and bonito, followed by perch, brace, cod and snappers, while sharks and skates are among the least valued.

Important shellfish include crabs, crawfish, shrimps, lobsters, and pearl oysters.

4.5.2 Utilization

Fish forms an important part of the diet of Sri Lankans; in rural areas it is the most important source of protein. Because the country is presently able to meet only about 70% of its needs for fish and must import the remainder, the government has been attempting to expand and modernize the fishing industry. Extreme food shortages in recent years have made this an increasingly more important goal.

Sri Lanka has declared a 200 mile limit for fishing in its waters.

4.5.2.1 Fishing Industry

| | 1973 | 1975 |
|--------------------------|-------------|--------------|
| <u>Total catch</u> | 98,686 tons | 126,420 tons |
| <u>Inland fisheries</u> | 6,860 tons | 13,034 tons |
| <u>Coastal fisheries</u> | 92,000 tons | 113,386 tons |
| <u>Tuna</u> | 18,620 tons | 29,694 tons |
| <u>Crustaceans</u> | 2,940 tons | 6,076 tons |
| <u>Mollusks</u> | 49 tons | 58 tons |

An estimated 40,000 persons were engaged in fishing in 1974.

4.5.2.1.1 Inland fisheries

Inland fishing is conducted in rivers, irrigation tanks, and large reservoirs. The fish production of reservoirs and large tanks has been increased greatly by the recent introduction of species adapted to such a habitat: most productive have been various species of Tilapia. There is now a move to develop fisheries in smaller community and village tanks; in those tanks that dry up in the dry season, yearly stocking of fish measures to enhance the food supply for fish must be employed. With the aid of such fisheries development programs, which also include supplying of fishing equipment, the Department of Fisheries has estimated a yield of 20,265 metric tons for 1977 and predicts that with the successful continuation of the programs, yields will be as high as 47,075 metric tons by 1982.

The success of tank fisheries development is highly dependent on the maintenance of both good water quality and a proper level of nutrients in tanks. It is not known to what extent the increased use of fertilizers and pesticides, residues of which enter tanks in runoff waters, will effect fish production.

4.5.2.1.2 Coastal fisheries

Coastal fisheries are by far the more productive at this time. Fishing is conducted in most coastal areas but most profitably in the Jaffna Peninsula, the Isle of Mannar, the Palk Straits, the bays of Galle, Batticaloa, and Trincolamee, and large lagoons such as Negombo and Puttalam.

Most coastal fishing is carried out on a very primitive level, usually involving the use of nets and rods or outrigger boats. Government programs under the Ceylon Fisheries Corporation are therefore attempting to make motorized boats available and to instruct fishermen in their use, to promote deep sea fishing, now only in the beginning states, and to develop fishing harbors.

The development of coastal and deep sea fishing is currently deterred by several factors: poorly developed fishing methods; a lack of capital; and the monsoon winds, which during substantial parts of the year produce surfs that bring a halt to fishing activities (some fishermen actually migrate with the monsoons). Social and religious practices also have an important effect: most Sinhalese and Tamils are traditionally farmers, and fishing is a practice traditionally relegated to the lower castes. Furthermore, the low count of microorganisms and the low level of plankton in the Indian Ocean indicate that Sri Lanka's fishing waters may not be able to support the numbers of fish necessary for the development of a large-scale fishing industry.

4.5.2.1.3 Fish processing industry

The fish processing industry is quite small. Fish processing on a limited scale is practiced by the Ceylon Fisheries Corporation, which produced over 181,000 cans of fish in 1973 in its plant at Pesalai. This plant and another at Mutwal also produce fish meal.

4.5.2.1.4 Exports of fish

Exports of fish included in 1973: tuna (190,802 tons), skip-jack (88,807 tons), lobster (56,044 tons), prawns (82,516 tons), dried shark fins (1,535 tons), and conch shells (101,415 pieces).

4.6.1 MINERAL RESOURCES

Sri Lanka's mineral resources are limited and cannot serve as the base for extensive industrial development. Nevertheless there are important mineral exports, including graphite, of which Sri Lanka is the world's largest producer, and a variety of gemstones. Deposits of limestone and silica sand serve as raw materials for the manufacture of cement, ceramics and glass.

After years of explorations petroleum deposits have been found on the northwest coast in a quantity estimated at 200 million tons. The first successful drilling operation is reported to have been conducted by an American firm in Palk Bay in mid-1976.

4.6.2 MINERAL WEALTH OF SRI LANKA

| MINERAL | OCCURRENCE | MINING/EXTRACTION METHOD | PRODUCTION | UTILIZATION |
|---|---|--|--|--|
| GEMSTONES: cordoned (sapphires and rubies), chrysoberyl (alexandrite and cat's eye), beryl (aquamarine), topaz, spinel, garnet, zircon, tourmaline, moonstone | -traditional gemming area in the southwest, within the upper catchment of the Kalu Ganga; new areas in Polonnaruwa District | winking of pits and panning of gem-bearing gravels extracted from them | 478,000 carats of precious and semi-precious gems in 1973 | export |
| GRAPHITE | vein deposits in the southwest of the island -- deposits said to be most productive in the world | mechanized deep mines of from 500 to 2,000 feet below surface | 10,413 tons | exported after dressing and grading, chiefly to Japan and the U.S.A. |
| MINERAL SANDS Ilmenite Rutile Zircon | black sand deposits at Pulmoddai, north of Trincomalee (east coast) worked for ilmenite, rutile and zircon -ilmenite deposits in black sands estimated at over 5 million tons | surface mining | export (1973): 85,638 long tons of ilmenite; 2,801 tons rutile; 100 tons zircon | exported |
| Monazite | seasonal concentrates along the west coast especially at Beruwela and Induruwa | extraction discontinued because of poor deposits | 10 long tons (1973) | |
| QUARTZ: pure white silica sand vein quartz | the area of Marawila-Nattandiya-Madampe (between Negombo and Chilaw on the west coast) | surface mining | | used in production of glass by the Ceylon Glass Company used in glass production by Lanka Glass Factory near Trincomalee |
| LIMESTONE | Jaffna Peninsula; Arukalu, north of Puttalam | surface extraction | 686,183 tons (1973) | cement manufacture at Puttalam Cement Works and Kankasanturai; purer crystalline deposits for lime manufacture dolomitic limestone: fertilizer and ceramics industries |
| FELDSPAR | | | 615 long tons (1973) | manufacture of glass and ceramics by Ceylon Ceramics Corp. and private firms; 27 tons exported (1973) |
| INDUSTRIAL CLAYS alluvial clays | occur in the flood plains of all major rivers, most extensive deposits in valleys of the Maha Oya, Kelani Ganga and Kalu Ganga | surface removal | estimated at several thousand tons per year | processed in local kilns for the manufacture of bricks and tiles, esp. in valleys of Maha Oya, Kelani Ganga and Kalu G. |
| kaolin | at Boralessgamuwa near Colombo (deposits of over 30 million tons); Meetiyagoda in Galle District | surface removal | 4,791 tons of refined kaolin produced in 1973 | manufacture of toilets, etc. by Ceylon Ceramics Corporation |
| clay for cement | large deposits at Murunkan and Ralmadu (north of Puttalam) | surface removal | 46,668 tons (Murunkan-1973) 21,800 tons (Ralmadu-1973) | used for manufacture of cement at Kankasanturai and Puttalam |
| SALT | driest regions: Elephant Pass (Jaffna); Hambantota; Puttalam; Talavi | evaporation of salt water in drying beds | quite varied: between 30,000 and 80,000 tons per year; 1974: 120,000 t | used locally |
| IRON ORE | about 2 million tons of easily accessible ore (from 30 to 54% metallic content) mainly in southwest region--there are superficial limonitic ores; northwestern region: banded iron ore deposits: about 5 million tons with 65% iron | NOT YET EXPLOITED potential surface mining potential deep mining | | |
| PEAT | nearly 40 million tons immediately northwest of Colombo; poorly drained | NOT EXPLOITED | | |
| APATITE | promising deposit near Eppawela in North-Central Province; possibly 20 million tons | NOT EXPLOITED | | would be used as raw material for manufacture of phosphate fertilizer and chemicals |

4.7 COASTS AND BEACHES

4.7.1 The resource

Sri Lanka is an island with nearly 1,100 miles of coastline, much of which is characterized by shifting sandbars and lagoons of varying extents, the most prominent of which are at Puttalam and Negombo on the west coast and Batticaloa on the east coast. Parts of the southwest coast are marked by drowned rivers, and cliffs front the sea north of Trincomalee on the east coast. Much of the coastline is fringed by coral reefs which, in conjunction with coastal vegetation, help to prevent coastal erosion. There are few good natural harbors, with the notable exceptions of Galle in the southwest and Trincomalee in the east, which is reputed to be one of the best natural harbors in the world. Colombo, the major port has an artificial harbor.

4.7.2 utilization

Fishing thrives along many areas of the coast (see 4.5.2.1.2); salt is produced by the evaporation of sea water (see 4.6.2); beach sands are important sources of minerals such as ilmenite, rutile and monazite (see 4.6.2); pearl fishing takes place along the Gulf of Mannar; tourist complexes are common along both the west and east coasts; colorful tropical fish are collected in the waters of coral reefs; old coral is dug up for processing into cement and lime; and in many areas coral reefs are blasted and coral extracted for the manufacture of lime.

4.7.3 dangers to coral reefs

- 4.7.3.1 Special attention must be given to the extraction of coral, a process which has had its most devastating effects along the east coast in the Batticaloa district, where it has been estimated that over half a million cubic feet of coral are removed annually, brought to kilns in a local village, and burnt into lime, which is then loaded into trucks and delivered to locations throughout the island for use as fertilizer in vegetable gardens. This operation, which in 1977 was still reported to be flourishing, despite a 1973 prohibition order under the Crown Lands Ordinance, and involves the collusion of enforcement officials such as the local police, has been called the most egregious example of the destruction of multiple national resources known anywhere in Sri Lanka.

The consequences of this activity on the local area are manifold and include:

- sea erosion resulting in: the disappearance of mangrove communities because of loss of their soil;
- the disappearance of small lagoons;
- the erosion of cultivated coconut land;
- the virtual cessation of fishing activity because of the reduction of the quantity of fish which can be caught by traditional methods;
- the disappearance of useful plants within a half a mile of the coast because of increasing salinity of the soil;
- a high level of salinity in local wells.

In addition, trees throughout the area of these operations have been felled to supply firewood for the kilns; this includes both mangroves and coconut trees.

- 4.7.3.2 The crown of thorns starfish, which is destructive of coral reefs, has been found in large numbers off the east coast of the island, especially in the reefs extending from Trincomalee to Pulmoddai. It has been suggested that the proliferation of these starfish could be attributed to pollution or to the reduction by intensive fishing of the fish predators on star fish eggs.

5.0 THE ECONOMY OF SRI LANKA

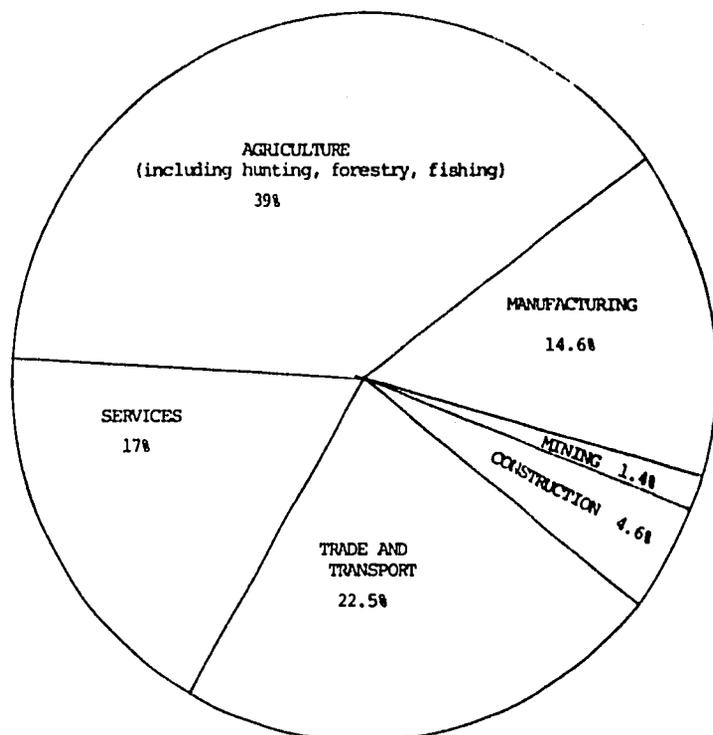
5.1 GENERAL ECONOMIC PICTURE

GNP: \$3.1 billion in 1976 (1976 prices) Per capita share of GNP: \$200

Real Growth Rate: 4.4% (1977); 3.0% (1976)

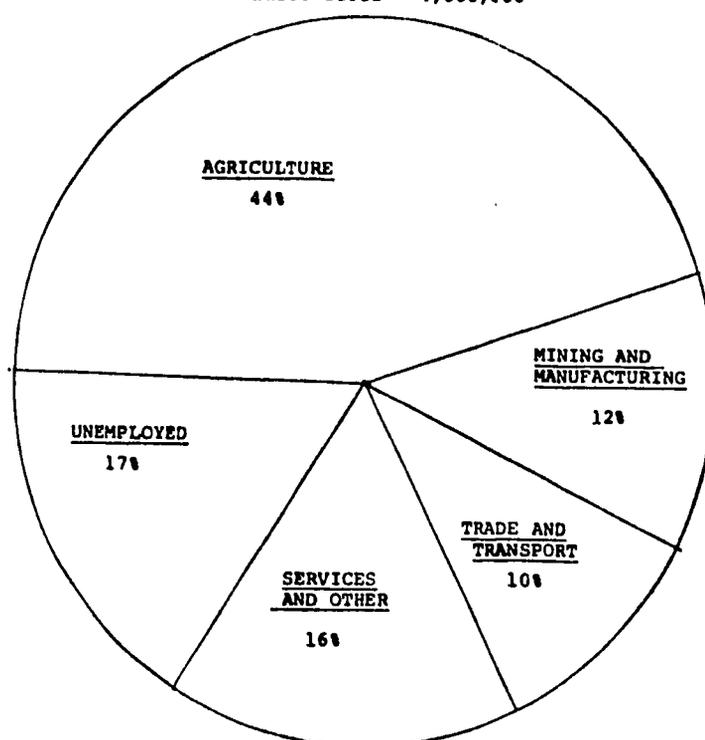
Monetary Conversion Rate: 16 rupees (Rs.16)=US\$1 (November 1977)

GROSS NATIONAL PRODUCT BY SECTOR (1975)



EMPLOYMENT IN SRI LANKA

labor force = 4,000,000



Sri Lanka's economy is basically agricultural; despite increases in industrial production in recent years, the country lacks the resource base necessary for large-scale industrial development. Through foreign exchange earned from its major crops (tea, rubber and coconut) Sri Lanka has been able to import a considerable percentage of its food needs (principally rice, wheat, and sugar); raise the standard of living for its people; improve social services; broaden the political base; and initiate land reform. Recent developments, coupled with Sri Lanka's continuing inability to meet its food needs, have put a serious strain on the Sri Lankan economy: a general decline (beginning in the 1950's) in world prices for its major crops; a rise in the prices of imported manufactured products and of the raw materials used in domestic industries; soaring petroleum prices; a decline in foreign investments following nationalization of the major estate holdings in the mid-1970's; a high level of unemployment; and inflation. These problems were severely aggravated when drought in the early and mid-1970's lowered the production of Sri Lanka's major export crops at the same time that foreign exchange was desperately needed to supplement domestic food production, also seriously reduced by drought conditions.

Government programs to improve the economic outlook include: creation of attractive conditions for foreign investment; expansion of local industry based on Sri Lankan raw materials; diversification of export crops; and major irrigation projects designed to bring more land under cultivation with the ultimate goal of meeting the country's food needs.

5.2 Agriculture

Agriculture is the dominant sector in the economic life of Sri Lanka. Agricultural activities are fairly sharply divided between "plantation" agriculture (the usual designation for land under permanent crops such as rubber, tea, and coconut--the major crops--and such minor crops as cocoa, cardamon, pepper and cinammon) and peasant agriculture which, above all, means rice production. Animal husbandry is not highly developed.

| <u>Agricultural Land Use in Sri Lanka (FAO-1975)</u> | |
|--|---------------------------|
| | <u>thousands of acres</u> |
| Arable land | 895 |
| Permanent crops (plantation): | 1,804 |
| Grasslands | 439 |

5.2.1 Plantation Agriculture

Plantation agriculture occupies about 54% of agricultural land or about 16% of the total land area of the island; it accounts, however, for the overwhelming bulk of Sri Lanka's exports. Because of the considerable processing undergone by tea, rubber, coconut and other plantation crops before export, plantation operations are often referred to as plantation industries; their activities come under the aegis of the Ministry of Plantation Industries.

Since 1971 most of the large plantations have become nationalized under the Ceylon State Plantations Corporation. The state now owns 63% of tea plantations, 33% of rubber plantations, and 10% of coconut plantations.

World market prices for Sri Lanka's major plantation crops have declined in the recent past, causing a serious drop in the country's intake of foreign exchange.

5.2.1.1 Plantation crops (see tables)

5.2.1.2 Measures to increase production in the plantation sector

fertilizers

Fertilizers are employed extensively in the productive of tea, rubber and coconut; for all three crops schemes are in effect to subsidize the use of fertilizers by farmers.

pesticides

Pesticides are employed to combat the various pests and fungi which attack all three major crops. The Tea Research Institute, the Rubber Research Institute and the Coconut Research Institute (all participate in the development and testing of control chemicals.

5.2.1.2 (cont.)

biological control

Biological control of the coconut caterpillar is carried out through the breeding and release of pest parasites; the Tea Research Institute is reported to be working on such methods for the control of tea plant pests such as live-wood termites.

