

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**  
**PROJECT FOR THE DEVELOPMENT OF THE OASIS,**  
**MINISTRY OF RURAL DEVELOPMENT AND ENVIRONMENT**

**THE STUDY**  
**ON**  
**THE DEVELOPMENT OF THE OASIS ZONE**  
**IN THE**  
**ISLAMIC REPUBLIC OF MAURITANIA**

**FINAL REPORT**

**MAIN REPORT**

**SEPTEMBER 2004**

**PACIFIC CONSULTANTS INTERNATIONAL**

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Exchange rate (July 2004)		
US\$ 1.00	=	UM 247.36
UM 1.00	=	US\$ 0.00404
US\$ 1.00	=	Yen 108.70

## **PREFACE**

In response to a request from the Government of the Islamic Republic of Mauritania, the Government of Japan decided to conduct the Study on the Development of Oasis Zone in the Islamic Republic of Mauritania and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a study team headed by Mr. Michiaki Hosono of Pacific Consultants International for 7 times to the Islamic Republic of Mauritania between May 2001 and July 2004.

The team held discussions with the officials concerned of the Government of Mauritania, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government and those concerned in the Islamic Republic of Mauritania for the close cooperation they have extended to the study.

September 2004

Etsuo Kitahara

Vice-President

Japan International Cooperation Agency

Mr. Etsuo Kitahara  
Vice-president  
Japan International Cooperation Agency

### **Transmittal Letter**

We are glad to submit the Final Report of “The Study on the Development of Oasis Zone in the Islamic Republic of Mauritania”

The report consists of the master plan and priority projects/programs on the development of the study area, which have been prepared in consideration of the advices and recommendations of relevant ministries of the Government of Japan and JICA on formulation of the development plan, as well as the discussions with the Mauritanian counterpart on the Draft Final Report and their comments on the report.

The study area, Adrar region and Tagant region, are located in the arid zone of central Mauritania where severe poverty dominates over the numerous oases. To secure the existence and longevity of the oases by establishing sustainable livelihood of the inhabitants is of significant importance, from the viewpoint not only of poverty alleviation but also of the cultural traditions of Mauritanian people.

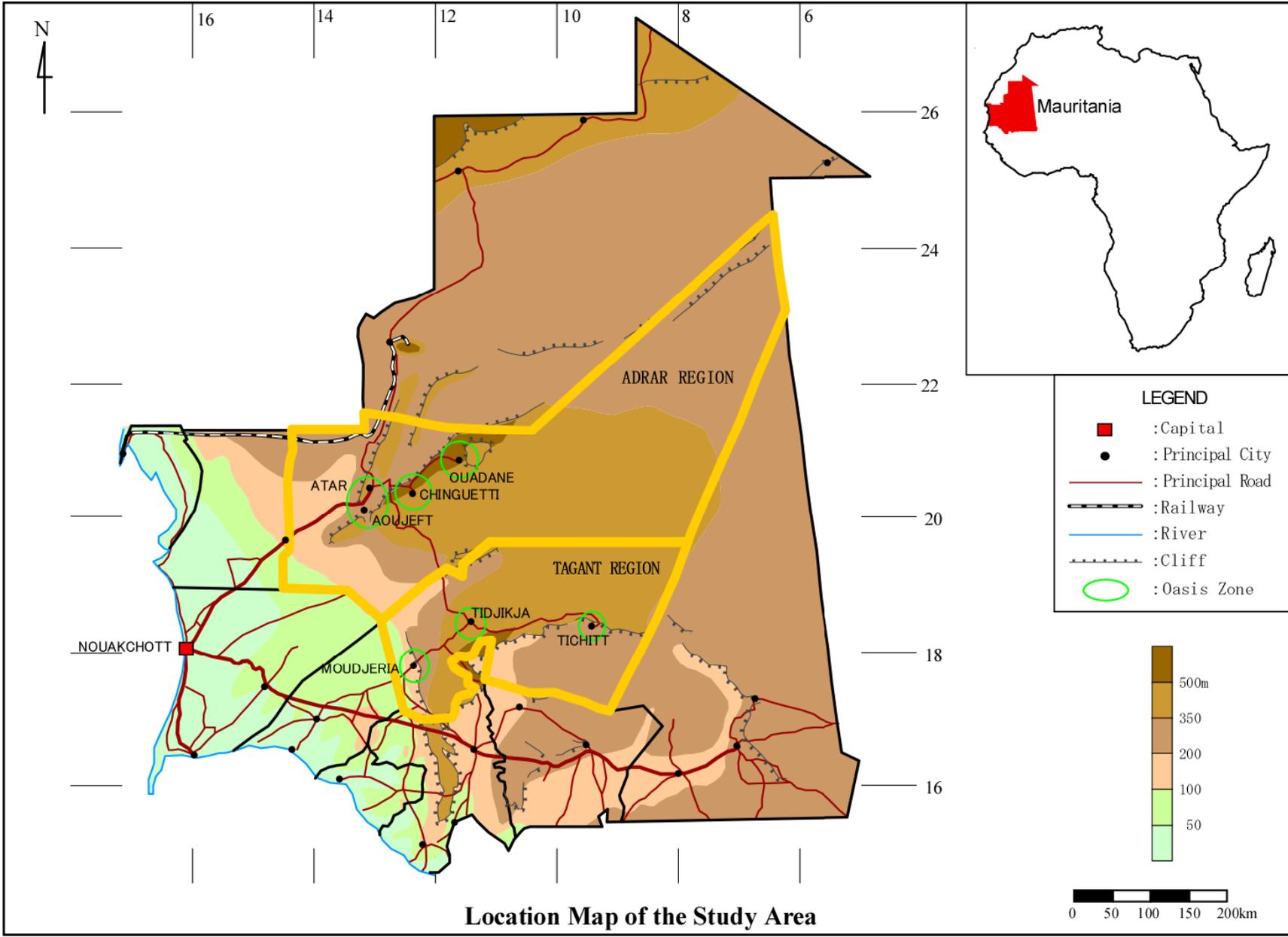
In this report, we proposed an integrated regional development plan, which will contribute to the achievement of the reduction of poverty by half in the oasis zone. Introduction of appropriate agricultural techniques, improvement of public health conditions, sustainable use of natural resources and development of basic infrastructures are the major components of the plan, aiming at activation of regional economy and improvement of living standards of oasis people. High possibility of realizing these components has also been verified by the results of pilot study. It is thus anticipated that these plans be put into implementation as soon as possible following the implementation schedule proposed in the report.

Taking this opportunity, we express our sincere gratitude to the officials of your Agency, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries of the Government of Japan for their valuable advices and recommendations for our study. We are also grateful to the officials of the Ministry of Rural Development and Environment of the Islamic Republic of Mauritania and the Oasis Project and other public organizations involved in the Study for their devoted cooperation and support during the implementation of the Study in Mauritania.

Sincerely yours,

Michiaki Hosono  
Team Leader

The Study on the Development of Oasis Zone



## 1. NATURE



Wadi between plateaus



Sand dune



Plateau

## 2. PRINCIPAL INDUSTRIES



Nomadic grazing of camel



Nomadic grazing of sheep



Raising of goat



Cultivation of date palm



Vegetable cultivation under date palms



Vegetable cultivation under date palms



Rain-fed farming



Handicraft



Ecotourism in desert

### 3. OASIS



Overview of oasis



Overview of oasis



Kindergarten



Primary school



Primary school

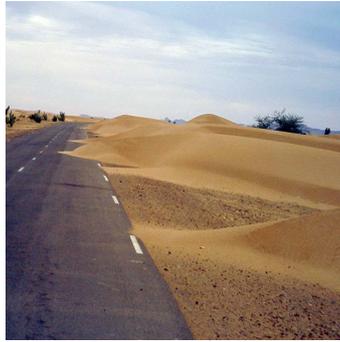


Literacy education for adults

#### 4. DISASTER



Afforestation against damages by sand shifting



Damage on road by sand shifting



Fencing to prevent damages on road



Flood after rainfall



Scenery after rainfall

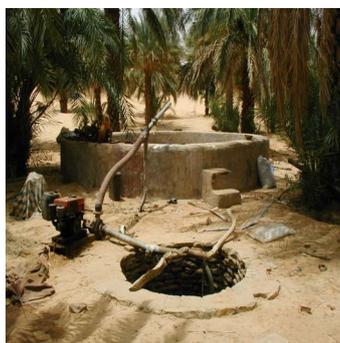


Destruction of road by flood

#### 5. WATER RESOURCE AND ITS UTILIZATION



Water drawing with shadouf



Water drawing with pump



Provision of drinking water



Water loss in canal and damage by excessive irrigation



Excessive irrigation



Well for livestock

## 6. PILOT STUDY



Workshop



Meeting of women at workshop



Technical training on vegetable cultivation



Practice of ridging



Monitoring of yield of vegetable



Vegetable cultivation



Monitoring of groundwater level



Water-saving cultivation



Chicken house



Poultry farming



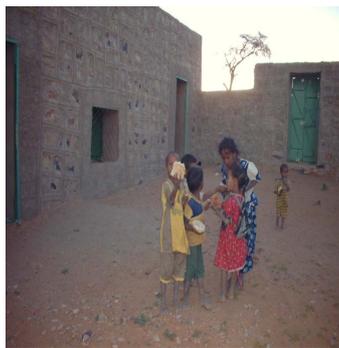
Education on public health and hygiene



Practice of cooking with solar-cooker



Practice of baking bread



Tasting the bread after practice



Tasting the harvested vegetable

THE STUDY ON  
THE DEVELOPMENT OF THE OASIS ZONE  
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FINAL REPORT

*Executive Summary*

**1 INTRODUCTION**

(1) Background of the Study

The great majority of the Islamic Republic of Mauritania (hereinafter referred to as IRM) lies within desert zone, with an average annual rainfall less than 50 mm. Repeated droughts taken place recent years brought about serious damage on agriculture and livestock sector, a mainstay in economic activities of the oasis region of the country.

In the light of the situation mentioned above and aiming at promoting an efficient development in the Oasis areas of Adrar and Tagant regions, the Government of IRM requested the Government of Japan a technical cooperation for “The Study on the Development of the Oasis Zone” (hereinafter referred to as “Study”) on August 19, 1999.

(2) Objective and Scope of the Study

The target region of the present Study is: Adrar region (Approx. 223,000 km<sup>2</sup>) and Tagant region (Approx. 97,000 km<sup>2</sup>) and the objectives of the Study comprise:

- 1) To formulate an integrated regional development plan serving to an achievement of a stable livelihood among the local people based on sustainable use of the natural resources in the Study area.
- 2) To hasten self-reliance of Mauritanian counterpart personnel by means of technical transfer relevant to planning procedure and methodology of development projects/programs as well as study methodology of respective item.

**2 OUTLINE OF THE COUNTRY**

(1) Natural Conditions

IRM is located at the western end of the African continent. Although the country has an area of 1,030,000 km<sup>2</sup>, equivalent to 2.7 times as extensive as that of Japan, its population is only 2.7 million in 2000. The population had been increasing at an average rate of 3% per year for the period 1996-2000. Population density of the country is extremely low, 2.6 persons per km<sup>2</sup>, because roughly two-thirds of the land belong to barren Sahara Desert and the rest is occupied by Sahel zone that is unsuitable for crop

cultivation. Topographically, the country is almost flat except for the central plateau that is 400 to 500 m in altitude.

## (2) Economy

The average growth rate of GDP during the period 1998-2002 was 9.5% and primary industries showed a slightly lower growth rate (6.1%) than that of the average of all industries.