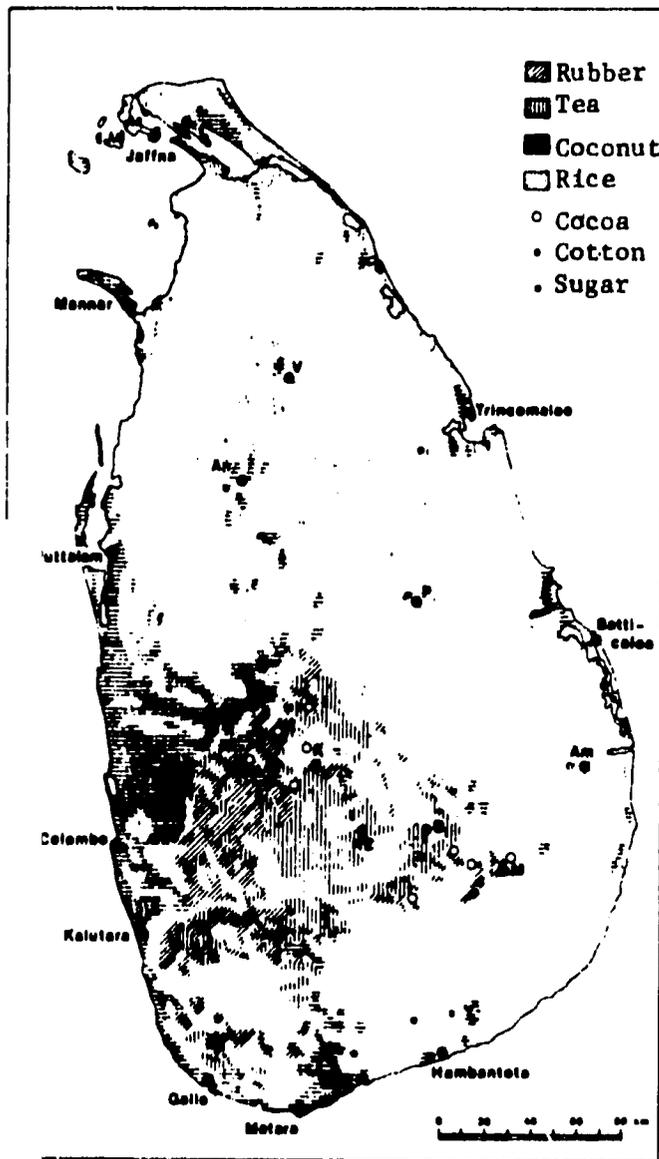
intercropping and replanting of unproductive lands

The planting of unproductive plantation land with alternative crops is also being encouraged. The Crops Diversification Subsidy Scheme, begun in 1970 on an experimental basis, is aimed at the replanting of uneconomic tea lands with coconut, cocoa, cardamon, mulberry (for silk production), lemon grass, cloves, nutmeg, pepper, pineapple, passion fruit, pasture, timber, rubber, and sugar cane; as of 1974 about 10,286 acres had been authorized for replanting, of which 3,176 had actually been replanted, chiefly with coconut, rubber, pepper, timber and cardamon.

Some coconut plantations are being intercropped with grasses suitable as cattle forage.

PLANTATION CROPS OF SRI LANKA

| CROP | Area of cultivation | acreage | % of ag. land | annual yield | types of holdings | ownership | processing | consumption |
|-------------------------|---|---------------------|---------------|---|---|--|---|---|
| Major crops TEA | wet zone, in areas of evenly distributed rainfall; elevations of up to 6,000 feet | 598,466 (1974) | 12% | 465.9 mil. lbs. (1973); 470.6 mil. lbs. (1972) | small (under 10 acres): 18.5% of holdings; estates (10-500 acres): 36% of holdings; estates (500 acres+): 45.6% of holdings | private ----- public (Tea Control Dept.) (about 63%) | extracting of juices, drying, etc. carried out on estates | about 95% exported |
| RUBBER | wet zone: lower slopes to the west and southwest of the central highlands; areas of evenly distributed rainfall and good drainage | 563,406 (1974) | 11.5% | 129,993 tons (1974); 152,232 tons (1973). | small (under 10 acres): 33% of holdings; estates (10-100 acres): 23% of holdings; estates (100 acres+): 23% of holdings | private ----- public (Rubber Control Dept) (about 33%) | processed principally into ribbed smoked sheet (60%); also: latex crepe, block rubber; processing carried out on estates | about 96% exported, chiefly to People's Rep. of China; in 1974, 6.141 tons consumed locally for the production of tires for both and bicycles, toys, mats, etc. |
| COCONUT | lowland areas of the wet zone, especially concentrated in the Coconut Triangle: Negombo, Kalutara, Kurunegala | 1,153,951 (1972) | 23.5% | 2,500 to 3,000 nuts per acre, depending on type of holding; estimated 2,500,000 in 1976 | small holdings and gardens: 75%; estates: 25% | private ----- public (about 10%) | processed on estates and in plants to produce: desiccated coconut, coconut oil; copra; also: coir (fiber), yard, rope and matting); liqueur and fermented drinks; vinegar | about 50% exported as fresh and desiccated coconut; remainder consumed domestically |
| Minor crops CINNAMON | principally along the southwest coast; concentrated in Galle and Matara | 48,678 acres | 1% | 50-160 lbs per acre | small holdings; few estates; usually grown in mixed coconut and cinnamon estates | private | -fermentation, skinning, re-fermentation, drying, rolling; little technical expense involved; some oil produced from chips and leaves | export |
| CARDAMON | wet zone; grows best in wet mountain forests at between 3000 and 5000 ft. | 11,000 acres | .2% | 40-360 lbs per acre | grown most often as supplemental crop on tea estates | private/ state | green-curing; drying by hot air or over a charcoal fire; also some chemical bleaching by sulfur-drying | 90-95% consumed domestically as curry spice |
| PEPPERS | wet zone; altitude of from 1200 to 1400 ft | 14,500 acres (1972) | .2% | not known | cultivated exclusively as intercrop in gardens or on tea estates | private/ state | not known | domestic consumption |
| COCOA | wet zone; good conditions in the lower areas of the central highlands where rubber is grown | 24,215 acres (1972) | .5% | 2,204.6 tons (1974-1976) | cultivated as intercrop in gardens as well as in small rubber and coconut holdings | private | not known | export (about 0.5% of total); some consumed by small domestic chocolate industry |
| COFFEE | wet zone (in Kandy and Matale)--the major export crop in the 19th century | 11,600 | .2% | 9,207 tons (1974-1976) | a garden crop | private | not known | domestic consumption covers about 1/3 of domestic demand |



Areas of most important crops

Source: Domrös (1976)

5.2.2 Small-scale (subsistence) Agriculture

5.2.2.1 Rice production (paddy cultivation)

Rice is the chief crop of the subsistence sector of the Sri Lankan agricultural economy. In 1976, approximately 1,568.1 million acres were estimated to be under rice cultivation, mostly on small holdings of two acres or less. The major rice growing areas are in the dry zone.

dry zone

Dry zone agriculture is dependent on irrigation as well as on rainfall. In the maha season (between October and February/March), when rainfall is heaviest, the major period of cultivation occurs, and although by far the largest quantity of rice is grown under irrigation, rainfed production is also possible at this time. In the yala season (April to August), when rainfall is low, cultivation is dependent almost entirely on irrigation.

Rice acreage in the dry zone 1973/74

| | <u>maha</u> | <u>yala</u> | <u>total acreage in course of year</u> |
|--|----------------|---------------|--|
| <u>Major irrigation</u> (large schemes, etc.) | 392,000 | 285,000 | 650,000 |
| <u>Minor irrigation</u> (village tanks, etc.) | 227,000 | 82,000 | 309,000 |
| <u>Rainfed</u> | <u>285,000</u> | <u>43,000</u> | <u>28,000</u> |
| TOTAL | 904,000 | 382,000 | 1,287,000 |

wet zone

In the wet zone, where too much rainfall is more often a problem than too little, paddy cultivation takes place during both the maha and yala seasons, mostly under rainfall, although in drier areas some water is supplied by minor irrigation works. However, the wet zone offers only limited area for paddy cultivation, since most of the land is utilized for plantation crops or urban settlements.

5.2.2.1.1 increasing rice production

Since independence, Sri Lanka has succeeded in increasing its food production considerably; whereas land under rice had stood at about 914,000 acres in 1946, it had increased to about 1,568,100 acres by 1976, mostly in small holdings of two acres or less. Rice production was adversely affected by drought in the early and mid-1970's, and Sri Lanka has, therefore, generally remained quite heavily dependent on rice imports to meet its rice needs (about 30% or 377,000 tons in 1973). For the 1977-78 maha season, however, the government has reported a bumper crop of 61,626,000 bushels (as compared with 54 million in 1976), an average of 53 bushels per acre for the country as a whole, and running as high as 84.6 bushels per acre in some areas.

So confident has the Sri Lankan government become in the continued success of its efforts to increase rice production, that it recently announced that rice imports would be discontinued after 1979. Furthermore, it announced that in November 1978 about 8,700 long tons of rice would be exported to Indonesia--the first Sri Lankan rice export in 232 years.

5.2.2.1.1 (cont.)

Increased rice production has been attributed to several factors:

- the use of fertilizers;
- the use of weedicides and pesticides;
- use of modern machinery to plough and clear lands;
- irrigation, which has permitted:
 - double cropping in areas of the dry zone where previously only single-cropping had been possible;
 - the opening up for rice cultivation of previously uncultivated land.

5.2.2.1.2 Irrigation schemes and their environmental effects

Irrigation has been practiced in the dry zone of Sri Lanka in varying degrees since the third century B.C. Irrigation schemes involve the damming of streams and rivers to form reservoirs (tanks), the diversion of rivers into reservoirs, or the diversion of rivers for continuous-flow irrigation. Recent development of the dry zone has involved the reopening of irrigation works which had fallen into disrepair, but for the extensive agricultural land development which figures so prominently in Sri Lanka's plans to achieve food self-sufficiency, major multi-purpose scheme involving not only irrigation water but also hydroelectric power production and flood control are of overwhelming importance.

Important irrigation schemes involve the Gal Oya River, the Uda Walawe River, and the Kelani Ganga, among others, but by far the most ambitious project is the Mahaweli Ganga Project, which involves the diversion of water from Sri Lanka's largest River in order by the year 2000 to provide water for 900,000 acres of land, 650,000 of which are presently undeveloped. Stage I, which supplies water to about 130,000 acres of existing irrigated land, is complete, while Stage II, which will involve the irrigation of some 60,000 acres of already irrigated land and provide water for about 40,300 new acres, is well underway. This phase of the project, which calls for the transbasin diversion of water into the Kala Oya basin, also entails the settlement of 14,000 new families into the project area, already occupied by about 25,000 families.

The impacts of the project, here taken to be indicative of the environmental effects of other dry zone major irrigation schemes, are expected to be on: public health; soils and agricultural practices; water and its quality; the flow of the Mahaweli Ganga; and flora and fauna both within and outside of the project area.*

public health

The project is expected to increase the incidence of malaria by providing new breeding grounds for mosquitoes. The incidence of waterborne diseases is also expected to increase, especially if proper sanitation is not practiced by the increased population in the area. Although measures can be taken against these potential effects, precautionary measures such as the boiling of water for domestic use may become increasingly difficult

*See Weatherly and Arnold (1977) for a detailed assessment.

5.2.2.1.2 (cont.)

because of the shortage of firewood. Unless they are applied properly, pesticides used in the project, are expected to lead to a certain amount of pesticide poisoning.

water and its quality

The quality of water is expected to be affected by the increased use of both pesticides and fertilizers; this will have its impact not only on human health but also on the fish in irrigation tanks and on wildlife not only within the project area but also in nature reserves on its fringes.

Increased use of irrigation water is also expected to lead to a rise in the water table with possible waterlogging and increase in soil salinity. However, seasonal rainfall is expected to flush excess salts from the soil, and it is felt that waterlogging can be controlled through well-managed use of irrigation water. It is also felt that the heightened water table and the consequent increase in underground water even on the higher slopes, will permit a certain supply of water to the relatively shallow wells used to supply domestic water for the project.

soil

The agriculture presently practiced in the area targeted for development under the Mahaweli Project, Phase II (see 5.2.2.3 in this connection) permits only a minimal amount of soil erosion. The clearing of land for development and the more intense working of upland areas that are particularly susceptible to soil erosion are expected to increase soil erosion in the area considerably.

deforestation

Clearing of land for development will mean the removal of large forested areas presently used for firewood supplies.

the effects on the flow of the Mahaweli Ganga and the Kala Oya

The diversion of water from the Mahaweli Ganga will cause a decrease in the flow of that river and a concomitant increase in the flow of the Kala Oya, the catchment area receiving the diversion waters. With the decrease in flow of the Mahaweli Ganga, salt water will penetrate further up the estuary at the river's mouth, causing changes in vegetation; there may also be detrimental effects on endemic fish in lowland pools normally recharged by the river during flood. In the Kala Oya, on the other hand, freshwater will penetrate further down the estuary, expanding the territory of animals and plants dependent on freshwater riverine habitats and reducing the territory available for salt tolerant species such as mangroves and animal life associated with them.

effects on wildlife (see 4.4.6.3.2)

5.2.2.1.3 possible problems with irrigation efforts

Rapid siltation of river beds and irrigation reservoirs is a problem in areas of the country where the surface flow of rivers is rapid and substantial and where indiscriminate clearing of land has led to soil erosion.

Drought and the felling of forests with large waterholding capacities could lead to a serious reduction of the water available for irrigation schemes. There is some evidence that clearing of forest land has already had adverse effects on river flow (see 4.2.3).

5.2.2.1.4 water wastage and the need for efficient water management

It has been pointed out (see Chambers[1975]) that in Sri Lanka the limiting factor in agricultural development is not the unavailability of land so much as the availability of water. Robert Chambers has argued that present methods of water distribution in major irrigation schemes (those which come under bureaucratic control) encourage the wastage of valuable irrigation water and that better water management, in conjunction with other administrative policies, could lead to increased production, possibly even help to close the gap between food needs and food production, without the investment in expensive new irrigation schemes.

5.2.2.2. Gardens

Gardens of various sorts are cultivated throughout Sri Lanka, distributed over about 9% of the total land area of the country. In the wet zone, the gardens growing among the houses and huts of towns and villages produce a great abundance of fruits such as bananas, papayas, bread fruit, and mangoes and vegetables such as taro, cassava, tomatoes, as well as onions cucumbers, squash and beans. Gardens in the dry zone are less luxuriant in their growth, producing bananas, papayas, and citrus fruit and limited in their vegetable yield chiefly to cassava.

In addition to these more typical gardens, which are intended chiefly for consumption by their owners, are those vegetable gardens whose produce is intended for the market. In the lowlands these yield cassava, sweet potatoes, chillies, onions, and beans, while in the central highlands there grow potatoes, cabbage, red beets, carrots, leeks, tomatoes and onions.

Emphasis on the produce from such gardens was especially strong during the worst period of food shortages in the early 1970's. Plantings and yields, especially of cassava, were increased considerably during that time.

5.2.2.3 Chena (see map, page 63)

In chena, or shifting cultivation, land is cleared, worked for a few years until it loses its fertility, and then allowed to lie fallow for a long period of time. In 1961 it was estimated that about 1.6 million acres of land were used for this type of cultivation, predominantly in the dry zone, although a limited amount of chena is practiced in a small and geographically concentrated area of the wet zone as well.

Traditionally chena has been practiced by peasants to supply their own food needs and to supplement rice agriculture. Land is cleared and burned at the end of the rainy season, plantings follow in September and November, and the harvest follows in January and February. During such maha (rainy season) chena, crops are not tended, and yields usually depend on the strength of the rains. Little chena is practiced during yala, except in areas of heavy rainfall. Crops grown on chena lands are: dry or mountain rice; corn; sorghum; kurakkan and cucumbers; squashes; herbs; legumes; and cassava.

Chena has traditionally been practiced on state-owned (Crown) lands, where farmers, for a minimal fee, are given permits to work from about one to two acres per applicant. A significant number of such chenas are worked without such permission, however.

Some recent developments in chena agriculture have been the use of fertilizers and even agrochemicals in order to extend the life of the chena and the keeping of chenas primarily for the production of cash crops such as chillies. Traditionally chena lands were utilized for about one to two years and allowed to lie fallow for about 20. This period is becoming increasingly shorter due to population pressure and the consequent shortage of suitable land.