Iron ore and marine products are the major exports of the country accounting for 99% of the foreign trade earnings, but export of iron has showed declining trend recently.

The leading imports are industrial goods, foodstuff and raw materials; import amount of foodstuff is variable year by year, meanwhile that of industrial goods is expanded rapidly in recent years.

## (3) Agriculture

Agricultural production represents 3.2% of the GDP. Most of crops except for paddy are cultivated rain-fed and their production is largely dependant on amount of rainfall resulting in remarkable fluctuation in their production for the period 1996 – 2000, as a consequence of extraordinary meteorological behavior. Meanwhile, paddy is cultivated under irrigation along the River Senegal, attaining relatively consistent production.

Livestock sector plays a major role in the national economy accounting for 14.2% of total GDP and 76% of GDP of the primary sector.

The most consumed foodstuff is wheat, but almost all food is imported. The average self-sufficiency ratio of cereals, therefore, is only 44%. Vegetable cultivation is expanded in recent years, but its self-sufficiency ratio is still only 34%.

## (4) Society

### 1) Outline of the Society

During the 90s, the country invested intensively in education, medical care and poverty alleviation measures. As a result, several social indicators showed slight improvement from 1990 to 1996 in such manner as: life expectancy (from 48.6 to 51.8 years), infant mortality (from 128.7/1,000 to 113.7/1,000 persons), illiteracy rate (from 66% to 62% (as of '95)) and poverty rate (from 56% to 50% (as of '95)) etc.. However, these figures still remain at low levels.

### 2) Gender Issues

The national plan for the promotion of women's status was prepared in 1995. The plan was made for the purpose of improving the socio-economic environment of women. The plan especially focuses on improvement of productivity and quality of the products made by women in order for them to achieve higher income. It also foresees women's more active contribution to the social and economic activities. However, the proportion of female officers in governmental organizations and political bodies remains at only 10% and most of them are working in SECF (Secrétariat d'État à la

Condition Féminine).

The Law of Personal Status Code was enacted in 2001 to encourage gender equality and established the legal foundation to protect women's rights.

(5) National Development Policy

One of the major national policies of the country is poverty alleviation. About a half of the country's population lives in poverty (with income less than UM 53,841/capita/year) and one-third of them are in extreme poverty (with income less than UM 40,701/capita/year). It also showed that three-quarters of such poor population lives in rural areas. Therefore, reducing this poverty-level population by half by 2015 in the rural areas was selected as one of the major national development goals.

The strategies proposed to achieve this goal are:

- Increase income by propagation of appropriate dates cultivation techniques
- Increase vegetable productivity
- Livestock development

### **3 OUTLINE OF THE STUDY AREA**

(1) Administrative Division

The administrative division of the Study area consists of: 2 regions, 7 departments (Moughataa) and 21 cities (Commune); each city comprises several oases.

At present, a total of 117 (57 for Adrar and 60 for Tagant) oases are recognized in the Study area. Out of these 117 oases, associations (AGPO) have been formed at 23 oases in Adrar and in 18 oases in Tagant.

(2) Population

The population in the Study area was approximately 78,000 in 2000 accounting for 3% of the total national population. The population decreased at a rate of 4.2% per annum during the period 1988 to 2000. Main causes of thus decreased population are migration to urban area for job hunting and high infant mortality rate.

(3) Regional Economy

As of 1998, the GRDP for Adrar region and Tagant regions represented only 1.4% and 0.5% each of the GDP, which means that the two regions do not make much contribution to the national economy. The per-capita GRDP value was: UM 47,713 for Adrar region and UM 29,453 for Tagant region, which are below the national average by 71% and 44%, respectively.

The major economic activities in the regions are livestock raising and dates cultivation. In recent years economic activity has diversified thanks to introduction of vegetable cultivation and handcraft at many oases, which triggered organizing of associations and cooperatives.

#### (4) Society

For the primary school in both Adrar and Tagant regions, the number of pupils per teacher is similar to the national average: 84 pupils per school and 35 pupils per teacher. Both regions have schools twice as many as the number of the oases. These facts suggest that the primary education is well developed in the Study area.

Per capita annual income in Adrar (UM 23,761) is much higher than that of Tagant (UM 14,073). The average annual income levels of the two regions are far below the poverty line of UM 53,841. It is also revealed that the income of women-headed household is lower in both regions than that of men-headed household.

The people in Adrar earn more money from vegetable (22%) and dates (20%), while the people in Tagant earn more from non-agricultural activities (48%) and from allowances (10%) their relatives sometimes send them.

#### (5) Agriculture

Annual production of date in the Study area is estimated to be 7,173 tons in Adrar region and 5,670 tons in Tagant region, accounting for 36 % and 28% of the national production, respectively. The production volume of date in the Study area represents close to 65% of the country's production volume.

The vegetable production for the year of 2000 was 13,862 tons in Adrar region and 50 tons in Tagant region. The total output within the Study area, therefore, is 21% of the national output.

The share in number of animals of the Study area within the country is 3.7 % for sheep and goats and 8.5 % for camels. At the national level, livestock production accounts for 65% within the agricultural sector in terms of GDP. In the Study area, livestock production's share within the agricultural sector of the GRDP is 43% in Adrar region and 75% in Tagant region. These figures are lower than the national average for Adrar region and higher for Tagant region.

#### (6) Natural Conditions

##### 1) Meteorology

Meteorologically there are three seasons in the Study area: Rainy season with high temperature (July – October), Dry season with low temperature (November – March) and Dry season with high temperature (April – June). Annual mean rainfall is 75.0 mm at Atar station and 118.1 mm at Tidjikja station for the last 40 years. About 80 - 84% of the annual rainfall concentrates during the rainy season. The distribution of annual rainfall is irregular with random occurrence of rainy and drought years; the range of fluctuation is quite large. Single drought and rainy years have appeared roughly every other year after 1990.

The mean annual temperature is 28.4 °C. The highest monthly temperature was 34.9 °C recorded in July in Atar and 34.8 °C recorded in June in Tidjikja, respectively. The difference between maximum monthly temperature and minimum one is 24.4 °C in Atar and 22.3 °C in Tidjikja. Monthly mean wind velocity is more than 3 m/sec at both stations. The dominant wind direction is from between

the north and the west in Atar and from between the north and the east in Tidjikja.

## 2) Geography

The topography of the Study area is divided into: plateau/waved hills, alluvial fan, flood plain, sand dunes and wadis. The most important geographical unit from the hydrological point of view is the wadi. The principal wadis extend along lineaments, which have close relation with the distribution of oases.

## 3) Geology

Geological layers are composed of sandstone, schist, calcareous rocks overlay crystalline basement with gentle dips. Quaternary sediment, which is composed of eolian, wadi, flood and fan deposits, is distributed over paleo-geographical depressions.

## 4) Vegetation

In the Study area, there is little woody plant and the dominant vegetation is gramineous grass, which is called *Stipagrostis pungens*.

## (7) Sand Stabilization and Afforestation

The first attempt to control sand in the Study area was started by the Project of Fighting against Sand Dune Invasion and the Development of Agriculture, Livestock and Pasture (Projet Lutte contre L'Ensablement et Mise en Valeur Agro-Sylvo-Pastorale: PLEMVASP) in 1983. This project aimed not only at sand stabilization and afforestation but also at pastoral management and agricultural production increase. By the end of the project in 1997, projects on sand stabilization and afforestation including new development activities were realized at 765 sites (approximately 6,900 ha). Most of the afforestation projects were carried out in the southern part of the country and those conducted in the Study area accounted only 9 % (6.1% in Adrar and 2.7 % in Tagant).

## (8) Hydrogeology

The groundwater in the Study area can be classified into the following three types:

- Groundwater along wadis
- Groundwater under sand dune
- Fissure water along fracture zones in Basement rocks.

The most popular groundwater is located along wadis. Rare and intensive rainfalls recharge the shallow aquifer through percolation. This type of groundwater is under slight confinement. Groundwater under sand dune is recharged through percolation into sand dune without evaporation along ancient river courses. Fissure water consists of two types of groundwater: one stored within fractures, joints and schistositities, and the other stored within permeable zones along regional faults and shear zones. This groundwater plays an important role in the water supply for the urban area.

#### (9) The Oasis Development Project

Oasis Development Project is under MDRE and is engaged in development activities in oases regions with the financial support from FADES and IFAD. The Project accelerates establishing oasis participatory management association (AGPO) in conjunction with the Regional Coordination Committee that is usually headed by the WALY. In the year 2000 the projects were implemented in the following fields:

- Supporting of oasis organization formation
- Supporting of oasis organization activities
- Infrastructure improvement (roads, drinking water, water withdrawal facilities)
- Credit system
- Hydraulic facilities improvement
- Afforestation activity
- Enlightenment activity aiming at increasing income for women
- Technical extension and training

The budget for the year 2000 is UM 617 million and one-third is allocated to management, the rest to association activities. The activities of the Oasis Participatory Management Association (AGPO) cover a wide range of activities relevant to lives of oases like: water use, ecology, gender issue, etc., besides agricultural production, a mainstay of economic activities.

#### (10) Tourism

The number of tourists in 1999 was 3,055 in Adrar region and 156 in Tagant region, respectively; it is expected to reach 10,000 in the former and 800 in the latter, respectively in 2000. On the other hand, environmental pollution turns out a serious problem because of the garbage left by tourists.

### **4 GENERAL CONDITIONS OF OASES**

#### (1) Agriculture

##### 1) Land Use

The soils in the Study area consist of mostly fine sand in their greater portion characterized by low nutrient contents and low cation exchange capacity. Alluvial soil covers only 24,000 ha, which is very important for rain-fed agriculture.

The total area of land used for agriculture in the Study area is only 29,000 ha (0.1 %). About 57 % of the agricultural land is used for rain-fed cereal cultivation, followed by 40% for dates cultivation and 3% for vegetable cultivation.

##### 2) Date Palms

Dates are most important agricultural products in the oases both economically and culturally. Date palms are considered productive only from the 10th to 60th years and reach its peak production at around the 40th year. The number of tress of date palm showed upward trend from 1995 to 2000

within the Study area as a general, although decreasing trend is observed at remote oases. The productivity of date palm in Tagant region is higher about by 50% than that in Adrar region.

The varieties of date palm cultivated within the Study area are 5 in total and their share is different from region; in Adrar region, the variety of El Homr represents 80% of the total varieties, meanwhile in Tagant region the varieties of Tentegal and El Homr account for each 49% and 47%. Harvested dates are forwarded to Atar and Tidjikja, both are capital of the region.

### 3) Vegetables

The vegetable cultivation in the Study area has expanded rapidly after the formation of oasis associations (AGPO) at many oases and a variety of vegetables are cultivated at these oases. Even though most of the other remote oases simply consume their production within the oases, a dozen of oases located near Atar or Tidjikja produce some common vegetables like carrot to send them to the markets in these cities. However, high transportation cost and severe price competition during the harvest season ( October –March) usually act counter to the benefit to the farmers. The farm gate prices end up usually one-fifth of the retail price in Nouakchott. This seems to be a constraint that needs to be eased in promoting vegetable cultivation. The planted area of vegetables is 950 ha in Adrar region and 44 ha in Tagant region and unit yield of vegetables remains low: 14.6 tons/ha in Adrar region and 1.1 tin/ha in Tagant region. The depressed productivity is attributable to the incident of root rotting caused by excessive application of irrigation water.

### 4) Cereals

Cereals cultivation area is 5,430 ha in Adrar region and 11,145 ha in Tagant region. The principal crops are sorghum and millet. However, their output is inconsistent because they depend on rain-fed cultivation that limits planted area according with the amount of rainfall.