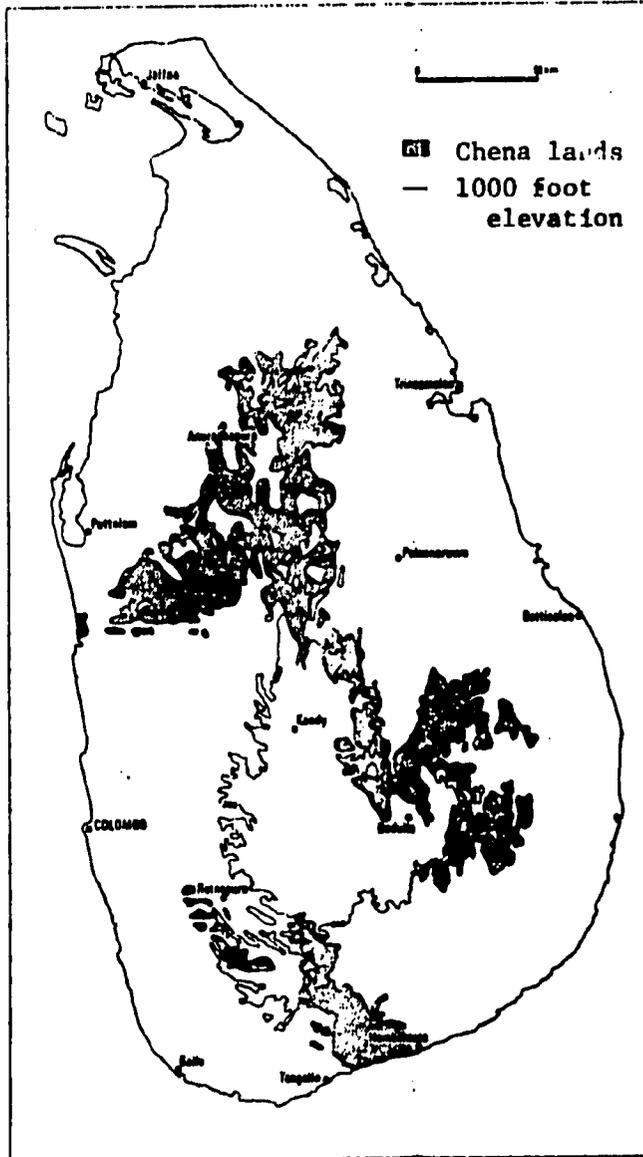
soil erosion and chena agriculture

Certain features of traditional chena agriculture, including a minimal amount of land preparation by ploughing and turning of soil and only a limited amount of weeding, have meant that soils under chena agriculture have been only minimally subject to the erosive effects of heavy rainfall. However, certain changes in practices could lead to erosion problems. For example, in areas where population pressures have caused the fallow period to drop from twenty to twelve or even ten years the threat of decreased productivity resulting from over-utilization could lead chena cultivators to the use of more modern agricultural practices, including the use of agrochemicals. The increased intensity and duration of cropping thus permitted is expected to lead to greater erosion problems in chena areas.

Special pressures on chena land are expected to occur on the scrubland fringes of large irrigation projects, where project settlers, wishing to follow the traditional paddy-chena agricultural combination, are likely to compete with existing chena farmers, thus causing over-utilization of the scrub jungle adjoining the project area and resulting in land degradation.

negative effects of chena agriculture

Chena agriculture has distinct environmental disadvantages, specifically the exploitation and deforestation of woodlands and the resulting degradation of woodlands to secondary forests and eventually to savannas.



DISTRIBUTION OF CHENA AGRICULTURE

Source: Domrbs (1976)

5.2.3 Animal Husbandry

5.2.3.1 Present situation

Animal production has played an unimportant economic role in Sri Lanka. Cattle and water buffalo have functioned above all as draft animals, and elephants are occasionally used as work animals (about 1,200 to 1,500 working elephants in 1976).

Livestock [1962 and 1976] and food and skins production [1976]

Livestock (in thousands)

| | 1962 | 1976 (t=metric tons) | | | | |
|----------|-----------|----------------------|-------------|-------|-------|---------|
| | | nos. | slaughtered | meat | milk | eggs |
| Buffalo | 597,481 | 854,000 | 40,000 | 6 t | 45 t | 5,940 t |
| Cattle | 1,363,785 | 1,744,000* | 240,000 | 137 t | 147 t | |
| Goats | 309,906 | 562,000 | 137,000 | 1 t | 5 t | 205 t |
| Sheep | | 30,000 | 7,000 | n/a | | 14 t |
| Pigs | 56,184 | 36,000 | 20,000 | 1 t | | |
| Chickens | n/a | 5,700,000 | n/a | 10 t | | 16 t |
| Ducks | n/a | 14,000 | n/a | | | |

*includes 350,000 milk cows

The general increase in the numbers of livestock shows the effect of a government program, initiated in 1962, to expand government livestock farms, thereby increasing the availability of upgraded breeding stock, particularly of cattle and buffalo for draft and milk purposes, but also of poultry, pigs, goats and sheep. Incentives for milk producers have been offered in the form of higher prices for milk delivered to government sterilizing, processing and packaging plants. The opening of the first condensed milk factory in Polonnaruwa in April 1968 gave a considerable boost to milk production.

Reasons for the low production of animals relate particularly to religious objections by various groups: Buddhists are opposed to animal slaughter; Moslems reject pork; and Hindus consider cattle to be sacred animals. Furthermore, the natural grasses of Sri Lanka's grasslands and savannas are not of high value for grazing purposes, the best natural grazing lands reputed to be on the lower course of the Mahaweli Ganga. The FAO estimate for 1975 is about 1,100,000 acres of grazing land.

5.2.3.2 Programs for increasing livestock production

Government programs have identified grasses suitable for animal forage in Sri Lanka both in the dry regions and in cooler mountain areas. Furthermore, because native cattle are not suitable for large-scale milk production, Jersey cattle and breeding bulls have been imported and to some extent interbred with native cattle. Government farms and project promote milk production. In addition, Brachyaria miliformis has been

5.2.3.2 (continued)

identified as a forage plant suitable for intercropping with coconut palms, and planting is underway.

5.2.3.3 MAB Program

Under the Man and the Biosphere (MAB) project "Impact of human activities and land use practices on grazing lands," Sri Lanka is also experimenting on using the natural grasses of the dry hilly areas of the country for grazing. About 160,615 acres are available at altitudes between 2,500 and 5,000 feet; this is land which is not suitable for agriculture because of the amount and distribution of rainfall and because of the pattern of evapotranspiration in relation to soil moisture. The focus of the program is on the establishment and proper management of permanent pastures based on adapted, drought-resistant herbage. The study, concentrated on a project area in Bandarawela District, will examine the productivity of native grasses, evaluate the productivity and feeding value of selected species, and analyze the effects of pasture management on system stability, with particular attention to nutrient losses, soil organic matter status, erosion control, and water holding capacity. Cattle and sheep grazed on this land will be examined as to their weight gains and their economic profitability for beef and mutton production.

5.3 INDUSTRIAL PRODUCTION

Systematic industrial development in Sri Lanka did not begin until after independence in 1948 and has been concentrated chiefly on the production of consumer goods.

The chief groups of manufactured products are:

| | |
|---|--------------|
| food, beverages, tobacco: | 35% of total |
| textiles, wearing apparel, leather products: | 20% of total |
| rubber and plastic products: | 25% of total |

Other areas are the production of appliances and various metal products.

Most industrial employment is provided by the private sector, which still dominates production (about 75-80%) with a relatively small number of large-scale and well-organized factories and industries and a large number of smaller-scale industries such as workshops, cottage industries and handicraft operations. Small scale industries in the private sector employ about 65% of the industrial work force.

Heavy industry is limited to a few large state-owned firms producing cement, chemicals, steel and petroleum products. The public sector represents from 17-20% of industrial production and employs about 10% of the industrial workforce.

Sri Lanka has made an effort to develop industries based on locally available raw materials, but the bulk of industry, especially in the private sector, remains highly dependent on imported raw materials for its products.

Geographically, industry has tended to be concentrated in the southwest province in the area of Colombo, but the government has recently attempted to spread industrial development to other regions of the country.

5.3.1 Industry and pollution (see table, page 67)

The table indicates state-owned firms recently reported as major polluters of the Sri Lankan environment. No data on pollution from the private sector was found, but it is to be expected that private sector operations such as chemical production, textile production, food processing, and the manufacture of paper could lead to pollution, while these and other activities demand large quantities of water for their manufacturing processes.

The potential indiscriminate use of natural resources to increase industrial production is also a threat; the operations of the Ceylon Plywood Corporation in the Sinharaja tropical rain forest have been considered above (see 4.2.2.4).

INDUSTRIAL OPERATIONS AND POLLUTION IN SRI LANKA

| Industry | Location | Ownership | Production/Output | Source of Raw Materials | Pollution | Controls |
|---------------------------------|--------------------------------|-----------|--|--|---|---|
| Ceylon Cement Corporation | Kankasanturai, Puttalam, Galle | state | Combined production of 417,815 tons in 1973; 474,000 tons in 1974; meets S.L. demands for concrete; 5,000 tons exported in 1973 | Sri Lankan limestone: Jaffna Peninsula and Aruwakulu | Plants at Kankasanturai and Puttalam reported to be polluting with kiln dust | plants have been ordered to install electrostatic precipitators |
| Sri Lanka Tire Corporation | Kelani | state | truck tires, agricultural tires, car and jeep tires, tubes | Sri Lankan rubber; oil based raw materials (important) | not known | not known |
| Paranthan Chemical Corporation | Paranthan | state | manufacture and sale of caustic soda, chlorine, hydrochloric acid, table salt; byproducts such as ferric chloride, zinc | Sri Lankan salt, imported materials | has emitted into the environment, chlorine originally intended for DDT manufacture | not known |
| Ceylon Petroleum Corporation | Colombo | state | produces fuel oil, naphtha, bunker fuels, marine diesel, marine lubricants, aviation gasoline and turbine fuel; refinery produced 1,672,000 tons of refined products in 1973 | imported crude oil | sulfur dioxide emissions | not known |
| National Textile Corporation | Veyangoda, Thalhiriya, Pugoda | state | mills perform spinning, weaving, finishing; production of yarn and cloth | imported raw cotton from Egypt (14,043,336 lbs. in 1973) | untreated alkali and sizing effluents | not known |
| Spray Dried Milk Factory | Aabewela | state | powdered milk | National Milk Board dairies | alkali and milk washings enter water supply of neighboring villages | not known |
| Eastern Paper Mills Corporation | Valsichenai | state | production capacity of 22,500 tons per year; 19,338 tons of paper products in 1973 | straw(major raw material): S.L. sources; waste paper | alkali and particulate wastes from the plant said to be destroying the aquatic environment along the eastern coast in the vicinity of the plant | not known |

FUELS FOR DOMESTIC USE

| | utilization | source of supplies | consumption levels | costs involved |
|-------------------------------|---|--|---|---|
| FIREWOOD | cooking and boiling of water are major uses | local forests; scavenging; market sales in Colombo, Jaffna, and Kandy; little being done in the way of reforestation programs for firewood, but some development schemes include village forests | no exact figures, but an estimated 4-5 million tons burned in 1975; in 1970 over 94% of the population relied on firewood, burning an estimated 1/3 to 2/5 tons per capita per year | in rural areas cheaper than kerosene and LPG; costs of transport involved for other areas; no capital investment involved for cooker |
| KEROSENE | cooking and lighting; also used for small industrial boilers, glass manufacturing, tea drying, etc. | produced by Ceylon Petroleum Corp. from imported petroleum; about 57 millions gallons per year produced | 90% of population uses it for lighting; less than 9% of total rural population use it for cooking; about 3.3 gallons per capita per year | presently sold at prices below cost of production; price of cooker, lamp |
| ELECTRICITY | cooking, lighting, motors, radios, etc. | mostly hydroelectric power (see 4.2.2.1) | under 10% of household have access, with an average use of about 30 kilowatt hours per year per connected family; in 1975 an estimated 1050 kilowatt hours were generated | because of large amount of hydroelectric power, electricity is cheaper than kerosene, but costs of hookups, etc., especially in rural areas is high, and investment in cookers, etc. is also costly |
| PADDY HUSK | provide fuel suitable for cooking or boiling water; presently used in rice milling | byproduct of rice production | not known; stoves have been developed, but too large for home use | negligible for husk but high for adequate stove |
| SAWDUST | cooking, boiling water | byproduct of timber operations; available mostly in timber areas | not known; but cookers are available and in fairly wide use | sawdust is cheap; low price cookers available |
| DUNG | cooking, boiling water | animal manure | not known for Sri Lanka; from one to one and one half water buffalo needed to provide fuel of family of six for cooking for one year | cheap |
| LPG (liquid petroleum gas) | cooking, boiling water | produced by Ceylon Petroleum Corporation | not known; average family would consume a 18 kg cylinder in 2.5 to 3 weeks | more expensive than kerosene; higher initial investment in stove |

OTHER POSSIBILITIES: **BIOGASIFICATION:** experiments with biogasification, which involves the generation of methane from an input of human and animal wastes as well as kitchen refuse and dry leaves, is taking place under the Industrial Development Board. Fuel production would be relatively inexpensive but initial investment in facilities would be high. No practical results of present investigations expected until the 1980's.

SOLAR ENERGY: could be used for distillation of water and cooking; best possibilities in certain dry zone areas; a demonstration project on the use of solar energy in Sri Lanka is planned under the United Nations Environment Program.

WIND (AEOLIAN) ENERGY: experimentation on the use of windmills for power production is being carried out under the auspices of the United Nations Environment Program.

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Colombo. Usually about one or two issues per year.

The best source for information on conservation and environmental degradation, especially as it related to animal and plant life.

Tropical Agriculturist: Agricultural Journal of Ceylon. Published by the Department of Agriculture, Peradeniya. Quarterly.

APPENDIX A: Animals protected under the Fauna and Flora Protection Ordinance

TABLE I

List of Animals Absolutely Protected During Both the Close and the Open Seasons

| Class | Order | Scientific name | English name | |
|-------------------------|--|---|------------------------------------|-----------------------|
| Mammalia | Insectivora | <i>Feroculus feroculus</i> | Long-clawed shrew | |
| | | <i>Suncus etruscus fellowes-gordoni</i> | Ceylon Pigmy Shrew | |
| | | <i>Suncus murinus zeylanicus</i> | Ceylon Jungle Shrew | |
| | | <i>Crocidura miya</i> | Long-tailed Shrew | |
| | | <i>Crocidura horsfieldi</i> | Horsfield's Shrew | |
| | | <i>Solisorex pearsoni</i> | Pearson's Shrew | |
| | | Chiroptera | <i>Rousettus seminudus</i> | Ceylon Fruit-bat |
| | | | <i>Murina cyclotis eileenae</i> | Ceylon Tube-nosed Bat |
| | | Primates | <i>Kerivoula hardwicki malpasi</i> | Malpasi's Bat |
| | | | <i>Loris tardigradus</i> | Slender Loris |
| Pholidota | <i>Presbytis senex monticola</i> | * Bear Monkey/Hill Wanderer | | |
| | <i>Manis crassicaudata</i> | Indian Pangolin | | |
| Rodentia | <i>Petaurista petaurista lanka</i> | Gray Flying-squirrel | | |
| | <i>Petinomys fuscocapillus layardi</i> | Small Ceylon Flying-squirrel | | |
| | <i>Ratufa macroura macroura</i> | Highland Giant Squirrel | | |
| | <i>Tatera indica ceylonica</i> | Ceylon Gerbil/Antelope Rat | | |
| | <i>Bandicota bengalensis gracilis</i> | Lesser Bandicoot Rat/Mole Rat | | |
| | <i>Mus fernandoni</i> | Ceylon Spiny Mouse | | |
| | <i>Mus mayori mayori</i> | Highland Spiny Rat | | |
| | <i>Mus mayori pococki</i> | Bicoloured Spiny Rat | | |
| | <i>Rattus montanus</i> | Milnu Rat | | |
| | Carnivora | <i>Paradoxurus zeylonensis</i> | Golden Palm Civet | |
| <i>Felis rubiginosa</i> | | Rusty-spotted Cat | | |
| <i>Felis viverrina</i> | | Fishing Cat | | |
| Sirenia | <i>Dugong dugon</i> | * Dugong | | |
| | <i>Axis porcinus porcinus</i> | Hog Deer | | |
| Artiodactyla | <i>Equus caballus</i> | Delft Island Pony | | |
| Reptilia | Testudinata | <i>Dermochelys coriacea</i> | * Leathery Turtle | |
| | | <i>Lepidochelys olivacea olivacea</i> | Olive-back Loggerhead | |
| | | <i>Caretta caretta gigas</i> | Giant Brown-red Loggerhead | |
| | | <i>Eretmochelys imbricata</i> | * Hawksbill Turtle | |
| Squamata | | <i>Chelonia mydas</i> | Green Turtle | |
| | | <i>Testudo (Geochelone) elegans</i> | Starred Tortoise | |
| | | <i>Varanus monitor</i> | * Water Lizard/ Water Monitor | |

NOTE I: * indicates animals on the list of "Endangered and Threatened Wildlife and Plants" published by the Fish and Wildlife Service of the U.S. Department of the Interior

NOTE II: the Asian Elephant (*Elephas maximus*) is absolutely protected under Article 12 of the Fauna and Flora Protection Ordinance, as are all deer and fowl during the close season.

NOTE III: the following animals appear on the list of "Endangered and Threatened Wildlife and Plants" of the Fish and Wildlife Service of the U.S. Department of the Interior as endangered or threatened in Sri Lanka but do not appear on the Sri Lankan lists of protected species:

| English name | Sci. name |
|------------------|-------------------------------|
| Langur, entellus | <i>Presbytis entellus</i> |
| Toque macaque | <i>Macaca sinica</i> |
| Indian python | <i>Python molurus molurus</i> |
| Bengal monitor | <i>Varanus bengalensis</i> |

TABLE II

List of birds not protected during the open season (all others are absolutely protected) **

| English name | Scientific name |
|-------------------------------------|---|
| Ceylon Spotted Dove | <i>Streptopelia chinensis ceylonensis</i> |
| Indian Ring Dove | <i>Streptopelia decaocto decaocto</i> |
| Ceylon Wood Pigeon | <i>Columba torringtoni</i> |
| Blue Rock-Pigeon | <i>Columba livia intermedia</i> |
| Bronze-Winged or Emerald Dove | <i>Chalcophaps indica robinsoni</i> |
| Green Imperial Pigeon | <i>Ducula aenea pusilla</i> |
| Ceylon Orange-Breasted Green Pigeon | <i>Treron bicincta leggei</i> |
| Pompadour Green Pigeon | <i>Treron pompadora pompadora</i> |
| Ceylon Southern Green Pigeon | <i>Treron phoenicoptera philippai</i> |
| Common/Fantail-Snipe | <i>Capella gallinago gallinago</i> |
| Pintail Snipe | <i>Capella stenura</i> |
| Wood Cock | <i>Scolopax rusticola</i> |
| Jack Snipe | <i>Lunocryptes minimus</i> |
| Wood Sandpiper | <i>Pringa gareola</i> |
| Black-Tailed Godwit | <i>Limosa limosa limosa</i> |
| Curlew | <i>Numenius arquata orientalis</i> |
| Whimbrel | <i>Numenius phaeopus phaeopus</i> |
| Eastern Golden Plover | <i>Pluvialis dominica fulva</i> |
| Grey Plover | <i>Squatarole squatarola</i> |
| Painted Snipe | <i>Rostratula benghalensis benghalensis</i> |
| Watercock | <i>Gallinix cinerea</i> |
| Ceylon Bustard-Quail | <i>Turnix suscitator leggei</i> |
| Blue-Breasted Quail | <i>Excalfactoria chinensis chinensis</i> |
| Cotton Teal | <i>Nettapus coromandelianus coromandelianus</i> |
| Shoveller | <i>Spatula clypeata</i> |
| Pintail | <i>Anas acuta acuta</i> |
| Garganey | <i>Anas querquedula</i> |
| European Teal | <i>Anas crecca crecca</i> |
| Whistling Teal | <i>Dendrocygna javanica</i> |

** includes the Red-faced Malkoha (*Phaenicophaeus pyrrocephalus*)

TABLE III

List of animals not to be shot except on a special license at any time of the year

| English name | Scientific name |
|---|---------------------------------------|
| Leopard | * <i>Panthera pardus fusca</i> |
| Ceylon Bear | <i>Melursus Ursinus</i> |
| Ceylon Swamp-Crocodile | * <i>Crocodylus palustris kimbala</i> |
| Marsh-Crocodile or Estuarine or Sea-Crocodile | <i>Crocodylus porosus Schneider</i> |

TABLE IV

List of plants absolutely protected by law in Sri Lanka

| English name | Scientific name |
|-------------------------------|--------------------------------|
| Primrose Orchid | <i>Dendrobium heterocarpum</i> |
| Wesak or May Orchid | <i>Dendrobium maccarthiae</i> |
| Daffodil Orchid | <i>Ipsa speciosa</i> |
| Foxtail Orchid | <i>Rhynchostylis retusa</i> |
| [orchid family--no Eng. name] | <i>Vanda spathulata</i> |
| Anuradhapura Orchid | <i>Vanda tessellata</i> |
| Madara Tree | <i>Clistanthus collinus</i> |
| Baobab Tree | <i>Adansonia digitata</i> |
| Sphagnum moss | <i>Sphagnum zeylanicum</i> |

LIST OF NATIONAL COMMITTEES FOR THE MAN AND THE BIOSPHERE (MAB) PROGRAMME

- Chairman Prof. B.A. ABEYWICKREMA,
Department of Botany,
University of Sri Lanka,
Colombo Campus,
Colombo.
- Secretary Mrs. S.P. PRELIS,
National Science Council of Sri Lanka,
47/5 Maitland Place,
Colombo 7.
- Members Dr. G.C.N. JAYASURIYA,
Secretary-General,
National Science Council of Sri Lanka,
47/5 Maitland Place,
Colombo 7.
- Prof. R.R. APPADURAI,
Dean,
Faculty of Agriculture,
University of Sri Lanka,
Peradeniya Campus
Peradeniya.
- Mr. L.C.A. de S. WIJESINGHE,
Senior Asst. Conservator of Forests,
Forest Department,
Kew Road,
Colombo 2.
- Mr. E.E. JEYARAJ,
Head, Industrial Microbiology Section,
Ceylon Institute of Scientific & Industrial
Research,
Baudhaloka Mawatha,
Colombo 7.
- Prof. K.N. SENEVIRATNE,
Head,
Department of Physiology
Faculty of Medicine,
University of Sri Lanka,
Kynsey Road,
Colombo 8.
- Mr. A.S.A. PACKEER,
Deputy Director,
Department of Wild Life,
54 Chatham Street,
Colombo 1.

Dr. W.P.T. de SILVA,
Department of Geography,
University of Sri Lanka,
Colombo Campus,
Colombo.

Mr. A.M. RANAWEERA,
Chief Education Officer,
Curriculum Development Centre,
Baudhaloka Mawatha,
Colombo 7.

Sub-Committees

Sub-Committee on Forestry & Forest Ecology

Chairman Mr. W.R.H. PERERA,
Conservator of Forests,
Forest Department,
Kew Road,
Colombo 2.

Sub-Committee on Environment Pollution & Pollution Control

Chairman Mr. E.E. JEYARAJ,
Head, Industrial Microbiology Section,
Ceylon Institute of Scientific & Industrial Research
Baudhaloka Mawatha,
Colombo 7.

Sub-Committee on Education & Training in Environmental Studies

Chairman Prof. B.A. ABEYWICKREMA,
Department of Botany,
University of Sri Lanka,
Colombo Campus,
Colombo 3.

Sub-Committee on Grassland Ecosystems

Chairman Prof. R.R. APPADURAI,
Dean, Faculty of Agriculture,
University of Sri Lanka,
Peradeniya Campus,
Peradeniya.

Sub-Committee on Impact of Human Activities on Natural Ecosystems

Chairman

Prof. K.N. SENEVIRATNE,
Head, Department of Physiology,
Faculty of Medicine,
University of Sri Lanka,
Colombo Campus,
Colombo.

Official correspondence address: all official correspondence relating to the
MAB Programme should be addressed to:

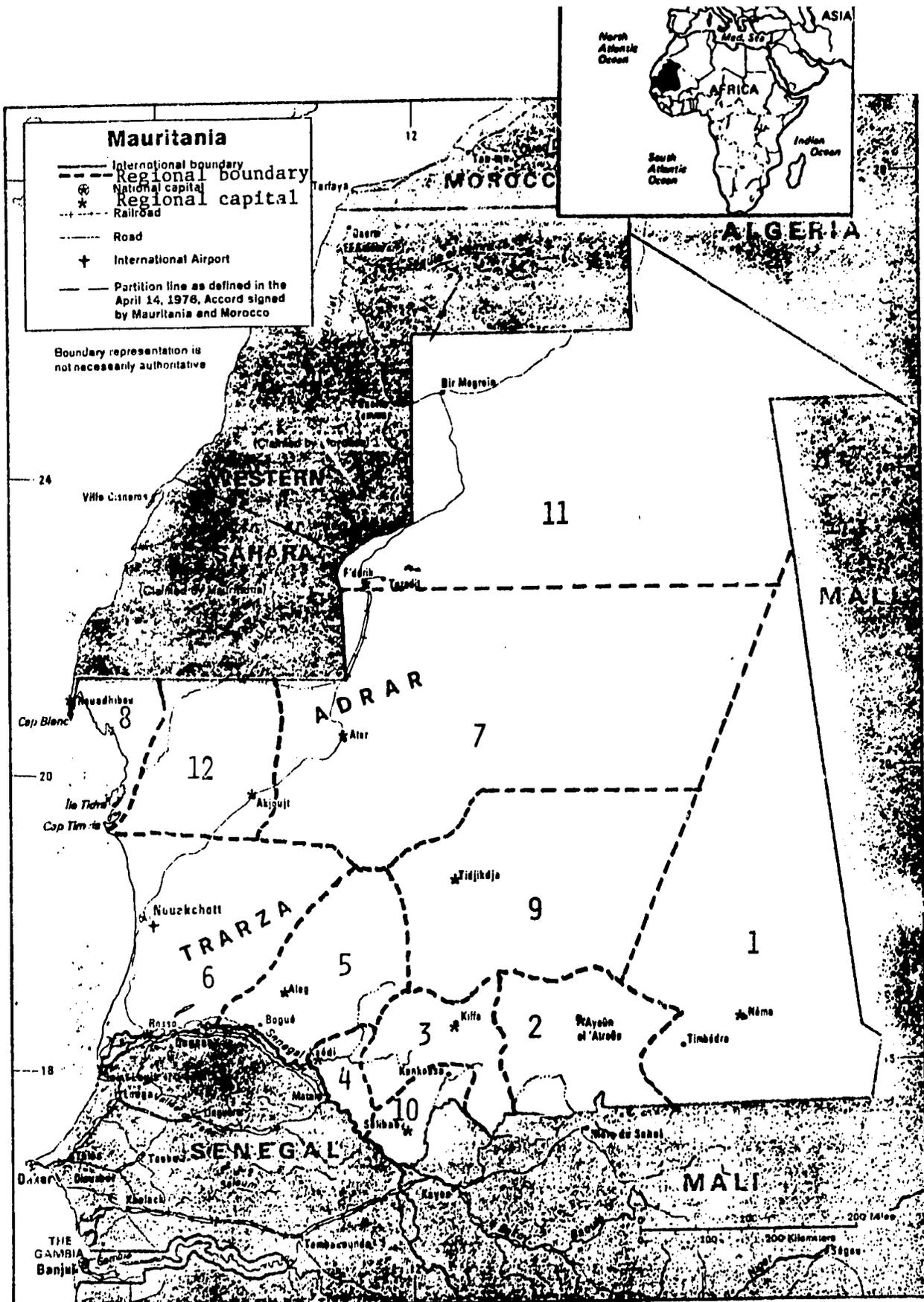
The Chairman

**DRAFT ENVIRONMENTAL REPORT
ON MAURITANIA**

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January 1979



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ENVIRONMENTAL REPORT ON MAURITANIA (Draft: Jan. 1979)

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INTRODUCTION AND SUMMARY

The Islamic Republic of Mauritania, formerly a part of French West Africa, received its independence in 1960; in 1961 it adopted a constitution providing it with a presidential system of government under Moktar Ould Daddah who, in conjunction with the Mauritanian People's Party remained in power until July 1978. At that time, as a result of increased internal dissent focusing on the war being waged with rebels fighting for the independence of the former Spanish Sahara, part of which Mauritania had annexed as its own territory in 1976, the government was overthrown in a coup. The country is now under President Ould Mohamed Salek.

Occupying territory about 4/5's the size of Alaska, Mauritania is divided administratively into 12 regions and the district of the capital (Nouakchott), apart from the Department of la Guera (Western Sahara).

A land of contrasts, Mauritania has a landscape ranging from the hot nearly rainless deserts of the Saharan north to the fertile and green banks of the Senegal to the south, a population split between Arab-Berber nomads and black sedentary farmers, and an economy clearly divided between a modern industrial sector and a traditional agricultural sector. Burdened with a precarious climate, Mauritania has recently suffered heavily under an extended drought, which has threatened its traditional agricultural base and led to the progress of desertification in its Sahelian zone.

The problem of rapid desertification of much of its territory and the consequent loss of land devoted to both grazing and subsistence agriculture are the major environmental problems facing Mauritania today. This process, although severely aggravated by the drought affecting the entire Sahelian area of Africa, has been made all the worse by certain practices which have upset the delicate balance of the area's ecology. These developments, which may to a large extent be attributed to population pressures, include the extension of agriculture to marginal lands formerly reserved for grazing; the growth of livestock herds, in many cases as a direct consequence of the establishment of new watering facilities, and resulting overgrazing; and deforestation resulting from foraging for firewood or clearing of land for agricultural purposes. With the failure of the rains beginning in the early 1970's marginal lands were no longer able to produce food and because they had been cleared of their natural, better adapted vegetation were frequently lost to the desert; livestock, deprived of both water and food, died in large numbers; and herdsmen, seeking to feed their animals, resorted to stripping of trees as fodder, accelerating the process of deforestation and the desertification which frequently followed.

In Mauritania, where, until recently, the overwhelming majority of the population consisted of nomadic herdsmen dependent on their animals as a source of both food and income (see page 2), the drastic depletion of animal herds also meant a loss of livelihood; this has resulted in the movement of nomadic herdsmen to urban areas where they live in crowded tent suburbs where decent water and sanitary facilities are in short supply and where disease is consequently rife. The problem of adequately dealing with these new "urban" dwellers is a major problem for the Mauritanian government.

The restoration of the delicate balance which has in the past has allowed for the successful if somewhat tenuous existence of the peoples of Mauritania is of vital importance for the continuing survival of the country.

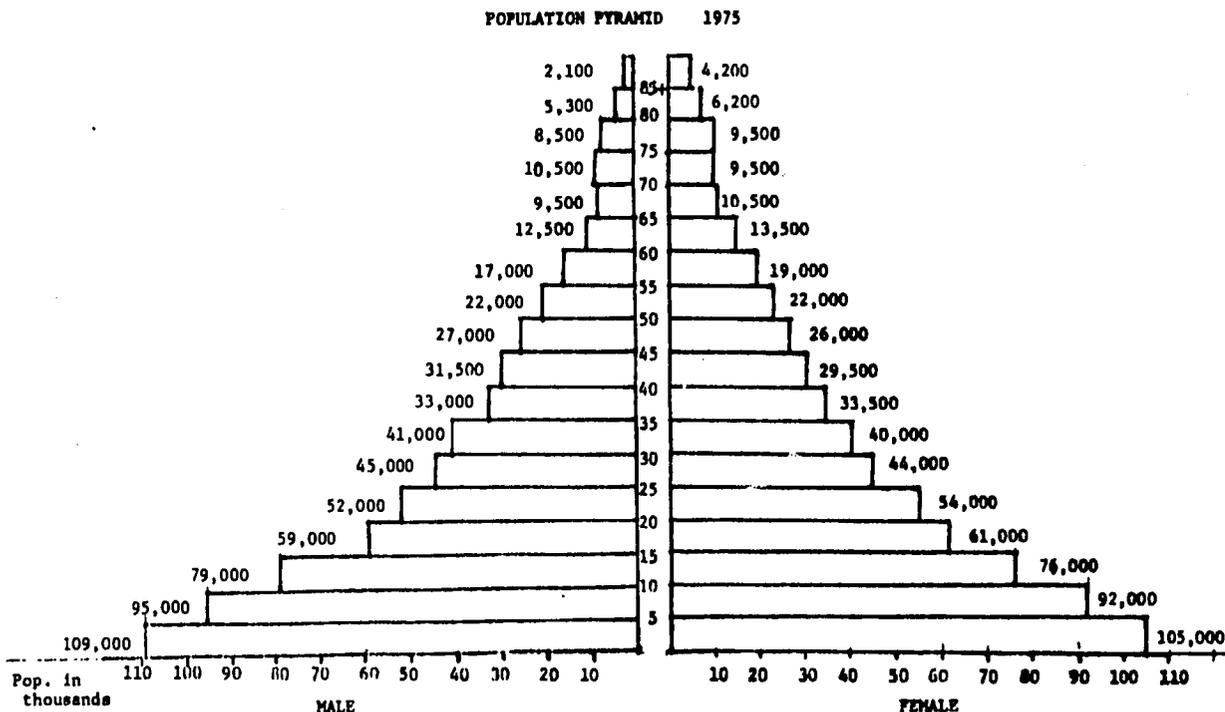
1. POPULATION CHARACTERISTICS

After years of planning, an official census was taken in Mauritania in late 1976, the results of which were released in late 1977. Unfortunately only scanty details of this census were available for this report. Other population data consists mostly of estimates.

Population: 1957-1976

| 1957 | 1960 | 1967 | 1975 | 1976 |
|---------|---------|-----------|-----------|-----------|
| 841,742 | 942,102 | 1,067,413 | 1,231,161 | 1,420,000 |

Population by age and sex(1975):



Population by region and major towns:

REGIONAL POPULATION BREAKDOWN

| Region | Population | Chief Town | Population | |
|----------------------|------------|-----------------|------------|----------------------------------|
| | | | 1975 est. | 1976 census (where available) |
| I--Hodh Oriental | 202,140 | Nema | 9,403 | |
| II--Hodh Occidental | 109,800 | Ayoun el'Atrous | 13,614 | |
| III--Assaba | 97,370 | Kiffa | 16,658 | |
| IV--Gorgol | 98,720 | Kaedi | 19,826 | 20,848 |
| V--Brakna | 147,080 | Aleg | -- | |
| VI--Trarza | 171,380 | Rosso | 18,463 | 16,446 |
| VII--Adrar | 62,500 | Atar | 18,897 | 15,326 |
| VIII--Bai Levrier | 32,240 | Nouadhibou | 22,931 | 21,976 |
| IX--Tagant | 73,530 | Tidjika | 8,193 | |
| X--Gulfmaka | 91,430 | Saibaby | 5,559 | |
| XI--Tiris-Zemmour | 25,500 | F'Derik* | 2,192 | |
| XII--Inchiri | 16,000 | Akjoujt | 13,001 | |
| District--Nouakchott | 103,480 | Nouakchott | 103,483 | 134,986 |

* Zouerate, the largest town in Tiris-Zemmour, had a population of 17,474, according to the 1976 census.