### 5) Livestock

Main livestock raised in the area are camels, goats, sheep and cows. Due to limited feed resources in Adrar, the number of cows is much fewer than that in Tagant. Average number of livestock per household is about 20 heads and about 90% of households raise livestock such as goats, sheep and camels.

Generally the economically efficient male/female livestock ratio is said to be 5 to 10% for males. The ratio of female animals in the Study area is about 80% and the male ratio is rather high.

### 6) Extension of technologies

The following agricultural extension institutions exist in the Study Area:

- Regional office of Ministry of Rural Development and Environment (MRDE)
- Oasis Project
- Regional rainfall natural resource management project (PDRNG)

However, they cannot perform their expected functions because of deficient assignment of personnel.

Means for acquaintance of necessary technologies by farmers is different by region; in Adrar region through other farmers, while in Tagant region depending on technical assistance rendered by government institutions and non-government organizations. . Application of chemical fertilizers and agricultural chemicals is scarcely made in both of the regions.

#### 7) Marketing organizations

SONIMEX purchases nothing but carrot from farmers in order to support them at oases in Adrar region through market in Atar. Part (50 – 100 tons) of thus purchased carrots are preserved at refrigerator for their sale afterward, from April to May and the rest are abolished due to the limited capacity of the refrigerator.

#### (2) Irrigation

Main irrigated crop at the oases is date and most water is used for this crop. In general date palm is irrigated only about 3 or 4 times a month during rainy season. It is after the rainy season that irrigation becomes intensive. It continues at a pace of 2 to 3 times per week for the following 6 to 7 months until the flowering season. The amount of irrigation water is gradually reduced after that.

Generally, irrigation water is distributed to the farms through earth canal and water loss by infiltration is estimated to be significant. Therefore, it is indispensable to come up with an idea to save water by either reducing infiltration or making use of the infiltrated water.

In terms of water quality, 61% and 77% of groundwater in Adrar and Tagant respectively falls under the category of S1 and S2, which are suitable for irrigation.

#### (3) Water Resources

##### 1) Groundwater

Groundwater is the only available water resource, which can be divided into shallow and deep groundwater in the Study area. There are 15,644 wells in Adrar region and 8,835 wells in Tagant region and combined number of these wells was increased by 42% for the past 10 years (1990 – 2000). Shallow wells are commonly made by traditional method with stones and concrete. Most of wells have a depth of less than 10 meters from ground level. In Adrar region, about 51% of irrigation wells are equipped with motor pump. Meanwhile in Tagant region, traditional manual drawing of water is common. The wells are principally owned by individual households and joint ownership is exceptional.

The successive drought years caused drastic drop of water level in the early 70s. 60% of wells indicate declining water level in Adrar region while only 20% of the wells are observed this drop in Tagant region. The introduction of motor pumps accelerated the drawdown of water table in Adrar region.

There are 54 boreholes depending on deep groundwater level in Adrar region and 65 boreholes in Tagant region and water taken from these wells is mainly used as potable water both at urban and rural sectors of the regions. All deep wells are equipped with a submersible pump that is usually

powered by diesel or gasoline generator in Adrar region and solar panel in Tagant region. In so far as the productivity of deep groundwater is concerned, some wells are not in a position to supply the expected water amount.

## 2) Hydrogeology

High salinity constitutes major problem of water quality. Oases depending on wells that contain highly saline water are scattered throughout the Study area. Other subject relevant to water quality is contamination of shallow groundwater caused by colon bacilli and some wells contain highly contaminated water not suitable for its use as potable water. This contamination occurs when animal dung and shifting of sand fall into shallow wells.

## 3) Groundwater demand projection

It is projected that water demand for domestic water supply for the year of 2000 is 39,000 m<sup>3</sup>/month in Atar and about 30,000 m<sup>3</sup>/month in Tidjikja. According to water demand projection by 2025, it is presumed that the demand would be increased by close to 55% in comparison with that in 2000.

## 4) Recharge of groundwater

During rainy season, from July to September, surface water often flows out along wadis causing even flooding. In view of efficient use of water resources and mitigation of flooding, a total of 82 dams and 43 weirs have been constructed in both regions. At reservoir of dams, as water level lowers, water is used for cultivation of cereals and for natural grazing land. It is said that about 10% of total reserved volume can be utilized. Weirs are constructed mainly against flooding and they serve at the same time for recharge of groundwater.

## (4) Sand Stabilization

### 1) Sand Shifting

Shifting sand and sand drifts occur throughout the Study area and severely affect daily lives of the residents and agricultural activities. There are two methods applied in Mauritania for sand fixation and prevention of shifting sand. One is the mechanical method in which fences with withered leaves and branch such as dates, *Acacia raddiana*, *Leptadenia pyrotechnica*, etc. are installed. The other one is afforestation.

### 2) Afforestation

The first attempt for sand stabilization and afforestation was made in Toungad and Azougui by PLEMVASP Project. A total of 35 ha was afforested in the project. By the end of the Project in 1997, it covered 429 ha at 39 sites. After that, the oasis associations took over the activity and implemented the sand stabilization and afforestation.

Implementation of the sand stabilization and afforestation in Tagant region started from 1992 and the total area of sand stabilization reached 186 ha at 17 project sites by 1997. In 2000, 8 sand stabilization projects targeting 36 ha of plantation were planned of which 7 projects for 23 ha have

been executed with a budget of UM 5.6 million. The tree species for afforestation is only *Prosopis juliflora*, while various species of trees are considered to be introduced for afforestation in recent days.

## (5) Oasis Society

### 1) Outline of the Oasis Society

Main social features of the study area are as follows:

- The average number of persons per household is 3.9 for Adrar and 5.2 for Tagant.
- The male-female ratio of adult population for both regions shows higher proportion of females: 45 to 55 for Adrar and 39 to 61 for Tagant.

The excess of women population, especially within adult population, can probably be explained by migration of male population to urban areas in search of jobs. The ratio of households headed by women in Tagant region was 25%, which is far more than that of Adrar (16%).

The dominant occupation is crop cultivation and livestock raising accounting for 72% and 61% of the total for Adrar and Tagant. Another remarkable difference between the two regions may be the proportion of unemployed households. This is much higher in Tagant (16%) than in Adrar (7%).

There are still many traditional systems in the oases such as land ownership and caste (which used to determine the occupation of a person according to the rank of his caste). However these systems are gradually decaying and losing their meaning as a result of enforcement of legislation, extension of education and modernization, etc.

Generally, in a family, the householder is the decision-maker in economic matters and the other members are often responsible for deciding social matters. Decisions in a village are basically made by the village chief. In oases with an AGPO, decisions are made by the leaders of association.

### 2) Guetna

Guetna is an important traditional event where families from an oasis get together to celebrate the harvest of dates and many people from outside come to buy the products. In this sense Guetna plays a very important role in oasis society since it helps to maintain traditional oasis society rather than to bring economic benefit to the oasis. It should be noted that more than 80% of people visiting oases for Guetna want to return to their home oasis.

### 3) Gender Issues

The working hours for 70% of women is 8 hr/day. In households headed by women, the ratio of women who work more than 8 hr/day is higher (50%) than women in households headed by men. Major tasks allocated to women are harvesting activity, followed by weeding, irrigation, watering, raising livestock and preparation of meals.

Nearly 100% of the women want to continue their lives in the oases with their families.

The illiterate rate of women is as high as 75%. The boy and girl ratio in primary education is nearly 1 to 1 (53:47). However, the proportion of male students is much higher in secondary education, although the ratio is decreasing.

#### (6) Health/Sanitation and Dietary Habits

There are region hospitals (Centre Hospitaliers Regionaux) in Atar with Tidjikja at the top. This is followed by health centers (Centre de sante) at the department and medical care centers (Poste de Sante) at the town level. At the oasis level, there is not even a nurse in most of them. Medical service is in short supply.

Most of households in the oases don't obtain sufficient meat, vegetables and cereals. As a result, there are many cases of malnutrition.

The average number of births per women in Adrar region is 6.0 and 5.7 in Tagant region. Of this figure, the death rate is 1.4 and 1.2 in Adrar and Tagant regions, respectively, which signifies that the number of child deaths is very high. This high death rate can be attributed to common diseases, infectious diseases (epidemics), miscarriage, malnutrition, etc.

The most commonly seen diseases in both regions are diarrhea and malaria, which account for about 50% of all the diseases that occurred in the region. Other diseases characteristic to both regions were respiratory and eye diseases, and nyctalopia, etc.

#### (7) Development of Oasis

The oasis project is now in the second phase (1995-2003) sponsored by IFAD and FADES through FAO's technical assistance. In this phase the project aims at organizing 70 associations in oases across the country, which has been mostly achieved. The third phase is scheduled to start from 2004.

The EU has conducted a feasibility study for the Development Project of Adrar region. Outline of the expected projects are:

- Improvement of unpaved road (8 sections, 174 km)
- Dam construction (25 dams in Atar and 4 in Aoujeft)
- 10 borehole excavation (Average depth is 350 m).

## **5 OUTLINE OF THE MASTER PLAN**

### (1) Constraints and Development Potentials of the Oasis Region

#### 1) Prevailing Constraints

Droughts have greatly affected the traditional social systems of the oases and economy through damage to agriculture and livestock production. This situation created a number of poor households, especially households headed by women, and it has become a major social issue.

Many of the oases cannot afford transportation to carry their products to the market and they also do

not have access to health care facilities. These conditions greatly affect every aspect of life at the oases.

The oasis area is characterized by low agricultural productivity and water is not effectively utilized because of low irrigation efficiency. In addition, basic data relevant to water resources is deficiently compiled.

## 2) Development Potentials

The majority of the oasis residents wish to live at the oasis and those who have left their oases for job-hunting at urban area strongly desire to return to their oases subject to being secured job opportunity. The strong local identity and nostalgia for the oasis is a major factor that supports oasis development.

Many associations are already organized at oases and it is probable that development works would be promoted with participation of these associations. The progress of primary education in recent years shall hasten extension of technologies among local people.

Rational utilization of water resources is expected to contribute to increment of available water resources leading to an expansion of agricultural production at oases.

## (2) Needs of the Residents

The surveyed needs of the residents mainly center on well digging to alleviate water shortage and the construction of a road network hastening access to nearby cities. The needs of individual resident may enumerate: improvement of cultivation and processing of vegetables, medical facilities, education, market distribution, and handicrafts.

## (3) National Development Plan

In the Mauritanian National Development Plan, major policies targeting poverty alleviation focus on productivity improvement, economic development, human resources development. The current administration continues to pursue the policies that prioritize the development of rural regions such as the oases within the Study area.

## (4) Regional Development Plan

### 1) Basic development concepts

The basic development concepts of this Study are: i) poverty alleviation, ii) improvement of social infrastructure, iii) sustainable use of resources. The following specific goals of the National Policy for Poverty Alleviation by 2015 are also targeted in the development plan:

- a) Reduction of poverty-level population by 50% in the rural areas.
- b) Redressing malnutrition.
- c) Establishment of a water resources management systems by users.

Main strategies to achieve the targets are as follows:

a) Regional Development Strategy 1: Priority issues for the development.

- Effective use of both internal and external resources in the area
- Improvement of the nutritional conditions and attainment for rise in income through technical improvement of agriculture and livestock
- Improvement of social environment and resource management through extension of education

b) Regional Development Strategy 2: Establishment of regional center

The concept of oases as regional centers should be fostered as a development base to fulfill roles such as vegetable production center, distribution center of agricultural products, center for public facilities, etc.

c) Regional Development Strategy 3: Effective use of existing organizations.