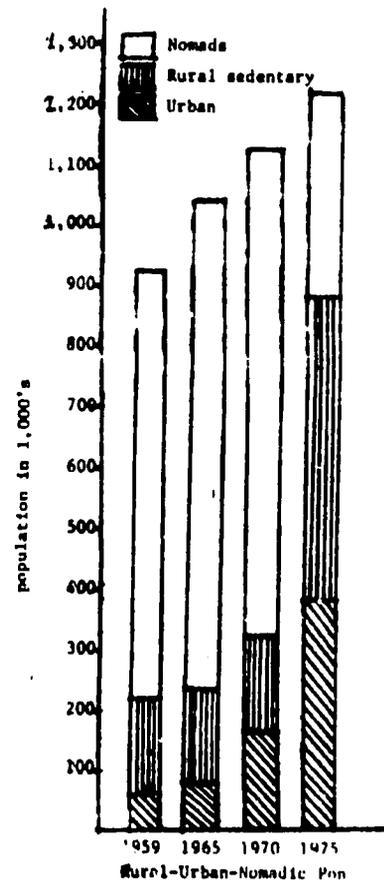
Population by race:

| THE PEOPLES OF MAURITANIA | | | | | | |
|---|---------------------|-----------|--|---------------------------------------|----------|--|
| GROUPS | racial background | % of pop. | area of country | language | religion | traditional occupation |
| MAURES | | | | | | |
| "White" | Arab-Berber | 33% | northern | Hassania-Arabic | Islam | warriors, nomadic herdsmen |
| "Black" | Arab-Berber-Negroid | 33% | northern, but some in Senegal Valley | Hassania-Arabic | Islam | nomadic herdsmen, some sedentary farmers |
| BLACKS | | | | | | |
| Toucouleurs Fulbe (Peuls) Soninke Wolof Bambara | Negroid | 33% | southern, especially in Senegal Valley | various sub-Saharan African languages | Islam | sedentary farmers and cattle raisers; fishermen (Senegal River); exception: the semi-nomadic (transhumant) Fulbe |

Population by urban-rural-nomadic:

As indicated in the accompanying graph, a significant change in population figures has taken place within the last ten years in Mauritania: there has been a complete switch in the ratio of nomadic to settled populations and a concomitant growth in urban population. Nomads, who constituted more than 65% of the population in 1965, are, according to the 1976 census, now only about a third of the population.

This drastic change in the population pattern may be attributed above all to the Sahelian drought of the first half of the 1970's and its renewed occurrence in Mauritania. By devastating their flocks, the drought brought an end to the economic base of nomadic life, driving the nomads towards areas where food and water could be obtained and bringing them in great numbers to the cities, where they must rely on the government to supply them with food. Around larger towns such as Nouakchott, large tent cities have sprung up (Nouakchott has recently been reported to have more tents than houses), where people live without proper water supply, without proper sanitary facilities and without employment.



Educational characteristics of population:

Literacy: 1960: 5% of population;
1970: 10% of population.

Children of secondary school age actually enrolled in school:

1960: 0.4%
1970: 2.0%

Health characteristics of population and population growth:

Average annual birth rate: 44.4 per 1,000

Annual rate of population growth: 2.1%

Number of years to double population: 33 years

Infant mortality rate: 187 per thousand live births

Crude death rate: 24 per thousand

Expectation of life at birth: 43.5 years

Health problems and disease: Recent and long-range health statistics (neither of which are particularly reliable) indicate that, apart from malnutrition resulting from drought-caused food shortages, malaria and respiratory and parasitic diseases are the major causes of illness, as shown by the following table:

Reported cases of communicable diseases:

| <u>Disease</u> | <u>1971</u> | <u>1972</u> | <u>1973</u> |
|------------------------------|-------------|-------------|-------------|
| Malaria | 45,916 | 36,713 | 30,545 |
| Tuberculosis | 7,126 | 8,780 | 4,331 |
| Whooping cough | 3,231 | 4,088 | 4,330 |
| Influenza | 9,830 | 12,697 | 18,541 |
| Pneumonia | 732 | 1,281 | 2,431 |
| Bacillary & Amoebic Dys. | 1,732 | 1,823 | 14,152 |
| Vesical Schisto- somiasis | 7,374 | 5,629 | -- |
| Brucellosis | 1,448 | -- | -- |
| Measles | 5,628 | 10,681 | 11,636 |
| Chicken pox | 3,608 | 2,061 | 2,364 |
| Mumps | 2,408 | 2,065 | 3,158 |

Based on data from the Mauritanian Health Services

The major cause of death, especially among the nomadic population, has been respiratory disease; this has been attributed to their exposure both to extreme variations in temperature and to sand suspended in the air. Malaria has been particularly widespread, ranging in its occurrence from the Senegal River region to the northern oases; it has been estimated that about 70% of the population contracts the disease at some time. Small-pox has been effectively eradicated.

The drought and the consequent crowding of former nomads into tent cities on the outskirts of cities, where health and sanitation facilities are inadequate, has led to an increased incidence of contagious and waterborne diseases. The increased occurrence of measles (see above table), which has taken place despite an expanded immunization program, may be attributed to the exposure of new populations to the disease and to a weakened resistance resulting from drought-related malnutrition. The drought has also led to a substantial increase in infant mortality: In some nomadic camps the average overall death rate has soared from 23 to 65 per 1,000 population.

Health care in Mauritania has been spotty; as recently as 1973 it was estimated that only about 15% of the population was receiving medical attention. Faced with this deficiency, Mauritania, with the help of external aid, has been strengthening its efforts to improve health services, with the goal of providing basic health care for large numbers of the population. Mobile teams are being created for prophylactic medicine and health education in rural areas, and health centers are being established in regional capitals and secondary cities.

Population control

There is no population control program in Mauritania; the government has been reported to be opposed to such efforts.

2. GOVERNMENT ORGANIZATIONS RESPONSIBLE FOR ENVIRONMENTAL AND NATURAL RESOURCES ACTIVITIES

NOTE: The past several years have seen fairly frequent shifts in the distribution of functions among government ministries, and the actual number and names of ministries have varied from time to time. Several of these changes have affected the responsibilities of the Ministry of Rural Development, the agency with the heaviest burden of environmental functions. What effect the coup d'etat of July 1978 has had on this ministry is not yet known; it is listed among those ministries functioning under the new government, but its responsibilities may be somewhat different from those mentioned here.

MINISTRY OF RURAL DEVELOPMENT (Minister: Ba Oumar--July 1978)

The functions of this ministry were most recently outlined in a decree of May 3, 1976, which assigns the ministry overall responsibility in the areas of agriculture, livestock, and forests and the protection of nature:

- agricultural directorate: responsibility for, among other things, the sanitary examination of food products; conservation, improvement and research on cultivated plants; and agricultural research in general;
- livestock directorate: responsible for animal health and the inspection of animal products; matters relating to herding and transport of livestock;
- directorate for the protection and improvement of agro-pastoral land: responsibility for the conservation of waters and forests; the protection of wildlife and control of hunting; controlling agricultural pests and dangerous wild animals; forest development.

There are two subdivisions or services:

- the nature protection service;
- the service for the improvement of rural land.

Assuming that this Ministry has taken over the functions of the former Ministry of Water Resources, it is also responsible for matters such as: water extraction; regulation of waters and policing of surface and underground waters; hydro-geological studies; and the study, construction and control of barrages, irrigated areas, and dikes.

UNDER THE AEGIS OF THE MINISTRY OF RURAL DEVELOPMENT:

1) Societe national pour le developpement rural (SONADER) (National Association for Rural Development)

Location: Nouakchott Established: by decree in 1975

Functions:- study, implementation and control of work related to hydroagricultural projects;

- the determination, identification and implementation of procedures for the realization of hydroagricultural projects, including pre-feasibility studies;
- management and training for the programs with which it is entrusted;
- coordination and maintenance of the hydro-agricultural equipment entrusted to it.

SONADER's initial task is to focus on the Senegal River, where 80% of its activities are to be directed. Assistance from OMVS (see below) and from AID is being utilized to help to make this an effective organization for the development of irrigated agriculture.

Initial budget: 25,000,000 UM (ouguiya) (\$1.00=44UM)

- 2) Centre national des recherches agronomiques et de developpement agricole(CNRADA)
(National Center for Agronomic Research and Agricultural Development)
Location:Kaedi Established: by decree in 1974
Functions: Research into agricultural matters, including: study of techniques and methods to ensure rational exploitation of natural resources such as pasturages, water and forests with the aim of effectively preserving the environment and fighting desertification; training of agricultural personnel.

- 3) Centre national d'elevage et des recherches veterinaires (CNERV)
(National Center for Livestock and Veterinary Research)
Location: Nouakchott Established: by decree in 1973

- 4) Office Mauritanien des cereales (OMC) (Mauritanian Cereals Office)
Location: Nouakchott Established: August 1975
Functions: to determine overall needs for cereals and to assure their marketing and equitable distribution throughout the country.

- 5) Coordinating Committee for Drought Control Planning (Comite de coordination du projet du lutte contre la secheresse)
Established: December 17, 1976
Functions: the planning of drought control. Funded by a \$2,500,000 grant from A.I.D., the committee meets three times a year.

- 6) Comite pour la protection et la conservation de la nature
Established: 1959; reorganized in February 1977
Functions: its preliminary advice is obligatory for any activity capable of changing the natural environment and for all questions relating to:
 - the protection of soils, water resources and flora and fauna;
 - the conservation and rational use of natural resources
 - national parks and nature reserves.
 The committee meets two times a year at the request of its president, who is the Ministry of Rural Development or his appointee.

THE MINISTRY OF PLANNING AND MINES (Minister: Mohammed el Moktar Ould Zamel--July 1978)

The functions of this ministry were most recently enumerated in decree of September 26, 1977.

The ministry is charged with: development plans and programs, including their financing and execution; the establishment of statistical documentation concerning the economic, social and cultural life of the nation; and through its Directorate of Mines and Geology, with prospecting for mineral resources, the implementation of mining legislation, and the administrative and technical control of classified establishments and of trade in petroleum products.

OTHER MINISTRIES:

Ministry of Health, Work, and Social Affairs (Minister: Dr. Diagana-
July 1978)

Two of the branches of this ministry are concerned with health: the Directorate of Health handles most health care programs and administers training programs; the Directorate of Social Affairs bears the responsibility for maternal and child care programs. Although efforts are being made to integrate the functions of these two directorates, they continue to operate separately and on separate budgets.

There are no provisions within the ministry for the collection of accurate health statistics.

Ministry of Industry and Fishing (Minister: Ahmed Ojld Bouceif--July
1978)

- no details available.

GOVERNMENT CORPORATIONS (The Ministry to which these organizations are responsible under the newly reorganized government is not clear)

Societe nationale industrielle et miniere (SNIM)

Location: Nouakchott Established: October 1975

Functions: SNIM is the organization with basic control of exploitation of the mineral resources of Mauritania. Under it are placed both copper and iron mining operations.

It is run by Council, which includes the Ministry of Rural Development; day to day operations are under a director general; it is under the general supervision of the president.

Societe nationale d'eau et d'electricite (SONELEC)

Location: Nouakchott Established: May 1975

Functions: SONELEC is charged with the production, transport and distribution of water and power. It is the Mauritanian Water and Power Company.

INTERNATIONAL ORGANIZATIONS

Organization pour la Mise en Valeur du Fleuve Senegal (Organization for the Development of the Senegal River) OMVS

Established: 1974

The organization consists of three member states: Senegal, Mali and Mauritania.

The main objective of OMVS is to plan and finance for the integrated development of the Senegal River Basin. Its overall program is expected to extend over 35 years and cost a projected \$3.7 billion dollars. While its goal is improvement of the living standard through agricultural development and increased agricultural and mining production, its programs for achieving this goal include:

- the development of irrigated agriculture to achieve double-cropped irrigation agriculture;
- livestock improvement;
- expanding mining and processing of iron, bauxite, and phosphates;
- improvement of fisheries, forestry and tourism.

Major projects include:

- the dam at Diama on the Senegal Delta to arrest salt water intrusion and provide water for irrigation;
- the improvement of ports of call along the Senegal River.

Construction of the Diama Dam is planned for 1978-1980.

C.I.L.S.S. (Permanent Inter-State Committee for Drought Control in the Sahel)

Formed in 1973. Members: Cape Verde, The Gambia, Upper Volta, Mali, Mauritania, Niger, Senegal, and Chad.

Periodic meetings of the organization involve the participation of the heads of state of these nations.

The organization's programs, which depend on heavy international investment (the Club of the Friends of the Sahel was formed in 1976 to obtain this support), have the goal of the long-term development of the Sahel and its eventual self-sufficiency in the production of millet, sorghum, maize, wheat, rice, sugar cane, meat and fish. Its initial program covering the period 1977-1982, is a food-supply scheme requiring international investments of more than three million dollars.

3.0 LAWS GOVERNING THE ENVIRONMENT AND NATURAL RESOURCES

As part of French West Africa, Mauritania was subject to laws promulgated for that jurisdiction; the Mauritanian constitution, adopted in 1961, provides that such laws are to remain applicable to the new state until replaced by new ones. This explains why several of the laws dealing with the environment date, as do nearly half of the Mauritanian statutes currently in force from the period prior to Mauritania's receiving its independence in 1960.

Although many aspects of environmental control are covered under this "modern" law, important questions such as land ownership, land use, and water rights are regulated in whole or part either under Islamic law or under traditional systems. This holds true perhaps most significantly in the flood plain of the Senegal River, where there exists a complicated traditional system of land ownership and usage little understood by outsiders.

OVERVIEW OF LAWS GOVERNING THE ENVIRONMENT AND NATURAL RESOURCES

[Numbers indicated those sections of the report in which the laws are summarized; blank areas indicate that no legislation was found.]

| RENEWABLE RESOURCES | Pro-tection | Reserves | Owner-ship | Res-toration | Utili-zation |
|--------------------------------|-------------|----------|------------|--------------|--------------|
| Water | 3.1 | | 3.2.1 | | 3.2.1 |
| | 3.2.1 | | 3.2.2 | | 3.2.2 |
| Air | 3.1 | | | | |
| Forests | 3.3.1 | 3.3.1 | 3.3.1 | 3.3.1 | 3.3.1 |
| | | 3.3.2 | | | 3.3.2 |
| Wildlife | 3.6.1 | 3.6.1 | | | 3.6.1 |
| | 3.6.2 | | | | 3.6.2 |
| Fisheries | 3.5 | | 3.5 | | 3.5 |
| NON-RENEWABLE RESOURCES | | | | | |
| Minerals | | | 3.4 | | 3.4 |
| LAND USE | | | | | |
| Agriculture | | | | | |
| Pesticides | | | | | |
| Solid Waste | | | | | |

3.1 GENERAL POLLUTION CONTROL

Decree [of October 20, 1926] concerning regulation of dangerous, unhealthy or offensive establishments in French West Africa

Provisions: Subjects to government surveillance all industrial or commercial enterprises of any description which might cause danger or inconvenience to the safety, health, or convenience of a neighborhood, either with regard to public health, agriculture, or fishing.

Three classes of establishment are identified: 1) those which should be located at a distance from inhabited places; 2) those which, although they may be located in inhabited places, must take special precautions so as not to adversely affect those areas; and 3) those which, because they seem unlikely to be detrimental to an area, are subject to only broad provisions.

Establishments determined to come under the provisions of the law are to be specified by decree. Both class 1 and class 2 establishments are subject to authorizations before they may be set up; these authorizations may place conditions on their operations.

In principle, this law provides for the control of both air and water pollution from industrial establishments; a similar law has been, in fact, the basis for the control and regulation of pollution in France. The extent to which this law has been invoked in Mauritania is not known.

3.2 WATER LEGISLATION

3.2.1 Decree [of March 5, 1921] regulating the water regime in French West Africa

Provisions: Regulates principally state waters (defined elsewhere as coastal waters up to the high tide line as well as a zone of 100 meters measured from this limit; navigable waters; non-navigable waters and their sources; lakes, ponds and lagoons; and navigation and irrigation canals--in effect, all waters are state waters).

Provisions covers: the conservation of waters; dredging, widening, and straightening of watercourses; the use of water for irrigation and for mining operations; protection from flooding; reclamation of ponds and swamps; draining of wetlands; and sanctions and penalties.

Water protection and use: -prohibits the depositing of refuse, animal wastes, stones, gravel, wood, etc., in the bed or on the banks of a watercourse, lake, lagoon or canal;
-prohibits the discharge of infected or dangerous waters;
-requires a permit for any diversion or use of state waters.

3.2.2 Civil Code:

Provisions: Article 640 and following of the Civil Code detail the obligations of landowners with regard to waters flowing through their property; in general property owners are required to pay an indemnity for any action which would reduce the natural flow of such waters through adjacent properties. The Code grants landowners the right to use and dispose of rainwater falling on their properties, but requires them to pay an indemnity if their use of such waters reduces the flow of watercourses through adjacent properties.

3.3 FORESTS

3.3.1 Decree [of July 4, 1935] concerning the forest regime of French West Africa

Provisions: declares as state forests all non-occupied and unowned forests, as well as all perimeters of reforestation;

-recognizes three types of state forests:

1. classified forests: these include all forests already under special regulations at the time of the promulgation of this decree and any declared as such under this decree; rights of usage in such forests are limited, the actual extent of permitted usage to be specified in the classifying decree;
2. protected forests: all state forests other than classified forests;
3. perimeters of reforestation: all unvegetated land and insufficiently wooded areas, including:
 - mountain slopes of 35 degrees or more
 - littoral dunes
 - terrains which might produce dangerous landslides.

In general, activities such as the felling of trees and the grazing of animals are limited in classified forests; traditional rights in such forests are limited to the collection of deadwood, the picking of fruit and of food and medicinal plants, and other activities as specified in the classifying decree; commercial activities require a permit; burning and clearing of land for farming is formally prohibited. In protected forests, traditional rights of individuals and communities, including commercial exploitation of gum trees, palms, etc., may be exercised without a permit, but such activities are not to harm the productive vegetation. All activities are prohibited in perimeters of reforestation; when such areas are declared sufficiently reforested, they are to be treated as classified forests. Exploitation of forests by public or private corporations requires a permit.

Protected species: special authorization is required for the felling uprooting or mutilation of gum trees (Acacia senegal), Khaya senegalensis, Borassus aethiopica, Pterocarpus orinaceus, Bombax costatum, Faidherbia albida, and coconut palms. Other species enjoying partial or complete protection can be specified by decree.

Other provisions of the law deal with the prevention of brush fires, the restriction of activities in private forests (no permits are to be issued, for example, for the felling of trees on mountain slopes or in important hydrological basins), and the apprehension and punishment of offenders.

Implementation: this law and other forestry legislation is implemented by the officials of the Service des Eaux et Forêts of the Ministry of Rural Development with the assistance of police officers and other officials.

3.3.2 Other forestry legislation

The Decree no. 65.080 of 29 April 1965 fixing the fees for the exploitation of forest products

Provisions: establishes fees to be paid for the right to exploit various types of trees; generally, higher fees are required for "protected species": Khaya senegalensis, Borassa aethiopica, Pterocarpus orinaceus, Bombax costatum, and Faidherbia albida; consideration is also taken of the purpose for which the wood is to be used. The working of classified forests is limited to the Service des Eaux et Forêts; however, permission may be granted for the gathering of deadwood or for the working of trees specifically marked by the Service.

Other decrees issued in pursuance of the July 4, 1935 Decree include the Decrees nos. 10.027 and 10.028 of February 17, 1961, which change the boundaries of the classified forests of M'Boyo and Silbe; in both cases, specific areas lose their classified status and other areas are classified to compensate for this loss.

3.4 MINERAL RESOURCES

Law no. 77-204 of July 30, 1977 on the Mining Code

Provisions: Mines and quarries are declared the property of the state and prospecting for and exploitation of mineral wealth is put under state control. Permits of varying terms of validity are granted for research and exploitation of mines; the rights and obligations of holders of mining titles are detailed, including, among other things, the obligation to repair all damage which the work may occasion to surface property.

Implementation: the Directorate of Mines and Geology under the Ministry of Planning and Mines is responsible for the surveillance of mineral prospecting and exploitation; its agents as well as police officers are responsible for apprehending offenders against the provisions of the code.

3.5 FISHERIES

Law No. 62.038 Containing the Code Governing the Merchant Marine and Maritime Fishing

Provisions: Book VIII grants to the Maritime Authority the power to regulate: zones and times of the year in which fishing is permitted and those species which may be caught; fishing methods and equipment; actions to prevent the depletion of the stock of fish through capture or destruction of spawns or undersized individuals; the conditions for the establishment of fisheries; measures to ensure the conservation of fish both in the sea and on the littoral.

Decrees are to be issued to specify hygienic measures relating to conservation, treatment, breeding, and transport of fish. In Mauritanian waters, fishing is limited to Mauritanian vessels but agreements may be made to allow fishing by other fleets.

Fines are specified for infractions of the code or regulations made under it.

Implementation: The Ministry of Industry and Fishing, acting as the Maritime Authority.

Decrees issued under the code have established closed seasons for specific sea fauna (langoustes).

3.6 WILDLIFE AND GAME

3.6.1 Law no. 75-003 of January 15, 1975 on the Hunting Code and the Protection Fauna

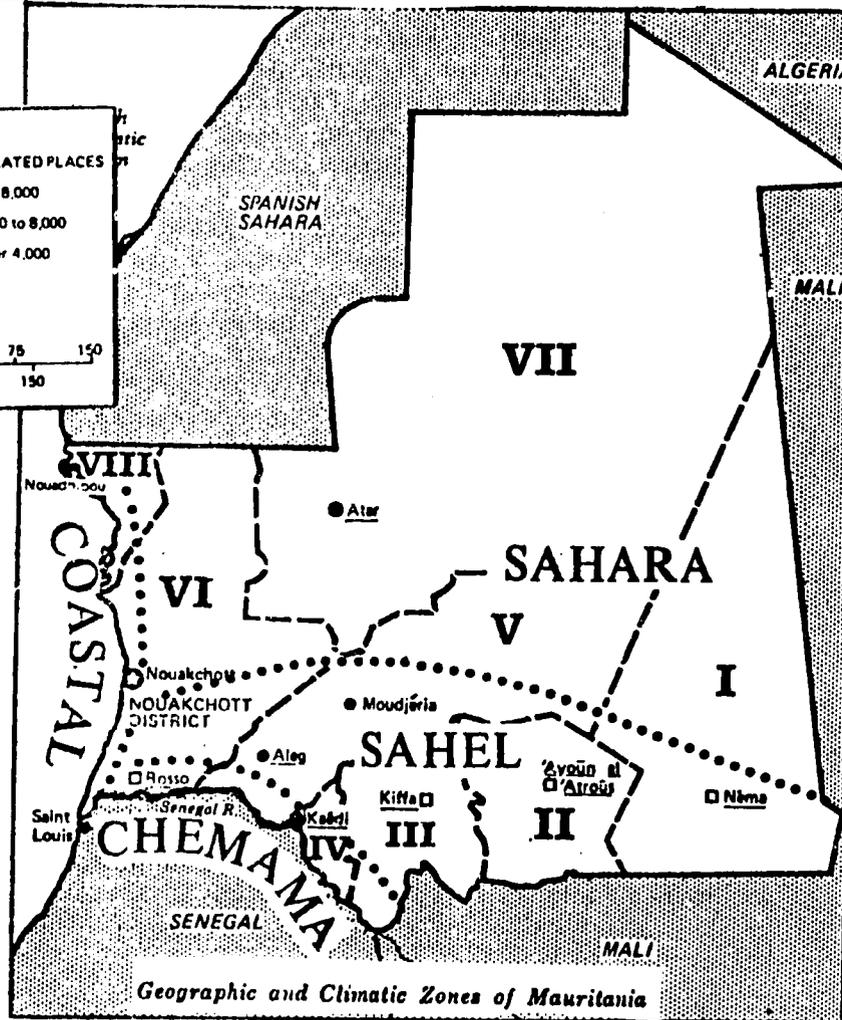
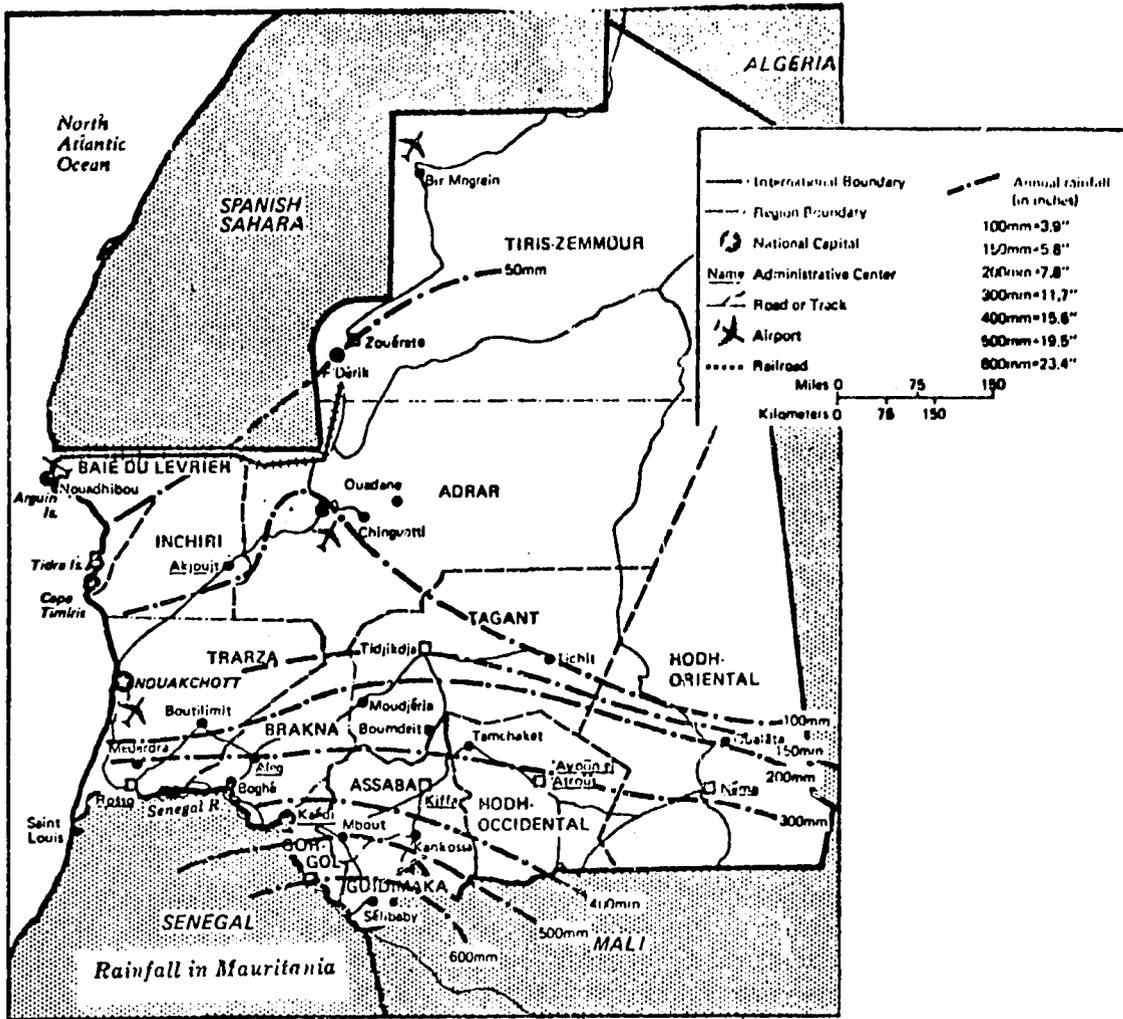
- Provisions:
- prohibits the capture, detention, possession or export of wild animals without a permit;
 - prohibits actions such as: hunting using lamps; burning the bush to rout out game; use of drugs in hunting; hunting from vehicles, motor boats, or airplanes; sales of meat from wild animals; shooting of animals with young; collection or transport of wild birds not recognized as harmful; the collection of eggs of protected birds, especially ostriches; (prohibitions against certain hunting methods may be suspended in the case of harmful or dangerous animals);
 - provides for the creation of national parks for the conservation of animals;
 - provides for declaration by decree of protected and partially protected species of animals but, apart from ostriches, the law itself contains no references to specific animals;
 - makes the minister charged with the protection of nature responsible for declaration of closed and open season for hunting;
 - permits may be issued by the ministry charged with nature protection for hunting certain protected species;
 - exceptions may be stated by decree for hunting of animals for food;
 - fines are specified for infractions as well as conditions for apprehension of offenders

Implementation: The Ministry of Rural Development (as the ministry charged with the protection of nature), specifically the officials of the Nature Protection Service (Service de la Protection de la nature, as well as various forestry officers.

3.6.2 Decrees issued under the Hunting Code

The Decree no. R-071 of August 13, 1976 concerning the closing of the hunting season closed the hunting season for an indefinite period of time beginning on June 1, 1976 throughout the whole of the country, with the exception of the hunting of ducks, teals, and warthogs in the Keur-Macene hunting area.

Law no. 74-177 of 29 July 1974 forbids the sale, importation, and possession of hunting arms throughout the country and requires that such arms be deposited with specified administrative officers. Exceptions to the law are persons authorized to hunt in designated hunting areas.



4. RESOURCES

WATER RESOURCES

Rainfall and climate

Mauritania is on the whole a hot and dry land, with daytime temperatures exceeding 38 degrees C over six months of the year in most areas and rainfall ranging from an average low of 36.3 mm in the coastal zone to an average high of 649.0 mm in the Chemama zone of the far south. For most areas precipitation is concentrated in the months from July to October. Heavy evaporation is typical of the greater part of the country.

Periodic failure of the rains seems to be characteristic of the Mauritanian climate in this century. 1913 was a year of scanty rainfall, followed roughly thirty years later by the drought of 1940-42. The most recent drought, which underlined the fragility of life in this area of the world, lasted from 1970 to 1975. After some respite, Mauritania experienced another bad year in 1977, with rainfall levels lower than those of 1972.

Rainfall and other features are the basis for a division of the country into four geographical and climatic zones (see map p. 16): the Saharan; the Sahelian; the Chemama; and the Coastal.

Rainfall in representative locations in Mauritania

| Zone | Location | Average rainfall | | Drought year low |
|---------|------------|-------------------------|-----------------------------|-----------------------------|
| | | Total | Heaviest month | |
| Saharan | Atar | 103.5 mm (4.1 in.) | Sept.: 37.8 mm (1.5 in.) | 19 mm (1971) (0.76 in.) |
| Sahel | Kiffa | 350.7 mm (14.03 in.) | Aug.: 121.1 mm (4.8 in.) | 119 mm (1972) (4.6 in.) |
| | Nema | 315.0 mm (12.6 in.) | Aug.: 116.7 mm (4.7 in.) | 183 mm (1973) (7.32 in.) |
| Chemama | Selibabi | 649.0 mm (26.0 in.) | Aug.: 226.3 mm (9.1 in.) | 289 mm (1972) (11.6 in.) |
| Coastal | Nouakchott | 138.4 mm (5.5 in.) | Aug.: 60.4 mm (2.4 in.) | 18 mm (1971) (0.72) |

Surface waters

The Senegal River, which serves as the border between Senegal and Mauritania in the southwestern area of the country, is the only major non-seasonal stream in Mauritania. Between August and December the river floods the alluvial plain, replenishing Lak Rkiz and supplying moisture for the re-

cession agriculture under which most Mauritanian crops are grown. Although the flow of the river at Bakjel, at the entrance to the alluvial valley, normally averages about 780m³/s (cubic meters per second), in 1924 it was measured at 1,247m³/s (a record high), and in 1972, a drought year, it dropped to the record low of 264m³/s.

Waters in the delta of the Senegal (roughly between Rosso and the Atlantic) are too saline for use in agriculture.

Other rivers are mostly of a temporary or seasonal nature. These are the wadis, dried stream beds which when filled with rainwater produce flows of often several hundred kilometers in length and overflow their banks to provide moisture for recession agriculture. Several wadis (Kolimbin, Karkara, Garfa and Gorgol) discharge into the Senegal, but their contribution is too insignificant to make them important tributaries of that river. Wadis usually converge on depressions where their waters are dispersed and drained; such areas are marked by a concentration of vegetation.

Groundwater

Groundwater resources of varying depth and quality are present throughout Mauritania and are of significance in supplying water for human consumption, for agriculture, and for mining operations. No complete survey of these water resources has yet been made, and despite government efforts in that direction, no hydrogeological map of the country has yet been produced.

Among the most important groundwater resources are the aquifers of the coastal sedimentary basin. These include the aquifers which supply the water needs not only for the capital of Nouakchott but also for the port of Nouadhibou and for mining operations at Akjoujt and Zouerate.

Many of the available groundwater supplies have been determined to be too saline for exploitation.

Recharging of groundwater supplies is of essential importance. In many areas rainfall is sufficiently heavy to recharge supplies, and in the south aquifers are recharged by drainage from the Senegal River basin. However, in many other areas, especially in the north, where rainfall is sparse and evaporation heavy, only a small portion of rainfall is available for recharge. This has led to the speculation that these resources may have been fed during humid periods in the past and, because of lack of continuing recharge, may dry up under extensive use.

Desalination

Desalination of seawater is another source of water supply and has been of special significance for the city of Nouakchott, which has had a desalination plant in operation since 1969.

WATER USE

Demand on water resources comes from several quarters: agriculture and livestock herding; industry; and domestic consumption.

Agriculture and livestock herding:

Presently most agricultural endeavors depend on seasonal floodwaters to meet their water needs; included here is not only the agriculture practiced on the flood plains of the Senegal and its tributaries (the Gorgol, the Karakora, etc.) but also that dependent on the seasonal flooding of the banks of wadis in other areas of the country.

Irrigation

The Maures have traditionally built small earthen dams to collect rainwater and prevent its loss from wadis; these dams, about fifty of which are reported to be found in Brakna, the Hoidh, Assaba, the Tagant, and even Adrar, serve for livestock watering and for the irrigation of relatively small land areas; they are slowly being replaced by more modern structures.

Although government development plans call for extensive use of irrigation, several large hydroagricultural projects presently being in the planning or construction stage, little modern irrigated agriculture is actually practiced at this time. Pilot projects along the Senegal, involving never more than about 125 hectares each, have demonstrated, however, that farmers in the basin can adapt to irrigated farming.

Major irrigation projects currently in progress are:

the Gorgol irrigation project: plans call for the construction of two dams and the irrigation of about 30,000 hectares of land for both rice and sugar production; by 1977 one dam was in operation and about 900 hectares under production;

the Diama Dam: part of the OMVS (see page 8) plan for development of the Senegal River, this dam, construction of which is scheduled for 1978-1980, would not only arrest salt water intrusion into the Senegal River but also provide irrigation waters that would allow the extension of cultivation to large areas of land.

Agriculture under rainwater (dryland agriculture);

Some agriculture in areas beyond the flood plains is practiced strictly with reliance on the scanty rainfall; mostly millet and beans are grown.

Utilization of groundwater in agriculture

Groundwater sources are tapped in a limited way for livestock watering and for agriculture; of special importance here are the oases, where wells, hand-worked or motorized, are used to irrigate palm groves and other crops, chiefly grains and legumes.

water for domestic consumption

Groundwater sources throughout the country are tapped for human consumption; these include not only wells designed to meet local needs, but also aquifers supplying major population centers such as Nouakchott and Nouadhibou. In 1970, 2,400 connections in Nouakchott were supplied with a total of 980,000 cubic meters of water drawn in part from the aquifer of Trarza (about 60 kilometers away) and partly from a desalination plant.

Increasing water supply to rural populations, only 10% of which were judged to have reasonable access to decent water in 1970, is a goal of the Mauritanian government, which, with United Nations assistance, has been training prospecting and drilling teams to locate and tap groundwater resources. Supplying the tent camps around Nouakchott and other urban centers with water is also the object of a government program.

Chief responsibility for domestic and industrial water supply falls to SONELEC (the National Corporation for Water and Energy Supply).

SOIL AND VEGETATION

The resource (see map, page 22)

Except for the small area of the country along the Senegal River, Mauritania is a land of poor soils and scanty vegetation. About 40% of the country is covered by sand, some in fixed, some in mobile dunes. Soils and vegetation differ generally in accordance with the geographic and climatic zone in which they occur: the Sahara, the Coastal Zone, the Sahel and the Chemama (Senegal River zone) (see maps of rainfall, climate and geography and soil and vegetation).