The existing oasis associations (AGPO and cooperatives) should be fully utilized to promote development activities.

(5) Framework of the Master Plan

Provided that the target for reduction of poverty-level population in the Study area by 50% by 2015 should be fulfilled by an increase in income depending exclusively on agricultural production, the required expansion of agricultural production in comparison with actual level shall be as follows:

Adrar region : 1.71 times      Tagant region : 4.38 times

## **6 PLAN FOR PILOT STUDY**

(1) Objective and Development Projects of the Pilot Study

The measures proposed in the regional development plan had been evaluated individually from viewpoints of the needs of the residents and their effectiveness in terms of regional development. As a consequently, the objectives and eligible development projects had been forged as follows:

1) Vegetable cultivation by farmers

Objective: Extension of water-saving cultivation, Increasing productivity, Increasing income with diversification of cropping season, Improving nutritional conditions by increasing consumption of vegetables.

2) Water-saving cultivation of dates

Objective: Extension of water-saving cultivation, collection of basic data through monitoring of water level at wells and of drawing water amount for preparation of an appropriate water resources management plan.

3) Increasing livestock production

Objective: Examination on possibility of egg and chicken meat production to match improvement of nutritional condition and rise in income and to compensate for decreasing livestock products.

4) Improving public health conditions

Objective: Enhancing effectiveness of the pilot project items 1) and 3) by educating the residents to improve health environment, redressing malnutrition and infant mortality rate.

(2) Implementation Policy of the Pilot Study

The following factors were considered in implementing the Pilot Study.

- a) To introduce technologies acceptable by beneficiaries.
- b) To select materials and equipment to be procured locally with economical price, paying attention to sustainability of applied technologies.
- c) To make effective use of the Oasis Participatory Management Association (AGPO)

(3) Technical Content of Pilot Study

The technical content to be applied to the Pilot Study are as summarized below:

Pilot Projects	Major Components
Vegetable cultivation by farmers	Cultivation technique, Improvement of physical characteristics of soils, Diversification of crops and cropping season, Water-saving cultivation, Using un-used resources, Collection of basic data
Water-saving cultivation of dates	Collection of basic data for groundwater management, Water-saving irrigation, Extension of water-saving concept
Improving livestock production	Raising method, Use of un-used resources
Improving public health conditions	Education on public health, Processing of agricultural and livestock products, Sanitation of drinking water

(4) Selection of Oasis for Pilot Project

The following criteria are used to evaluate eligibility of the oases where pilot projects are to be implemented.

- Access to the regional capital.
- Experience in vegetable cultivation.
- Potential to function as a regional center

Characteristics of the eligible oases and the pilot projects by oasis are shown in the following table.

(Adrar Region)

Oasis	Tawaz	Toungad	Tenllaba
Pilot project	1) Vegetable cultivation by farmers 2) Water-saving cultivation of dates	1) Vegetable cultivation by farmers 2) Water-saving cultivation of dates	1) Increasing livestock production 2) Improving public health conditions
Characteristic	1) Large-scale vegetable cultivation. 2) Low groundwater level. 3) Better access to the market.	1) Center of dates production. Many visitors during Guetna. 2) Bad accesses to the market.	1) Bad access to the market. 2) Low average income.

(Tagant Region)

Oasis	Tidjikja	Nimlane	Lehoueitatt
Pilot project	1) Vegetable cultivation by farmers. 2) Water-saving cultivation of dates.	1) Vegetable cultivation by farmers. 2) Water-saving cultivation of dates.	1) Increasing livestock production. 2) Improving public health conditions.
Characteristic	1) Vegetable consuming area. 2) Expanding vegetable cultivation by women's association.	1) Better access to the market. 2) Being endowed fertile soil.	1) Bad access to the market. 2) Extreme poverty.

Tawaz and Tidjikja were eliminated from the target oases of water-saving cultivation of dates, because the trial experiment revealed the danger in implementing works there. On the other hand, Lehoueitatt was selected as new target oasis.

(5) Pilot Project Implementation Plan

The Pilot Study is to be conducted from January 2002 to August 2003 by dividing its implementation period into three stages:

- a) Stage I : Preparation for the implementation
- b) Stage II : Trial vegetable cultivation, pilot project implementation and monitoring
- c) Stage III : Implementation of all pilot projects

(6) Monitoring Plan

The monitoring plan by each pilot project is as follows.

- a) Vegetable cultivation by farmers:  
Yield and profitability, growth of crops, cultivation management, sales and consumption
- b) Water-saving cultivation of dates:  
Amount of pumping water, groundwater level at wells, irrigation water amount, fluctuation of soil moisture content
- c) Increasing livestock production:  
Survival rate of chickens, productivity of eggs, profitability
- d) Improving public health conditions:

- Physique of pupils, frequency for being contracted a disease, health and nutritional conditions
- e) Awareness of local people:  
Effect of project, development of human resources, degree of interest

## **7 IMPLEMENTATION OF PILOT STUDY**

### **(1) Particulars of the Pilot Study and Response of Inhabitants**

In any pilot project, no apparent fruits were borne at the initial stage of their implementation and some oases were compelled to suspend implementation of pilot project. Afterward entering in the Stage 3, thanks of close communication between the participants of the Pilot Study and the Study Team, more participants were willing to be involved in the Pilot Study performing their spontaneous activities and constraints began to be eased, both of which contributed to producing positive effect of the Pilot Study. As a consequence, the number of the participants satisfied with the contents of the Pilot Study was raised together with salient increase in number of new participants.

In the vegetable cultivation by farmers during the Stage 3, excess application of irrigation water was corrected and anticipated benefits such as boosting rise in productivity of vegetables were attained. In this project, the proportion of illiterate female participants was elevated. In view of the fact that improvement of productivity was recorded at all oases, the technologies applied to present pilot project are evaluated to be appropriate.

The implements and materials applied to the water-saving cultivation of dates were accepted by beneficiaries from the beginning of the project, at the oases like in Tagant region, in which hand-powered pumps prevail, and water-saving effect was grasped by the beneficiaries without difficulty. As an outcome of this favorable situation, some participants on their own initiative began to launch in management of water by controlling pumping amount of water, setting pumping hours, etc. By contrast, monitoring task was interrupted at the oases in which motor-powered pumps are commonly used, due to larger extension of farms, limited capacity of storage tank, etc.

Spontaneous activities of beneficiaries like installation of wind breaking wall, etc. were observed in the poultry farming (improving livestock production), and the number of raised chickens and production of eggs were increased after the beginning of the Stage 3. Procurement of feed is a pressing subject in poultry farming; in this connection, it is essential to make effective use of such locally available materials as livestock bones, vegetables wastes, etc. for feeding chickens. Although some portion of raised chickens and eggs are sold, most of eggs were hatched on or left without being consumed. Many inhabitants are aware of the effect of consuming eggs for improvement of their nutritional conditions. It is thereby recommended to disseminate cuisine of eggs and chickens among local people so that effect of poultry farming may be expanded.

In so far as the improving public health conditions is concerned, activities accepting spontaneously the content of the Pilot Study were observed in such manner as construction of additional public toilets by local people on their own initiative after installation of public toilets in Tenllaba by the Study Team, embarking of production and sale of bread by the members of female associations after receiving relevant class, etc.

The participants have an opinion that as the effect of the Pilot Study is materialized, the activities of association turns out to be invigorated owing to more intimate relation among participants. And, most of the participants were satisfied with the technologies applied to the Pilot Study and are interested in successive implementation of the Pilot Study in the future.

On the other hand, the majority of non-participants expressed their interest in the Pilot Study, even though the implementation of the Pilot Study had scare impact on their activities.

## (2) Technical Accomplishments through Pilot Study

### 1) Rise in yield of vegetables

In vegetable cultivation, so as to prevent plants from root rotting as well as in order to restrain rise of soil temperature, ridging, soil application and shading were applied. Thanks to these measures, the following fruits were borne contributing to salient rise in yield.

- a) Under ridging cultivation, soil moisture content is maintained within adequate range keeping suitable three-phase proportion and root rotting of plants was restrained accordingly.
- b) Shading served to lower remarkably surface temperature of soils and air temperature and provided favorable condition for healthy growth of plants.

### 2) Irrigation water amount

Evaluating prevailing irrigation water amount from the viewpoint of theoretical crop water requirement, it is judged that water-saving is highly probable subject to adequacy of irrigation interval. Present loss of water during conveyance through canals and at the field basin is estimated at around 20 to 30% of the total irrigation water amount. However, adequacy of irrigation interval based on theoretical crop water requirement and the total readily available moisture (TRAM) value can reduce total irrigation water amount to 1/2 – 1/3 of the actually applied amount.

### 3) Fluctuation of groundwater level and available volume of sustainable water resources

Available volume of water resources was estimated by means of regional analysis of groundwater. In Tagant region where hand-powered pump prevails, use of groundwater is in the range of 10 – 20% of the fluctuated volume of groundwater, meanwhile in Adrar region where motor-powered pump is commonly used, this use is estimated to be 35 – 40% and water is used under decreasing large-scaled hydraulic gradient. It is estimated that groundwater level in Tagant region should not go downward 30 cm lower than the actual level in case that water use amount should be doubled, resulting in little impact on water resources. In Adrar region, by contrast, the lowering of groundwater level in case of the same assumption mentioned above is estimated to be in the range of 2.5 – 4.5 m and, as a consequence, an expansion for use of groundwater should be limited.

### 4) Administration of groundwater

Prevailing practice for use of groundwater is not in accordance with potential amount of groundwater and control on usage amount of groundwater is not in force. If use of groundwater in the future is to be made on this trend, even though water resources within shallow aquifer are vulnerable to being

dried up and sustainability of oasis region would end up being jeopardized.

Aiming at accomplishment of water-saving, meeting among users was held in Tidjikja and setting of pumping hours at their wells was decided. As a result, the following effects was obtained:

- a) By limiting pumping hours, downward trend of groundwater level was decelerated and groundwater level has been stabilized.
- b) Under control of irrigation hours, an application of adequate irrigation water at farms has been made, which, in turn, has contributed to improvement in growth of plants.

The above favorable outcome gives a hint that administration of water resources on initiative of users is foreseeable and, at the same, it is meaningful as elaborating a guideline on water administration plan, a pioneer enterprise for sustainable use of water resources in the future.

#### 5) Quality of water for irrigation and its improvement opportunity

Wells with limited suitability for irrigation due to inferior quality of water represented by high salinity and alkalinity, contamination with colon bacilli receiving inflow of domestic wastes, etc. are scattered throughout Tenllabe, Tawaz, Toungad and Lehoueitatt.

As a consequence of investigation on these wells, it was disclosed that the quality of water at wells is closely related with location of wells, surrounding topography, actual use of wells, relative distance from wells to wadi and residential area.

As countermeasures against contamination of water at wells, recommendation is made to curb dissemination of contaminated water to other wells enjoying good quality of water, by maintaining prevailing water use of wells that are suffering from inferior quality of water.

#### 6) Increasing productivity of poultry farming

The raising method that leaves chickens within garden yard of farmers is advantageous because chickens are fed in pursuit of insects and other natural feeds, but the number of raised chickens was not increased because chickens are vulnerable to attack by raptors, harmful animals, etc.. In such circumstances, proposal under the present Pilot Study was made to raise chickens within hen house. Besides, in order to tackle with various problems relevant to poultry farming, the following measures were taken.