The arid desert soil of the Saharan zone, which occupies roughly two-thirds of the country, permits of little vegetation, except in those mountainous areas where water sources permit small-leaved and spiny plant and scrub grasses, and those areas between dunes where a high water table supports low growing acacia and soapberry trees, among others. The only cultivation occurs in the oases, where date palms flourish and other crops are grown on a limited basis.

The coastal zone, which receives the least rainfall of any region, is almost devoid of vegetation, especially in the northern areas, where the dunes are active; however, the generally higher level of humidity along the sea area does permit the growth of dwarf acacia, tamarisk bushes and swallowworts.

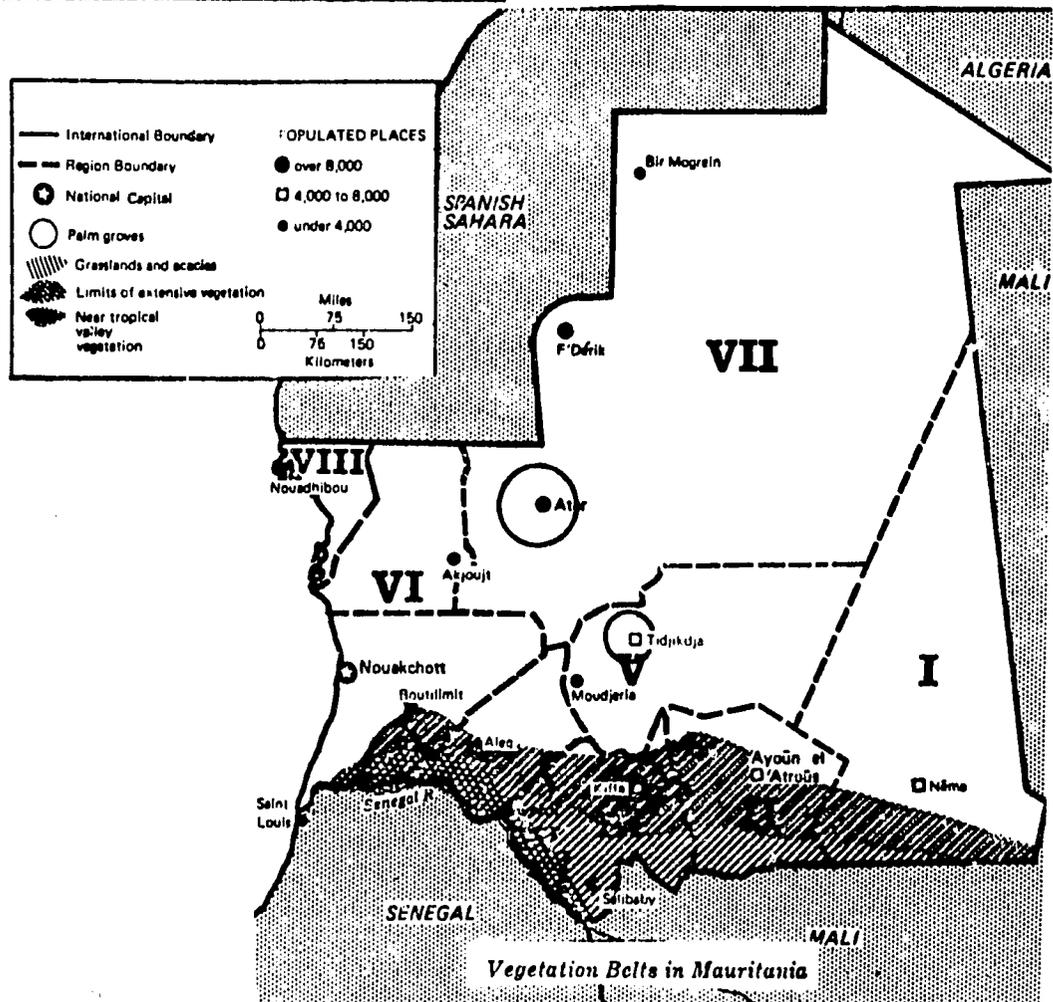
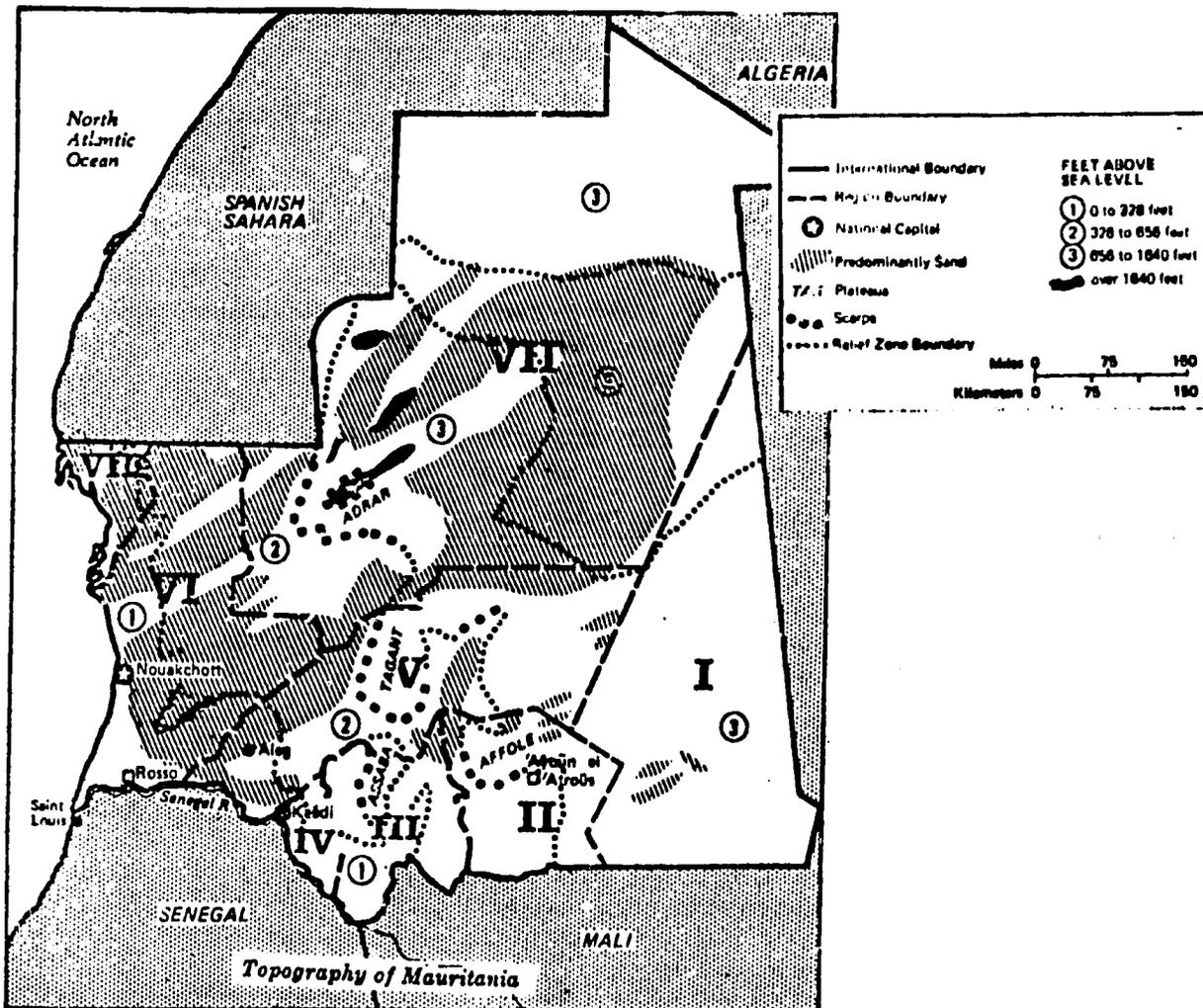
In the Sahelian zone the generally sandy soil begins to give way to clay towards the South. In the north scrub grasses and spiny acacias dominate the dunes, and date palms grow on the Tagant plateau. In the central Sahel fixed dunes are covered by savanna grasses, brushwood, balsam and spurge. The southern Sahel is an area of flat savanna grasslands broken by the occasional baobab tree. Here are forest areas of palms and acacias; in Brakna and Trarza are large forests of *Acacia senegal*, which is exploited for its gum. In the far southern Sahel rain is sufficient to support agriculture, and millet, maize and sorghum are grown.

The Chemama or Senegal River zone, with its rich alluvial and clayey soil, is an area of abundant vegetation; along the banks of the Senegal are found dense stands of acacias as well as willows and a rich grass cover. The flood plains are the chief agricultural area of the country. In the mixed marginal forest beyond the flood plains grow acacias and jujube trees

Utilization of soil and vegetation

The soils of the Chemama provide especially fertile ground for agriculture, while on the less rich soils of the drier Sahelian zone a more tenuous form of agriculture, dependent on rainfall for moisture, is practiced. Agriculture is also found in the oases (principally date palms) and along the seasonal wadis of the Sahelian and Saharan zones.

Vegetation of both the herbaceous and woody varieties has been utilized to support the herds of both nomadic and sedentary livestock herders. In the northern Saharan zone, the sparse vegetation growing between dunes has provided suitable feed for camels, while the somewhat more abundant vegetation of the southern Saharan zone and the Sahel has served as pasturage not only for camels but for also for sheep, goats, and, especially in the more southern regions, cattle. These areas have been the territory of the nomadic herdsmen. In the southern region cattle are also kept by sedentary farmers.



the effects of the drought on soil and vegetation

The soil and vegetation of Mauritania are an especially fragile resource. This is particularly true of the Sahelian zone, where during the drought of the 1970's the scant vegetation, already in desperately short supply because of lack of rain, was even further depleted by starving livestock. Deprived of its fixing vegetative cover, soil in many areas was carried away by the wind, thus contributing to the progress of desertification in many areas.

FORESTS

The Resource

Mauritania is predominantly a land of sparse vegetation, some desert areas being among the most barren in the world, others sustaining only occasional clumps of hardy grasses and no trees. Nevertheless there are forest lands in the southern sections of the country, and trees are a features of the landscape in most of the savannas and steppes of the Sahelian zone. In 1974 the FAO estimated the total forest land at 15,000,000 hectares or about 14% of the total area of the country.

As described in the section on soils and vegetation, dense forest growth is limited to the Senegal Valley. The most prominent genus of tree is the acacia, ranging in size from the relatively tall Acacia nilotica of the Senegal Valley to the often dwarfed Acacia raddiana of the dunes. Date palms, often growing wild along wadis and cultivated in oases, are also frequently in evidence. There are no coniferous species growing in Mauritania.

Uses of Forests

Mauritania's limited forest resources serve several important functions: as firewood; as forage for both wild and domesticated animals; as a source of gum arabic; and as construction material.

Forage trees include such important evergreen species as Balantes aegyptica, and evergreen acacia varieties, especially Acacia raddiana, which has been important as a forage food in especially dry years and is said to be a favorite food of the camel.

Firewood, the chief and most inexpensive source of energy, serves the dual function of both lighting and heating; annual use of firewood comes to about 0.45 m³ per person, or an average of 1000 kg of fuel wood for two people. Total national consumption has been estimated by the government at 460,000 m³. It was estimated in 1970 that about 500 of Mauritania's 10-15 million hectares of forest land were required to meet this demand for firewood. In that year, about 80% of this used in the form of charcoal.

Acacia senegal, growing in the Sahelian zone, especially in Brakna and Trarza, is exploited for gum arabic, a substance used in medications, confections, and adhesives, which is Mauritania's largest export from the agricultural sector (about 1,500 tons a year).

Wood is also used on a limited scale in construction (about 1,000 cm³ in 1972) and for other industrial purposes (about 35,000 cm³ in 1972-FAO estimates).

Deforestation

The Sahelian drought of the early 70's and the renewed occurrence of drought in Mauritania in 1977 have had a disastrous effect on forest areas across the entire Sahelian zone. Although figures for Mauritania are not available, it was estimated in 1975 that in Niger and Chad about 50% of Acacia raddiana trees died as a result of the drought. Undue stripping of trees by herdsmen desperate to provide forage for their animals has contributed to tree loss in the Sahel, since trees so severely amputated are often not able to regenerate. The continued lack of necessary moisture has also hindered the growth of new tree cover, further hampering efforts to replace trees lost as a result of use for firewood or construction material.

Losses caused by and as a consequence of the drought, however, have only aggravated a situation already made somewhat desperate by encroachments on forest land for firewood and construction materials as well as by the clearing of land for expanded agricultural activity. Deforestation around settled areas, where growing populations have exploited the forest wealth, is reported to be especially severe. Bush fires further contribute to forest loss, and the improper stripping of gum acacia trees is responsible for significant damage to this important resource. Deforestation problems extend to the palm groves of Atar, where the deterioration and loss of palm trees has been attributed not only to the drought but also to insect infestations and improper agricultural practices, including irrigation with overly saline water.

Government programs against deforestation

Moves to protect forest resources include the control of bush fires through a series of firebelts. Furthermore, the Mauritanian government has proposed several forestry projects for financing; these include: establishment of forest nurseries at Selibaby, Magua, Kaedi, Rosso and Boghe; the establishment of 600 village forests along the Senegal River; the regeneration and afforestation of forest stands in the Senegal River basin; sand dune encroachment control for the protection of tamourts, oases and towns; and a plantation of windbreaks as part of the Gorgel irrigation scheme. Such government programs are under the aegis of the Ministry of Rural Development.

WILDLIFE

The resource

In the northern Saharan zone of Mauritania wildlife is limited chiefly to insects, reptiles (especially vipers) and the occasional wild sheep and antelope, while the southern Saharan zone contains ostriches, gazelles, jackals and wild sheep, which also occur in greater numbers in the Sahelian zone along with bustards, wild ducks, fennecs, civets, otters, hyenas, warthogs, cheetahs, monkeys, and a great variety of birds. In the Senegal Valley there are lions, panthers, cheetahs, hippopotamuses in decreasing numbers as well as antelope, orxes, ostriches, warthogs and crocodiles.

The expansion of domestic herds on to grazing lands formerly limited to wildlife as well as uncontrolled hunting have led to serious declines in wildlife numbers in Mauritania and throughout the Sahel in general. In 1973 a French naturalist visiting Mauritania reported that he had not observed a single gazelle in an area where ten years before he had spotted at least twenty.

Wildlife utilization

The extent to which wildlife is exploited for consumption by Mauritians is not recorded, although antelopes and gazelles are reported to be hunted throughout the country. Hunting of animals for sport is also practiced.

Protection of wildlife and natural reserves

As indicated in the section on legislation, laws involving the protection of wildlife are in force; these contain, among other things, provisions prohibiting the carrying of firearms and completely proscribing hunting throughout the country. In addition, various reserves have been established; these reserves, the locations of which are indicated on the map on page 19a, are described below.

1. Reserve integrale de faune de la Baie du Levrier (Integral wildlife reserve of the Baie du Levrier)
Established: April 1962; Area: 3,100 sq km;
Wildlife: ostriches, gazelles, numerous seabirds.
Restrictions: within the reserve it is forbidden to destroy, to hunt or to capture game animals or to disturb their natural surroundings.
2. Reserve naturelle des Iles Mauritanienes (Mauritanian Islands Strict Nature Reserve)
Established: April 28, 1962; Area: 38 sq miles;
Wildlife: seabirds: long-tailed cormorant; gull-billed tern; royal, common, bridled and little terns; slender-billed and grey-headed gulls; spoonbill; grey heron; reef heron; flamingo.
Restrictions: complete prohibition on all hunting, whatever the weapons or methods employed, on the introduction of any species, collecting, forestry, agricultural or mineral exploitation, and on any act calculated to harm or disturb the fauna and flora. Exceptions permissible in the case of companies engaged in oil exploration and exploitation.

3. Parc nationale du Banc d'Arguin

Established: by decree of March 17, 1977

Purpose: propagation, protection, conservation and management of both marine and land flora and fauna as well as the protection of geological sites of a particular scientific and esthetic value, in the interest of and for public recreation.

4. Reserve partielle de faune d'El Aghor

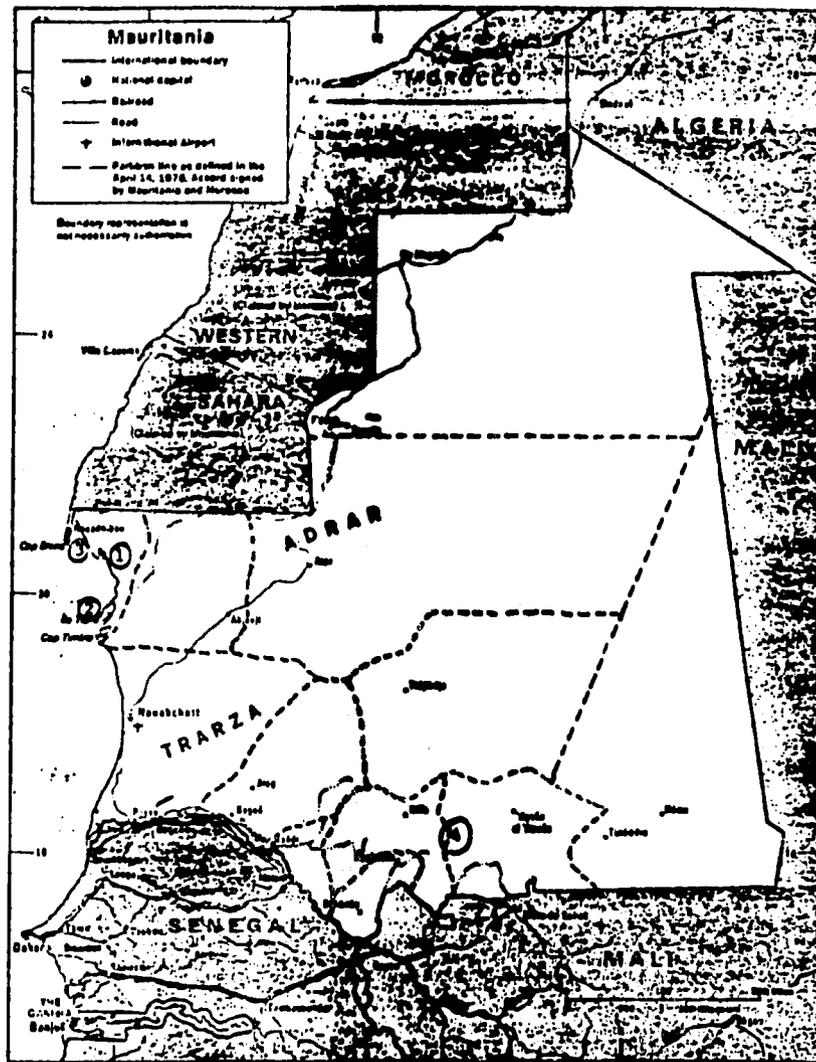
Established: June 21, 1937 Area: 3,710 sq km

Wildlife: elephants, gazelles (damas and dorcas), ostriches, lions, panthers, warthogs, leopards.