- a) To promote use of substitute feed to be procured locally (date seeds, meat/blood/bone of livestock and food and vegetables wastes) and to decrease the proportion of purchased feeds.
- b) To ease stress of chickens by installation of hatching box, improvement of facilities within hen house and construction of open house

As a result, the number of raised chickens and production of eggs were elevated in Tenllaba and Lehoueitatt and the participants there were able to sell chickens and eggs produced by themselves in the course of the Pilot Study.

## 7) Shifting of sand dune

Prior to forging countermeasures against shifting of sand dune, fixed observation of sand dune was conducted in an attempt to getting hold of forms and movement of sand dune.

It was revealed as a consequence of the said observation that sand dune forms are influenced by miniature topography, wind direction and velocity, moisture content of soil, vegetation, etc. The outcome of the fixed observation at different oases is as summarized below.

- a) The shifting and expansion of sand dune is variable even though within the same oasis, so it is not advisable to propose standardized countermeasures.
- b) The most commonly employed measures for stabilization of sand dune and prevention of sand shifting/sedimentation is afforestation and effect of this measure was positively confirmed.
- c) The most effective afforestation method is to establish forest at right angle to prevailing wind direction; in case of unstable wind direction, forest should be established directly against principal wind direction, with an arrangement of distance between forest strips.

## (3) Evaluation of the Pilot Study

### 1) 5 evaluation items

The evaluation of the Pilot Study in line with 5 items is summed up as follows:

#### a) Relevance

- The upper goal of the Pilot Study coincides with the principal targets of the poverty alleviation policy that is an important policy of the country and the content of the Pilot Study matches expectation of beneficiaries. The Pilot Study is thus highly relevant.

#### b) Effectiveness

- The outcomes of the Pilot Study suggests the probability to attain upper goals of the country.
- The external circumstances like meteorological conditions within target oases of the Pilot Study are conspicuously changed. Therefore, it is recommended to take a step against such change so as to minimize their presumed adverse impact.

#### c) Efficiency

- The technologies and materials/equipment employed in the Pilot Study can be procured locally with economical price and without entailing troublesome task for their operation and maintenance. Considerable fruits were borne owing to these technologies and materials/equipment supported by high willingness of beneficiaries for their use. The components of the Pilot Study are appraised to be efficient in this viewpoint.

#### d) Impact

- The majority of the participants in the Pilot Study, in particular female participants, began to

have confidence in their farming activity, putting faith in the outcome of the Pilot Study.

- Spontaneous activities by the participants were observed at each pilot project, resulting in production of considerable benefit.

e) Sustainability

- The participants are anxious for continuation of any of the pilot projects.
- It is anticipated that future assistance should be rendered from other donors; as an example, most of the components envisaged in the pilot projects are proposed to be handed over to the Oasis Development Project, Phase (III).

2) Overall evaluation

An overall evaluation of the Pilot Study in terms of its contribution to attainment of project's goals as well as to the national policies is as explained below.

a) Enhancement of nutritional condition and increase in income

It was verified that the technologies applied to the Pilot Study were highly benefited to improvement of productivity as well as to boosting of profitability of farm operation. On the other hand, diversification of cropping period was realized to bring about prolongation of harvest period, which enabled local people to consume fresh vegetables longer period leading to improvement of their nutritional conditions.

b) Rational water use

Subject to approximation of irrigation water amount to theoretical crop water requirement, it is probable that considerable amount of irrigation water should be saved.

c) Improvement of health and hygiene

Enhancement of nutritional condition is probable with expansion of vegetable cultivation, production and sale of bread, etc. By contrast, improvement of health and hygiene habits was hardly attained, except for raised awareness in use of toilet, etc.

Evaluating comprehensively the above outcomes, it is concluded that the goals of the Pilot Study have been accomplished in their greater portion. This suggests high probability for attainment of the national policies, provided that the technologies applied to the present Pilot Study should be disseminated to other oases in the future.

## **8 APPRAISAL OF MASTER PLAN AND SELECTION OF PRIORITY PROJECTS**

### **(1) Appraisal of Master Plan**

The viability to realize reduction of poverty by half, which is a quantitative target of the Regional Master Plan proposed under the present Study, was appraised, on the basis of the values verified in the course of

the Pilot Study. Provided that the regional economy should be developed by 2015 following the scenario envisaged in this Pilot Study, the deficient value of the GRDP for reduction of poverty by half shall be UM 464.2 million in Adrar region and UM 423.9 million in Tagant region, estimated both at constant price of 1998.

On the other hand, it is estimated that in order to attain an incremental agricultural output mentioned before, the irrigated area should be expanded to 72 ha in Adrar region and to 125 ha in Tagant region, calculated on the basis of the yield levels obtained in the course of the relevant pilot project.

In Adrar region, the total irrigated area at present remains 950 ha and profitability of farming there is about one-tenth of the accomplishment at pilot farm. In the light of this situation, it is presumed that the projected agricultural output by 2015 would be attained by boosting productivity and profitability of about 10% of actual irrigated area to the levels accomplished at the pilot farm.

Meanwhile, prevailing irrigated area in Tagant region is 44 ha in total; unit yield is extremely low and net benefit is hardly obtained from this farming. In this connection, it is probable that target value of the GRDP by 2015 required for reduction of poverty by half should be fulfilled by nothing but an expansion of agricultural output. This target may be attained within context of a desk projection, but it entails a tight effort for its realization at field. Anyhow, dissemination of vegetable cultivation is expected to play a leading role among economic activities of the region. It is thereby required to strengthen assistances to farmers in the regions with focus laid on by extension services of agriculture-related technologies and provision of necessary inputs for farming.

As above consideration suggests, an attainment of the goals of the Master Plan was evaluated to be highly viable in terms of technical aspect, verified by positive outcomes of the relevant pilot project. Nevertheless, in practical manner, the said attainment is subject to easing prevailing constraints such as an absence of adequate technical assistance to farmers, under-development of collection and forwarding facilities of agricultural products and other relevant marketing system, etc.

It is probable that vegetables cultivation would play an important role not only for poverty alleviation but also for improvement of nutritional condition of farmers if portion of harvests should be consumed by farmers. In this regard, recommendation is made on promoting vegetables cultivation for self-consumption of farmers at remote oases, apart from for commercial purpose.

## (2) Priority Programs/Projects

### 1) Implementation strategies

In due consideration of expectation of the inhabitants, it is inefficient to implement individually the projects/programs proposed aiming at reduction of poverty by half, one of the goals of the present Master Plan. In this regard, suggestion is made to make a package implementation of inter-related projects selected from priority projects in terms of immediate realization. Basic implementation strategies are as explained hereinafter

#### a) Projects for attainment of Master Plan's Specific Target

In order to attain the Master Plan's specific target, it is not possible to extend vegetables

cultivation and medical services to all oases simultaneously. So as to put development proposal into more efficient manner, eligible oases to which priority for earlier implementation of projects is given should be determined with an emphasis laid on the following subjects.

- Creation and encouragement of core oases
- Support to women's economic activities
- Capacity building of existing associations

b) Enhancement of Living Circumstances at Oases

Pursuant to efficiency for implementation of projects/programs, priority should be given to the eligible oases mentioned above. Nevertheless, it is feared that economic disparity between eligible oases and the rest of the oases which are likely to be alienated from development due to their geographical handicap should be enlarged. In the light of wiping out of this fear, some measures shall be taken to the small-scaled and geographically handicapped oases, aiming at raising their sustainability.

2) Priority projects

In compliance with basic development concepts and development strategies of the Master Plan, the following projects were identified as eligible priority projects.

- a) Extension of vegetable cultivation technology:  
To disseminate vegetable cultivation technology serving poverty alleviation and improvement of nutritional condition.
- b) Improvement of public health conditions:  
Aiming at improvement of health and hygiene condition of local people, to construct regional center for rendering the local people such services as traveling clinic, education on public health and hygiene.
- c) Enhancement of living circumstances at small and remote oases:  
To enhance living circumstances of local people at small and remote oases by means of extension of technologies for vegetable cultivation targeting self-consumption of farmers and poultry farming, as well as consistent supply of potable water, upgrading of education facilities, etc.
- d) Rehabilitation and development of rural water supply system:  
To enhance living circumstances by supply of safe potable water to local people.
- e) Basic infrastructure development:  
To develop basic infrastructure relevant to consolidation of road and transportation network, mitigation of flooding damage, recharge of water resources, securing of periodic transportation means, etc.

## 9 Conclusions and recommendations

### (1) Conclusions

- 1) The regional development plan forged under the present Study comprises such basic development concepts as poverty alleviation, development of social infrastructure and sustainable use of resources which are closely related with the national policies and consists of components of development projects aiming at satisfying the needs of local people at oases
- 2) The methodologies and technologies applied to the Pilot Study resulted in highly effective on rise of productivity for vegetable cultivation and poultry farming as well as rational use of water resources.
- 3) The following projects have been selected as eligible priority projects to be put into implementation urgently.
  - a) Extension of vegetable cultivation technology
  - b) Improvement of public health and condition
  - c) Enhancement of living circumstances at small and remote oases
  - d) Rehabilitation and development of rural water supply system
  - e) Basic infrastructure development
- 4) Raising social status of women by means of rendering support to economical activities of women and thus easing destitution of the households represented by female head is a prerequisite so as to attain the goal of the present regional development plan.

### (2) Recommendations

- 1) In view of producing expected benefits of the above-mentioned priority projects as far as possible, it is advisable to review the contents of the projects/programs proposed in the Oasis Development Project Phase (III), which are to be forged in compliance with the present regional development plan.
- 2) Priority projects proposed under the present development plan highly beneficial to poverty reduction, improvement of living circumstances and enhancement of nutritional condition of local people. It is thereby recommended to put these projects into implementation as early as possible, if sustainability of the oasis society should be sought after. On the other hand, it is prerequisite to prepare immediately a request for technical cooperation to concerned foreign government(s) or international agency(ies) in connection with such candidate projects vegetables cultivation, etc. for technical cooperation under ODA program.
- 3) The monitoring data on fluctuation of groundwater collected in the course of the pilot studies are highly useful for administration of water resources and for estimation of available water for development of projects. In the light of this, it is recommended to expand the covering area for monitoring on groundwater so that more effective administration of water resources might be realized.

- 4) The Geographical Information System (GIS) constructed under this Study is placed as an important data bank to be used for planning a number of development projects at oasis region in the future. In this regard, it is requested to renovate the said data of the GIS periodically so as to consolidate the circumstances for making access to updated data and information on oasis region.

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DEVELOPMENT OF THE OASIS ZONE IN THE  
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## Abbreviations

English		French	
AAGR	Average Annual Growth Rate	TMCA	Taux Moyen de Croissance Annuelle
AFESD	Arabic Fund for Economic and Social Development	FADES	Fonds Arabes pour le Développement Economique et Social
AGPO (APMO)	Association for Participatory Management of Oasis	AGPO	Association de Gestion Participative des Oasis
AGREMET (AD)	Agrometeorological Division	AGREMET	Division agrométéorologie
ASECNA	Agency for the Security of the Air Navigation in Africa and Madagascar	ASECNA	Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar
CHR (RHC)	Regional Hospital Center	CHR	Centre Hospitalier Régional
CNH (NHC)	National Hygiene Center	CNH	Centre National d'Hygiène
CNRE (NWRC)	National Water Resources Center	CNRE	Centre National de Ressource en Eau
CRC (RCC)	Regional Committee of Coordination	CRC	Comité Régional de Coordination
DPSE (DPFE)	Direction of Politics, Follow-up and Evaluation	DPSE	Direction des Politiques, Suivi et Evaluation
EC	Electric Conductivity	CE	Conductivité électrique
EU	European Union	UE	Union Européenne
FAO	Food and Agriculture Organization of the United Nations	FAO (OAA)	Organisation pour L'alimentation et l'agriculture
GDP	Gross Domestic Product	PIB	Produit Intérieur Brut
GIS	Geographical Information System	SIG	Système d'information géographique
GRDP	Gross Regional Domestic Product	PIBR	Produit Intérieur Brut Régional
GTZ	German Society for Technical Cooperation (German)	GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (Allemagne)
HIV	Human Immunodeficiency Virus	VIH	Virus d'Immunodéficience Humaine
IDA	International Development Association	IDA (ADI)	Association de Développement International
IFAD	International Fund for Agricultural Development	FIDA	Fonds Internationaux de Développement Agricole
IMF	International Monetary Fund	FMI	Fonds Monétaire International
IRM	Islamic Republic of Mauritania	RIM	République Islamique de Mauritanie
MAED (MEAD)	Ministry of Economic Affairs and Development	MAED	Ministère des Affaires Economiques et du Développement
MCTA (MCTH)	Ministry of Commerce and Tourism and Handicraft	MCTA	Ministère du Commerce et du Tourisme et d'Artisanat
MDRE (MRDE)	Ministry of Rural Development and Environment	MDRE	Ministère du Développement Rural et de l'Environnement
MEN (MNE)	Ministry of National Education	MEN	Ministère de l'Education Nationale
MHE	Ministry of Hydraulics and Energy	MHE	Ministère de l'Hydraulique et de l'Energie

## Abbreviations

English		French	
MICO (MIOC)	Mutual Investment and Oasis Credit	MICO	Mutuelles d'Investissement et de Crédit Oasien
M/P	Master Plan	P/D	Plan Directeur
NGO	Non Governmental Organizations	ONG	Organisme Non Gouvernemental
PARP (PIPR)	Project of Improvement in Pluvial Region	PARP	Projet d'Aménagement en Région Pluviale
PCM	Project Cycle Management	PCM	Methode de PCM
PDM	Project Design Matrix	PDM (MCP)	Matrice de Conception de Projet
PGRNP (PNRMP)	Project for Natural Resources Management in Pluvial areas	PGRNP	Programme de Gestion des Ressources Naturelles en zone Pluviales
PLEMVASP (PFS DALP)	Project of Fighting against Sand dune invasion and the Development of Agriculture, Livestock and Pasture	PLEMVASP	Projet de Lutte contre l'Enselement et Mise en Valeur Agro-Sylvo-Pastorale
PRS (RSP)	Regional Solar Program	PRS	Programme Régional Solaire
PSA (PAS)	Project for Agricultural Services	PSA	Projet des Service Agricoles
RRA	Rapid Rural Appraisal	RRA (EDP)	Etude de diagnostique Participatif
SAM (AMS)	Aerial Meteorological Service	SAM	Service Aérien Météorologique
SAR	Sodium Adsorption Ratio	RAS	Rapport d'Adsorption de Sodium
SECF (SSFC)	the Secretary of States for the Feminine Condition	SECF	Secrétariat d'Etat à la Condition Féminine
SONELEC (NSWE)	National Society of Water and Electricity	SONELEC	Société Nationale d'Eau et d'Electricité
SONADER (NSRD)	National Society for Rural Development	SONADER	Société Nationale pour le Développement Rural
SONIMEX (NSIE)	National Society of Import and Export	SONIMEX	Société National d'Importation et Exportation
S/W	Scope of Work	E/T	Etendue des Travaux
UCP	Unit Coordination of Projects	UCP	Unité Coordination des Projets
UM	Mauritanian Ouguiya (currency unit)	UM	Ouguiya Mauritanienne (unité monétaire)
UNDP	United Nations Development Program	PNUD	Programme des Nations Unies pour le Développement
UNSO	UNDP Office to Combat Desertification and Drought	UNSO	UNDP Office to Combat Desertification and Drought
URDO (RROD)	Regional Representative Office of Oasis Development	URDO	Unité Régional de Développement des Oasis
USB (BWU)	Basic Wealth Unit	USB	Unité de Santé de Base
WHO	World Health Organization	OMS	Organisation Mondiale de la Santé

## WEIGHTS AND MEASURES

UNIT	ENGLISH	FRENCH
mm	millimeter	millimètre
cm	centimeter	centimètre
m	meter	mètre
km	kilometer	kilomètre
m <sup>2</sup>	square meter	mètre carré
km <sup>2</sup>	square kilometer	kilomètre carré
a	are	are
ha	hectare	hectare
m <sup>3</sup>	cubic meter	mètre cube
l	liter	litre
kg	kilogram	kilogramme
t	ton	tonne
mASL	meter above sea level	mètre sur niveau de mer
sec	second	seconde
min	minute	minute
h	hour	heure
$\mu$ S	micro siemens	micro siemens
UM	mauritanian ouguiya	ouguiya mauritanienne
%	per cent	pour cent
°C	degree centigrade	degré centigrade

***CHAPTER 1***

***INTRODUCTION***

## **CHAPTER 1 INTRODUCTION**

### **1.1 Background of the Study**

The Islamic Republic of Mauritania (hereinafter referred to as IRM) is located at the western edge of the African Continent and is mostly low-lying desert, with an average annual rainfall less than 50 mm.

Although the living environment in the inland Oases is very severe mainly due to the limited water resource, the population somehow maintain their own traditional society based on the agriculture and livestock raising. However, recent droughts brought about serious impacts on both agriculture and livestock raising. This situation forced many people to look for work outside the Oases to earn cash income and the number of those who migrate is increasing.

IFAD (International Fund for Agricultural Development) and AFESD (Arab Fund for Economic and Social Development) have been supporting the development of the Oasis areas, however, the support they are providing is not sufficient.

The Government of Mauritania (hereinafter referred to as “GOM”) realized the importance of the development in the Oasis areas of Adrar and Tagant Regions and requested “The study on the Development of the Oasis Zone” (hereinafter referred to as “Study”) to the Government of Japan on August 19, 1999.

In response to the request of the GOM the Japan International Cooperation Agency (JICA), the official agency responsible for technical cooperation programs of the Government of Japan, dispatched a mission to IRM for preliminary survey. The Minutes of Meeting and the Scope of Work were agreed upon between the GOM (Ministry of Rural Development and Environment and Project for Development of the Oasis Zones) and the JICA mission on December 6, 2000.

### **1.2 Objective of the Study**

The ultimate objective of the Study is the achievement of a stable livelihood by the local people based on sustainable land use. To reach this target, Study intends to carry out the following tasks:

- (1) To formulate an integrated regional development plan (Master Plan, M/P) for the preparation of an appropriate resource management system by local people based on resource evaluation and use in Study Area.
- (2) To select priority oases in Study Area for implementation of a pilot project during the study period and the results will be taken as feedback to the Master Plan. The pilot project will be implemented in close conjunction with relevant governmental organizations, NGOs, oasis organizations, local people, etc., and in consideration of traditions and religious conditions to increase its chances of sustainability. The study intends to encourage involvement of other governmental institutions than that of counterparts, if they can play a meaningful part in the study.
- (3) To pursue the transfer of technical knowledge on the method of formulating a master plan and other technical issues to counterpart personnel through on-the-job training in the course of Study.

### **1.3 Study Area**

The study area covers all the oases in Adrar region (approximately 200,000 km<sup>2</sup>) and Tagant region (approximately 100,000 km<sup>2</sup>). Distribution of oases is shown in **Fig. 1.1.1**.

### **1.4 Scope of the Study**

The Study is scheduled to be carried out in two phases. The following are the major work items of each phase.

#### **(1) Phase I**

##### **1) Preparatory Work in Japan**

- Making of Inception Report

##### **2) First Field Survey**

- Explanation and discussion on Inception Report
- Field survey for preparation of regional development plan

- Preparation and Implementation of Sub-contracted works
- Inventory Survey and Household Survey
- Preliminary selection of Target Oases for Pilot study
- Making general framework for Draft Master Plan
- Making, discussion and submission of Progress Report (1)

### 3) First Work Period in Japan

- Selection of Target Oases for Pilot Study
- Establishment of Implementation Plan of Pilot Study
- Formulation of Draft Master Plan
- Making and submission of Progress Report (2)

## (2) Phase II

### 1) Second Field Survey

- Explanation and discussion on Progress Report (2)
- Preparation and Implementation of Sub-contracted works
- Construction of GIS architecture
- Abroad technical trainings (Morocco)
- Implementation of Pilot study (Stage 1: preparation period)
- Making, explanation and discussion of Progress Report (3)

### 2) Third Field Survey

- Implementation of Pilot study (Stage 2: Trial experiment on Vegetable cultivation and Implementation of other pilot projects)
- First Midterm Evaluation and Monitoring on Pilot study