The reserve consists of two sections: a) a very remote, uninhabited area which is full of game but receives no supervision; and b) a more accessible area between the towns of Kiffa and Aïoun-el-Atrouss, the major objective of which is the preservation of a herd of about forty elephants.

Nature reserves are under the administrative purview of the Service des Eaux et Forets of the Ministry of Rural Development.

Locations of Mauritanian Nature Reserves and Parks



FISHERIES

The resource

The abundant fish of Mauritania's coastal waters, especially those of the Arguin Banks of the north, are an important natural resource. Several varieties of fish occur, most prominently mullet, and lobster are also found in abundance. To increase its control of this important resource Mauritania in 1972 extended its territorial limits from 12 to 30 miles.

The waters of the Senegal River are also a plentiful source of fish, among which Tilapia nilotica (locally called sidere) and Citharinus citarus (locally called dimbere) are most valued as food fish.

Utilization

Mauritania's Atlantic fishing grounds are presently exploited chiefly by foreign vessels, among which Japanese and Canadian ships figure quite prominently, but considerable quantities of the catch (about 70,000 tons in 1974) are brought into Nouadhibou for processing in Mauritanian plants. With the completion of the construction of a deepwater port at Nouakchott, fish processing will be extended to that city as well. Products of Mauritanian fish processing operations are frozen fish, fish meal, dried fish, oil, and canned fish.

Little of the fish catch of the Atlantic is consumed by Mauritians (only about 1,000 tons in 1974); the Maures, with certain exceptions, are not fisheaters. The overwhelming bulk of the production of Mauritania's fish-processing plants is exported, Japan, whose fleets are also responsible for considerable quantities of the catch, being the chief customer, followed by Spain, the Federal Republic of Germany, and Italy. France is the principal customer for lobster (langouste), importing nearly 15 tons per year.

The fish catch of the Senegal River is consumed predominantly by the fishermen themselves (there are an estimated 500 fishermen along the Senegal, many of whom are members of specific minority-group castes) or sold in local markets; a small quantity is dried and shipped to other areas. An estimated 15,000 tons of Senegal River fish was consumed in 1972.

MINERALS

The resource

Mauritania's mineral wealth consists of iron ore deposits at Zouerate, copper deposits at Akjoujt, and gypsum deposits to the north of Nouakchott. These resources, which have exploited only in the past decade, are responsible for producing the major portion of Mauritania's foreign exchange. Important salt deposits are found in the Saharan zone not far from Zouerate; these have been exploited for centuries by the Maures, who transport the salt by camel to other areas of the country, principally Adrar and Tichitt. Reserves are said to be almost inexhaustible.

Presently exploited mineral wealth

| <u>mineral</u> | <u>reserves (tons)</u> | <u>production per year (tons)</u> | <u>expected date of exhaustion</u> |
|--|--|---|--|
| iron ore (rich) | 76,000,000 | 9,415,000 (1976) | 1987 |
| copper oxides (2.7% copper, 3.6g/t gold) | 2,300,000 (as of 1975) | 9,433 (copper con- tent of processed ore) | 1979 |
| copper sulfides (to be mined beginning in 1979) | 16,900,000 at 2.25% copper and 1.3g/t gold | a projected 1,220,000 tons of concentrate with a 25% copper content | 1993-1999 |
| | 36,000,000 at 1.28% copper and 1.28g/t gold | 100,000 tons of con- centrate or 25,000 tons of copper per year (projection) | 1993-1999 |
| gypsum | 4 billion | 11,991 (1976) | not foreseen |
| salt | immense reserves | 650-700 (15,000 bars) | not foreseen |

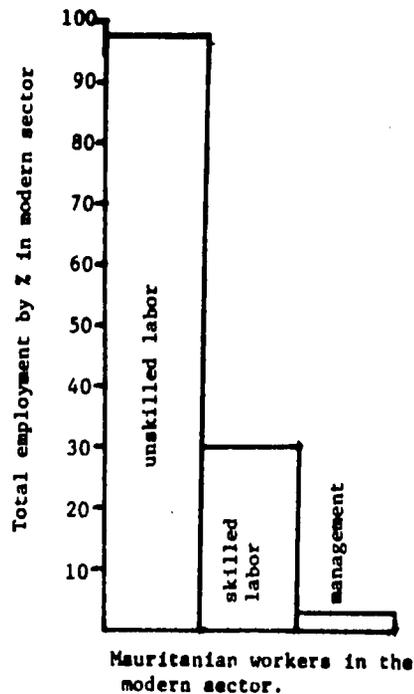
Faced with the foreseeable exhaustion of its richest mineral reserves, Mauritania intends to begin exploiting less rich iron ore deposits in about 1982. Meanwhile, the search is continuing for further deposits of copper and iron ore as well as for phosphates, sulfur, chromium, beryllium, and rare earths (yttric earths). Foreign firms have been conducting searches for petroleum along the Mauritanian coast since 1966; to date no reserves have been discovered.

Small scale mining operations yield construction materials such as sand, gravel, clay, and stone.

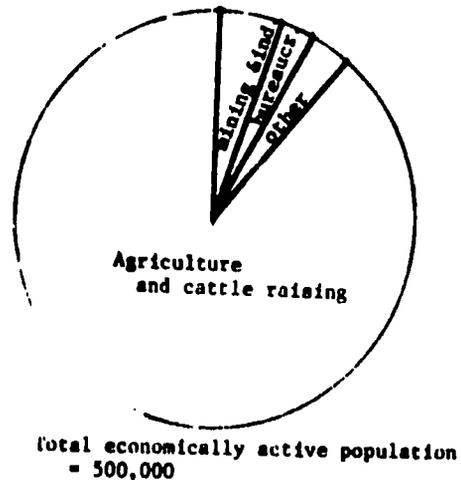
Utilization: Nearly all of Mauritania's minerals are exported, chiefly to France.

5.0 THE ECONOMY OF MAURITANIA AND ITS ENVIRONMENTAL CONSEQUENCES

The economy of Mauritania is sharply divided into two sectors: the modern (mining) and traditional (farming and livestock herding). Although the modern sector has been responsible for a great increase in the Mauritanian GNP (\$460,000,000 in mid-1975/\$340 per capita), little of the wealth generated by this sector actually reaches the mass of the population of the country. The modern sector offers few jobs for Mauritanians, and those available are mostly lower paying positions (see graph below).



ECONOMICALLY ACTIVE POPULATION BY SECTOR (1975)



For 1974, the GDP was calculated at \$241.5 million; per capita for the modern sector was about \$500, for the traditional, on the other hand, only about \$70.

The effects of the recent drought have led to increased government interest in the development of the rural sector of the economy: the present four year plan (1975-1979) calls for 18.6% of investments in the rural sector (previous plan: 14%); 20.5% in the modern sector (previous plan: 34%); 44.3% for infrastructure (previous plan: 33%); and 16.6% for the social and cultural sector (previous plan: 19%). More of the revenues from mining operations are also expected to be directed toward the rural sector than in the past.

Traditional Sector

Livestock

Livestock herding, chiefly by nomadic Maures, has been the dominating activity of the traditional Mauritanian economy. Most of the cattle, sheep and goats produced by this sector have been exported on the hoof to Dakar in Senegal, but because this is an unofficial activity, they do not occur in government statistics. For noncommercialized livestock herders, milk--the principal source of food for the nomads--has been the most important output. Livestock are also slaughtered for meat; a small-scale effort to commercialize this aspect of livestock raising was made with the establishment of a slaughterhouse in Kaedi in 1969.

Although livestock statistics for Mauritania are highly unreliable and vary widely from source, the following table using statistics taken from the Mauritanian government and from the UN Food and Agricultural Organization should give some idea of the growth and decline of livestock numbers over the past twenty years.

Livestock herds by category

| Herd | <u>thousands of heads</u> | | | |
|------------------|---------------------------|-------|-------|-------|
| | 1959 | 1968 | 1973 | 1975 |
| cattle | 1,250 | 2,300 | 1,900 | 1,900 |
| sheep & goats | 8,000 | 6,700 | 5,200 | 4,800 |
| camels | 500 | 720 | 700 | 722 |
| asses | 200 | 300 | 230 | 271 |

As reflected in these figures, the drought of the 1970's has had a serious effect on livestock; the reduction of pasturelands and water sources during these years led to the death, slaughter or transportation out of the country of large numbers of livestock. The loss of herds and the exhaustion of their pasturelands has resulted in the movement of nomads into the southern region of the country, especially into urban areas such as Nouakchott; although some reversal of this trend was noticed in 1976, the renewed drought of 1977 took many more nomads from the land. At worst, this important and once dominant sector of the economy, deprived of its workers, is threatened with collapse.

Environmental effects of livestock raising

The pressures of large herds of cattle and other livestock on the frail and limited vegetation resources of the land have frequently been cited as one of the chief reasons for the progress of desertification in the Sahelian region of Mauritania and other West African nations. In Mauritania, as in other nations of the Sahel, a series of years of good rains and the establishment of boreholes to provide watering places for animals, encouraged the growth of livestock herds; this, in conjunction with the expansion of farming activities, has not only led to the replacement of open woodland by grass steppe in much of the Sahelian zone of the country but also strained the scant vegetation resource to the point where it was unable to meet the demand placed upon it when the drought of the early 1970's struck. The loss of human and animal lives as well as of land to the desert were the result.

Farming

Traditional agriculture, consisting of the growing of millet and sorghum, is practiced mainly in the flood plains of the Senegal River, although small amounts of millet are grown under rainfall conditions beyond this zone, and seasonal crops are also harvested about the wadis in the Saharan and Sahelian zones. Most of this crop, which is grown under primitive conditions without the use of animal-drawn plows or fertilizers, is consumed by its producers as are also the dates grown in the oases of the north. Because of the drastic reduction in agricultural output during the early years of the 1970's and once more during the dry year of 1977, Mauritania has been forced to buy or accept as relief large quantities of its grain needs.

The following table compares agricultural production during a "normal" year (1969) with that during the drought years.

| Product | Production in metric tons | | |
|--------------------|---------------------------|-----------|--------|
| | 1969 | 1973-1975 | 1977 |
| millet and sorghum | 100,000 | 30,000 | 30,000 |
| wheat | 300 | 3 | * |
| sweet potatoes | 2,000 | 4 | * |
| dates | 17,000 | 13 | * |
| rice | 1,000 | * | 2,484 |
| cow peas | 400 | 8 | * |

* Indicates figure not available

A significant development on the agricultural scene is the increased production and consumption of rice. At M'Pourie, an experimental station near Rosso maintained by the Ministry of Rural Development, rice has been grown for the past several years with the financial and technical assistance of the Chinese. This farm, which harvested 2,484 tons of rice in 1977, is now expanding its operations and is expected to meet about 10% of the rice needs of the country. Rice, now being grown in other areas as well, is becoming increasingly preferred by Mauritanians, especially in the cities, to the traditional millet and sorghum, a changing food taste which is bound to have important effects on agricultural developments. In recent years, Mauritania has been importing or receiving in relief about 32 tons of rice per year.

The only current agricultural export item is gum arabic, about 1,500 tons of which are shipped to Senegal each year.

Farming and the environment

Expanded agricultural activities during years of abundant rainfall led to a clearing of land for farming and a strain on the limited soil and water resources which became all too evident during the drought years of the 1970's.

The Sahelian drought has forced Mauritania to place greater emphasis on agricultural development, especially on the kind of controlled irrigation that could open up new lands to agricultural endeavors not dependent on the often unreliable rains. Major schemes with their goal of food-independence for Mauritania have been considered under the section on water resources.

It is generally agreed that Mauritania, in its agricultural development, must strike a delicate balance between the needs of its people and the limitations of its soil and water resources.

THE MODERN SECTOR AND ITS ENVIRONMENTAL EFFECTS

The modern sector of the economy, based chiefly on the mining and exportation of iron and copper is responsible for the growth of the Mauritanian GNP in recent years and accounts for 80% of total exports. Exploitation of these resources is in the hands of state companies, iron mining having been nationalized in 1974 as COMINOR (Complexe Minier du Nord) and copper mining, earlier carried out by SOMIMA (Societe Miniere de Mauritanie), in 1975. Extraction of these minerals as well as of the gypsum reserves is under the general direction of a state corporation: Societe nationale industrielle du Nord (SNIM).

MINING

| MINERAL | Location | Production (1976) | Ownership | Resources affected | Environmental effects |
|---------|---------------------|------------------------|----------------------|---|-----------------------|
| Iron | Zouerate | 9,415,000 tons of ore | COMINOR/SNIM (state) | water piped in for mining | strip mining |
| Copper | Akjoujt | 9,433 (tons of copper) | SNIM (state) | water piped in for mining and processing operations | strip mining |
| Gypsum | north of Nouakchott | 15,000 tons | SNIM (state) | uncertain | uncertain |

No data is available regarding potential or actual environmental effects of current mining operations. Both iron and copper mines are, however, located in the Saharan region of the country in settings already so barren as to be scarcely susceptible of significant environmental damage. Nor are they located in the vicinity of significant groundwater or surface water resources that might be adversely affected by their operations. The possible effects of the operations on workers working in and living near the mines have not been documented. Data on environmental controls could not be found.

FOOD PROCESSING INDUSTRIES

FISH PROCESSING

The waters off the Mauritanian coast are rich in fish, an estimated 200,000 to 300,000 tons being caught each year, predominantly by foreign fishing fleets. Most of this catch is shipped directly to Europe. In 1974 about 70,000 tons of fish were unloaded in Nouadhibou for processing. Nine different firms are involved in the freezing, drying, and canning of fish as well as in the production of fish meal and oil. The following firms bore the greatest share of this work:

FISH PROCESSING PLANTS

| <u>Name</u> | <u>Location</u> | <u>Established</u> | <u>Operations</u> | <u>Ownership</u> | <u>Pollution</u> |
|---|-----------------|--------------------|--|------------------|------------------|
| IMAPEC Industries Mauritaniennes de Peche | Nouadhibou | 1970 | drying, oil and meal, freezing, canning | private | water? |
| SOFRIMA Societe des Frig- oriques de Mauritanie | Nouadhibou | 1966 | freezing | private | water? |
| MAFCO Mauritanian Fishery Co. | Nouadhibou | 1971 | freezing | private | water? |

No data could be found on environmentally damaging aspects of Mauritanian fish processing operations or on environmental controls.

OTHER FOOD PROCESSING INDUSTRIES

| Name | Location | Established | Ownership | Nature of activity | Production | Pollution |
|--|------------|--------------------------------------|-----------|--|-----------------------------|-----------|
| SONICOB (Societe nationale pour Industrial-du Betail) | Kaedi | 1969 | state | meat freezing & leather production | 500 t per year | water? |
| SOSUMA (Societe sucriere de M) | Nouakchott | 1978? (ready to begin operations) | | sugar refining, production of loaf sugar | 1,000 ton per year capacity | water? |
| SOBOMA (Societe des Boissons de M.) | Nouakchott | 1975 | | production of soft drinks | | |

CHEMICAL INDUSTRY

| Name | Location | Established | Ownership | Nature of activity | Production | Pollution |
|--|------------|-------------|-----------|---|--|-----------|
| SOMAUURAL (Societe M. des Allumettes) | Nouakchott | 1972 | private | production of matches | 17,280,000 matchsticks (1977) | |
| SMGI | Nouadhibou | 1968 | private | oxygen and acetylene for mining as well as medical and surgical materials | 10,000m ³ oxygen, 28,000m ³ acetylene (1973) | |

ELECTRICITY PRODUCTION

| Name | Location | Established | Ownership | Nature of activity | Production | Pollution |
|---------|---|--|-----------|------------------------|---------------------------|-----------|
| SONELEC | Nouakchott Nouadhibou Kaedi Rosso Akjoujt Atar | 1965 1955 1969 1970 1970 1973 | state | electricity production | 39,609,809KW total (1976) | |

INDUSTRIAL PLANS

Industries in the planning or study stage include dairy at Rosso, a textile complex in Nouakchott and a petroleum refinery at Nouadhibou with a capacity of one million tons per year of gasoline. Increases in electricity production to support mining operations are also planned.

INDUSTRY AND POLLUTION

Mauritanian industrial development is still at a very early stage, and, with the exception of the fish-processing operations in Nouadhibou, does not contribute significantly to the nation's overall economy. The environmental effects of this nascent industry have not been recorded, although pollution of sea water from fish-processing plants and air pollution from electricity production might be presumed to be present to some degree. In any case, pollution and environmental damage from the modern sector do not presently and most likely will not in the foreseeable future pose the same nearly overwhelming problems for Mauritania as do the complex of problems arising from the drought and abuses in the traditional sector.

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