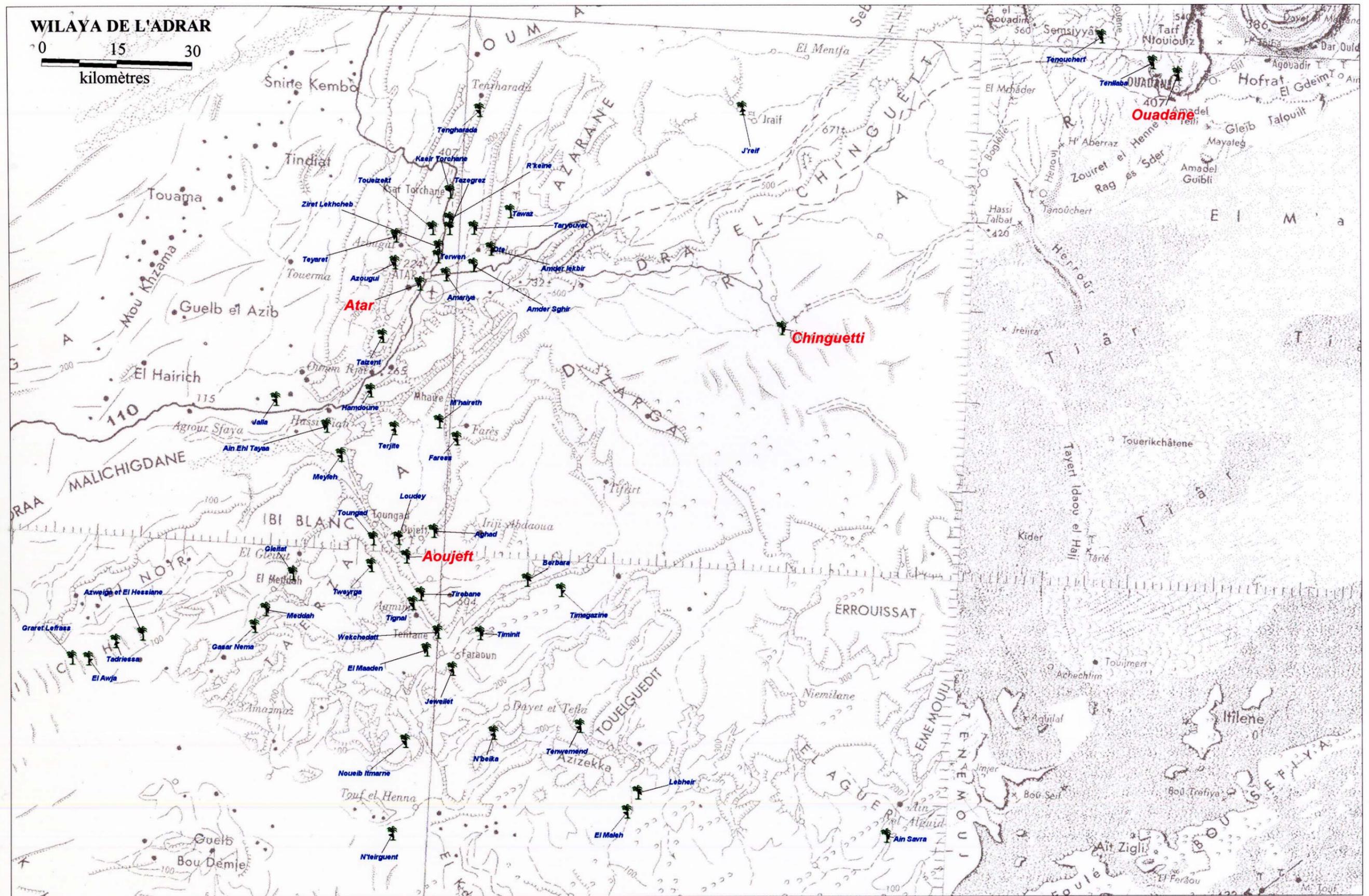
### 3) Second Work Period in Japan

- Making and discussion of Interim Report

### 4) Fourth Field Survey

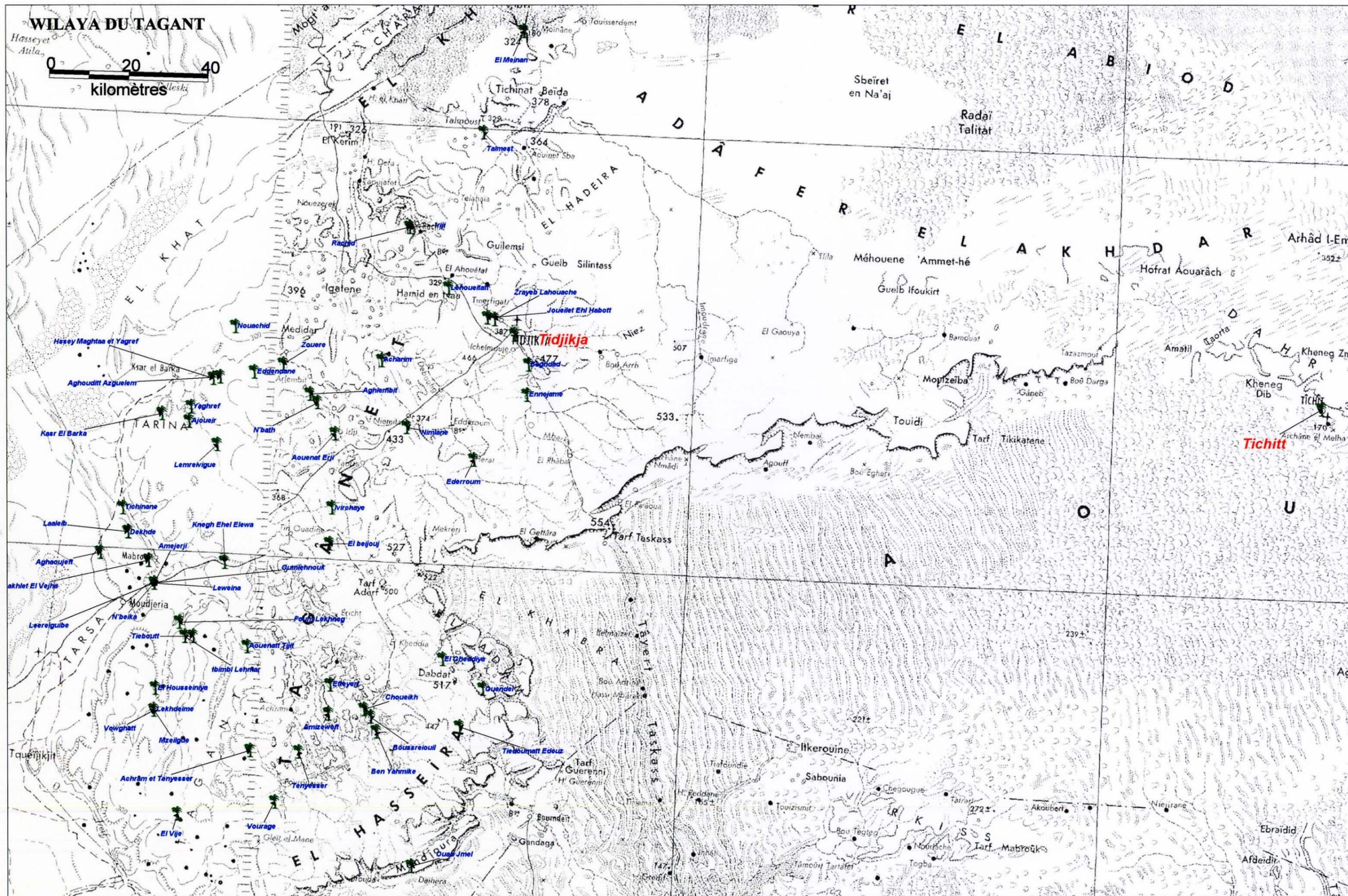
- Explanation, discussion and submission of Interim Report
- Implementation of Pilot study (Stage 3: Full implementation of pilot projects)

- Second Midterm Evaluation and Monitoring on Pilot study
  - Making, explanation, discussion and submission of Progress Report (4)
- 5) Fifth Field Survey
- Implementation of Pilot study (Stage 3: Full implementation of pilot projects)
- 6) Sixth Field Survey – Part 1
- Implementation of Pilot study (Stage 3: Full implementation of pilot projects)
  - Third Midterm Evaluation and Monitoring on Pilot study
- 7) Third Work Period in Japan
- Making of Progress Report (5)
- 8) Sixth Field Survey – Part 2
- Explanation, discussion and submission of Progress Report (5)
  - Making and submission of Report on Advance of the Study
  - Final Evaluation and Monitoring on Pilot study
  - Making, explanation, discussion and submission of Progress Report (6)
- 9) Fourth Work Period in Japan
- Formulation of Master Plan
  - Making and submission of Draft Final Report
- 10) Seventh Field Survey
- Explanation and discussion on Draft Final Report
- 11) Fifth Work Period in Japan
- Making and submission of Final Report



Source : Inventory Survey by the Study Team

Fig. 1.1.1 Distribution of Oases (1/2) (Adrar)



Source : Inventory Survey by the Study Team

Fig. 1.1.1 Distribution of Oases (2/2) (Tagant)

**CHAPTER 2**

**OUTLINE OF THE COUNTRY**

## CHAPTER 2 OUTLINE OF THE COUNTRY

### 2.1 Natural Conditions

IRM is located at the western end of the African continent and lies at 15° 45' - 27° 25' North Latitude and at 4° 10' - 16° 50' West Longitude. The country has an area of 1,030,000 km<sup>2</sup>, which is 2.7 times larger than that of Japan. Her population was estimated at 2.7 million in 2000, which had been grown at a rate of 3.0% per year between 1996 and 2000. The population density is as low as 2.6 persons per km<sup>2</sup> in 2000, because about two-thirds of the land is represented by Sahara desert and arable land suitable for agricultural production remains extremely limited. At the time of independence in 1960, the main economic activity of the country was nomadism and only 5% of the population lived in urban areas. Due to intensive migration from rural sector to urban sector, particularly over the last decade, more than half of the population in the country now live in urban areas.

Geographically the country is almost flat except for the central plateau that is spread in the range of 400 - 500 m.a.s.l.

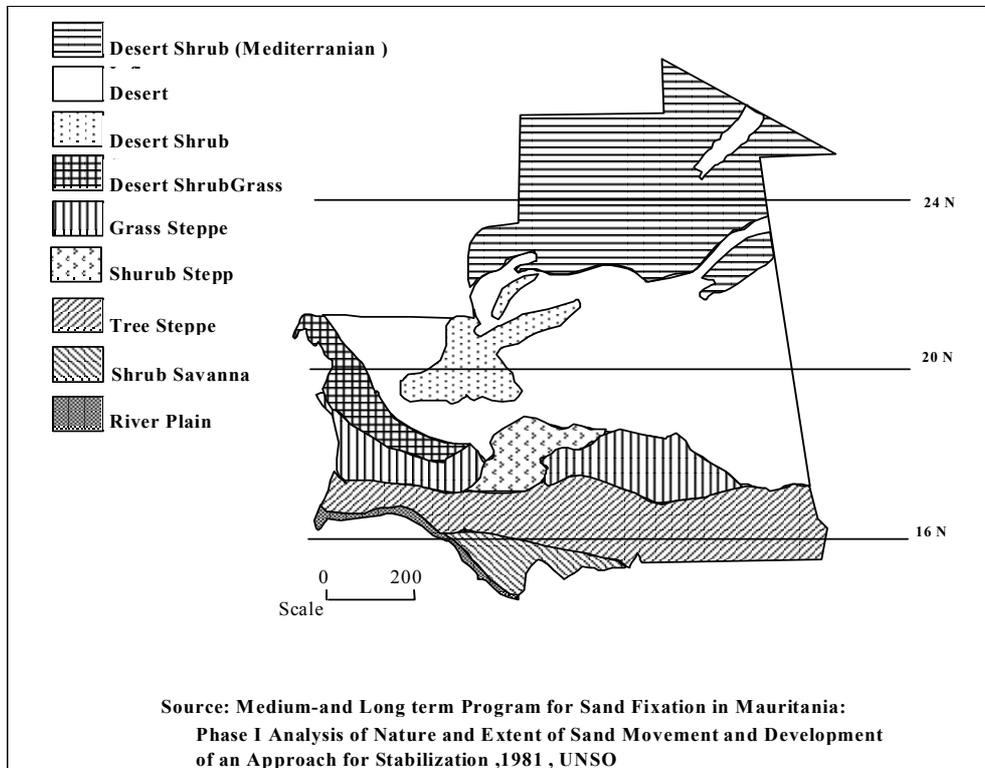
The country consists of three different climate zones: (1) Northern coastal zone represented by the city of Nouadhibou which is influenced by the trade wind and Canary cold ocean current, (2) Inland Sahara zone where temperature fluctuates violently throughout a day, and (3) the zone along the Senegal River where temperature scarcely fluctuates throughout a day and the humidity is high during the rainy season.

The natural vegetation in Mauritania is divided into 8 zones based on the climatic and environmental conditions. Distribution of each vegetation zone is shown in **Fig. 2.1.1**.

- |                         |                  |
|-------------------------|------------------|
| 1) Desert               | 5) Grass Steppe  |
| 2) Desert Shrub         | 6) Tree Steppe   |
| 3) Shrub Steppe         | 7) Shrub Savanna |
| 4) Desert Shrub / Grass | 8) River Plain   |

Zones of Desert, Desert Shrub and Shrub Steppe lie in the central and northern interior of the country that are arid areas with an annual precipitation below 100 mm. Zones of Desert Shrub/Grass, Grass Steppe and Tree Steppe present natural vegetation of climatic transitional zone with an annual precipitation in the range of 100 - 400 mm. The Zones of Shrub Savanna and River Plain lie in the area with an annual precipitation over 400 mm.

The country also has a coastal line with a length of 667 km. The coast of the country is blessed with fishery resources, being shallow to a considerable distance from the shore with an existence of wide continental shelf. Mineral resources are also abundant, but they scarcely have been exploited.



**Fig. 2.1.1 Vegetation Pattern in Mauritania**

In Mauritania, environmental issues are coped with separately dividing the national territory into 4 zones as given below, in accordance with specific environmental conditions for respective zone.

1) Arid Zone

The Arid Zone covers the largest extension in Mauritania. The biological resources in this zone are poorer than the rest of the environmental zones. Main issues of this zone are damage on buildings and man-made structures by sand sifting and erosion caused by flash flood water in wadis.

2) Sahelian Zone

Sahelian Zone is the transitional area between Arid Zone and Senegal River Zone. This zone has higher potential than Arid Zone in terms of biological

resources, blessed with drought-resistant bushes and trees. Main environmental issues of this zone are: i) protection and conservation of grazing lands, ii) agricultural development associated with soil conservation, iii) protection of infrastructure and houses against sand sifting, iv) control against deforestation for use of firewood and charcoal and protection of fauna in the northern part of Guidimakha and in the eastern part of Gorgol.

### 3) Senegal River Zone

The areas of Senegal River Zone have abundant biological resources owing to fluvial water of the Senegal River. Crops production and animal husbandry utilizing these biological resources constitute principal economic sector of the zone. Main issues of these areas are: i) conservation and regeneration of the forests along the river and extension of forest area, ii) mitigation of flood damages on farmlands which are vulnerable to flooding stemmed from wind and water erosion, and iii) deceleration of overgrazing by livestock in Guidimakha agricultural area.

### 4) Sea Littoral Zone

Sea Littoral Zone spreads along the coast of the Atlantic Ocean. Major issues on the zone are: i) damage on railways and cities due to sand sifting, ii) conservation of natural resources within the scope of the national park, iii) development of fishing activities such as aquaculture and deep sea fishing in order to brake concentration of population in Nouakchott, and iv) preservation of the ecosystems in line with development of various resources along the coasts.

## 2.2 Economic Conditions

As indicated in **Table 2.2.1** which shows GDP by sector from 1998 to 2000, an average growth of the GDP for this period is 9.5 %. The primary industry experienced a slightly less growth than an average one of the national economy as a whole, due to negative growth of an agricultural sector. The secondary industry also recorded a growth lower than the national average, diminishing its importance within the context of the national economy. By contrast, the tertiary industry has grown rapidly, propelled by the burgeoning trade, transportation and communication sectors; its average growth rate is about 120% of an average rate of three industries, jumping its share in the GDP from 41% to 45%.

**Table 2.2.2** shows the performances of major exports and imports. Iron ore and marine products are the major export items of the country accounting for 99% of the foreign trade earning.

Leading imports of the country are composed of industrial products, foodstuff and raw materials; an import of foodstuff has been heavily fluctuating year by year and that of industrial goods is increasing rapidly in recent years.

**Table 2.2.1 GDP by Sector at Current Prices (1998 – 2002)**

	(Unit : %)		
	1998	2002	Annual growth rate (%)
Primary Sector	21.1	18.7	6.1
Agriculture	5.3	3.2	-4.1
Livestock	14.4	14.2	8.8
Fishing	1.4	1.4	10.7
Secondary Sector	27.6	26.5	8.1
Tertiary Sector	40.8	45.0	11.9
Total GDP (million ouguiyas)	169,019	242,703	9.5

Source : Mauritanian authority and IMF staff estimates

**Table 2.2.2 Exports and Imports (1998 – 2002)**

	(Unit : Million of Dollars)		
	1998	2002	Annual growth rate (%)
<b>Exports</b>	357.9	330.3	-2.1
Iron ore	217.0	183.8	-4.1
Fish	140.6	143.5	0.5
Other	2.2	2.9	7.2
<b>Imports</b>	357.9	396.0	2.6
Total, excluding SNIM	257.3	314.2	5.1
Public investment and aid *	42.6	21.9	-15.3
Private sector	214.6	270.3	5.9
SNIM	100.6	103.8	0.8
Petroleum products	49.5	107.6	21.4

SNIM: National Industrial and Mining Company

\*Includes cereals and other food aid

Source: IMF staff estimate and Mauritanian authority

## 2.3 Agriculture

### 2.3.1 Land Use

Although modern farming with irrigation system has been introduced and is being developed in the zone along the River Senegal, most of the agriculture in the country depends on conventional land use. The land use in the country may be divided into 4 according with water availability.

- 1) The land use called “WALO” which utilizes flooding water during the rainy season extending over the middle and lower basin of the River Senegal.
- 2) The land use called “BAS-FONDS” which utilizes inundated water at lowlands during rainy season flown from vast catchment.
- 3) The land use called “DIERI” which utilizes water collected in the same way as BAS-FONDS but on a smaller scale, normally in a small depression at low plains.
- 4) The land use without a specific name which utilizes groundwater for crude irrigation. This is mostly found in oasis areas and the main crop cultivated is date palm.

The crops commonly cultivated in these four land use areas are sorghum, millet, niebe and date palms, and their production is largely affected by fluctuation of rainfall. Meanwhile, the modern irrigated rice farming areas along the River Senegal are gradually expanding in both area and production.

**Tables 2.3.1** and **2.3.2** show land use patterns of the major regions of the country and respective crop production for each type of land use.

**Table 2.3.1 Land Use by Region (2000)**

(Unit : ha)

Land use	DIERI	BAS-FONDS	WALO	Irrigation	HIVERNALE SONADER	Total
Adrar	39	360				399
Assaba	15,154	6,457				21,611
Brakna	13,615	5,014	17,011	3,223	3,172	42,035
Gorgol	14,192	2,579	9,166	3,762	3,661	33,360
Guidimakha	13,404	1,427		1,104	1,042	16,977
H. El Chargui	45,480	23,335				68,815
H. El Gharbi	14,111	5,904				20,015
Tagant	4,713	4,195				8,908
Trarza			1,680	15,729	3,641	21,050
<b>Total</b>	<b>120,708</b>	<b>49,271</b>	<b>27,857</b>	<b>23,818</b>	<b>11,516</b>	<b>233,170</b>

Source : Division des Statistiques Agricoles / DPSE / MDRE

**Table 2.3.2 Cereal Production by Land Use (2000)**

(Unit : ton)

Land use	DIERI	BAS-FONDS	WALO	Total
H. El Chargui	22,497	17,268		39,765
H. El Gharbi	5,366	3,856		9,222
Assaba	9,092	4,629		13,721
Gorgol	7,300	1,434	3,970	12,704
Brakna	5,953	1,941	5,385	13,279
Tagant	1,697	180		1,877
Adrar	12	2,517		2,529
Guidimakha	6,742	1,013		7,755
Trarza			756	756
<b>Total</b>	<b>58,659</b>	<b>32,838</b>	<b>10,111</b>	<b>101,608</b>

Source : Division des Statistiques Agricoles / DPSE / MDRE

### 2.3.2 Agricultural Production

**Table 2.3.3** shows an evolution in agricultural productions for the period 1996 – 2000. Most of crops except for rice are rain-fed and their production thus depends on amount of rainfall resulting in distinctive fluctuation year by year.

**Table 2.3.3 Crop Production during 1996-2000**

	(Unit : ton)					
	1996	1997	1998	1999	2000	Average annual growth (%)
Sorghum	41,518	49,830	72,400	85,990	75,361	16
Wheat	600	700	817	600	600	0
Maize	4,969	9,874	7,095	4,376	11,603	24
Rice	40,049	48,565	61,151	51,878	45,720	3
Niebe	21,495	21,495	7,041	7,041	9,905	-18
Peanut	2,346	2,000	2,141	2,141	2,256	-1
Vegetable	59,263	70,938	82,176	60,000	65,000	2
Water melon	7,978	8,500	9,666	9,666	1,111	-39
Dates	16,000	12,000	12,351	20,000	20,000	6

Source : Annual Statistic in 2000

The **Table 2.3.4** contains information on import of dates. The import of dates is in the range of 200 - 300 tons a year, which represents as few as 1% of the national production. It is thus concluded that domestic demand of dates is satisfied with national production.

**Table 2.3.4 Dates Imports**

	(Unit : ton)							
	1992	1993	1994	1995	1996	1997	1998	1999
Ton	205	85	166	462	312	246	315	269

Source : MDRE

The import of vegetables is given in the **Table 2.3.5**. Generally, about 15 thousand tons of vegetables are imported yearly, although an import of vegetables is strongly fluctuated by national production of vegetables for respective year.

**Table 2.3.5 Vegetable Imports**

	(Unit : ton)								
	1992	1993	1994	1995	1996	1997	1998	1999	
Potato	6,340	9,408	6,466	5,692	6,254	8,188	8,013	4,559	
Onion	4,922	7,779	5,222	3,380	4,664	5,931	4,936	3,612	
Root veg.	399	629	1,070	525	1,113	1,344	1,993	1,063	
Leaf veg.	225	577	803	893	493	254	442	288	
Tomato	183	263	455	80	385	311	233	225	
Total	12,069	18,655	14,016	10,571	12,909	16,028	15,617	9,747	

Source : MDRE

### 2.3.3 Livestock

Livestock plays a major role in the national economy accounting for 14.7% of the total GDP and 65% of the gross product of the primary industry sector.

There are 6 types of livestock farming patterns as listed below, in line with the amount of annual precipitation and the characteristics of soils.

- 1) The Sahara area (in the area of the Sahara desert)
- 2) Desert Sahel (annual rainfall 150 – 200 mm)
- 3) Typical Sahel (annual rainfall 200 – 400 mm)
- 4) Sahel – Sudanian (annual rainfall 500 – 600 mm)
- 5) Senegal River zone (flood plain)
- 6) Coastal pastoral area (annual rainfall 120 mm (north) to 300 mm (south), from Nouakchott to Senegal River Delta)

In the areas of Sahel-Sudanian and Senegal River where rain-fed farming is viable, cattle and sheep are mainly raised with the use of pasture and remains of cereal grains. In the areas of Sahara, Desert Sahel and Typical Sahel, camels and goats are mainly raised because these animals, in addition to pasture, eat shrubs that are resistant to dryness.

The number of livestock nationwide dropped dramatically due to the droughts in the 70's (1971, 1977) and 80's (1982, 1983). In addition to natural disasters, military skirmishes along the southern border along the river Senegal made it impossible for the nomadic livestock breeders move freely across the border, which negatively impacted the production of livestock.

**Table 2.3.6** shows the number of head of livestock represented by cattle, goat/sheep and camel. These livestock are increased in number of heads without exception recently.

In the dry and semi-dry areas where food production is unstable, the population of the area tends to depend more on animal products for food.

**Table 2.3.6 Number of Livestock**

(Unit: 1,000 head)

	1996	1997	1998	1999	2000
Camels	1,158	1,205	1,254	1,304	1,356
Cattle	1,124	1,157	1,192	1,228	1,264
Goats, Sheep	6,191	6,315	6,441	6,570	6,701

Source : Annual Statistic in 2000

**Table 2.3.7** presents the proportion of different animals for three areas of the country. Most of the livestock population is concentrated in the south-eastern and south-western Mauritania, both of which are bounded by the Senegal River on the south. In northern Mauritania where the study area is located, the number of camel and its proportion is relatively high, but the numbers of cattle, sheep and goats are less.

**Table 2.3.7 Distribution of Livestock by Area**

(Unit : %)

Area	Cow	Goat/sheep	Camel
South-east	64	49	40
South-west	33	44	22
North	3	7	38
Total	100	100	100

Source : FAO/PNUD (1996)

#### 2.3.4 Food Balance

The self-sufficiency ratio of food in the country is very low in general (Refer to **Table 2.3.8**). The most consumed item is wheat, but it is rarely produced in the country but depends on import. As a result, the self-sufficiency ratio of cereal as a whole remains as low as 44%. Vegetable cultivation is spreading in recent years; however, its self-sufficiency ratio is only 34%.

**Table 2.3.8 Food Balance Sheet (Average 1994-98)**

(Unit : 1,000 ton)

	Production	Imports	Total supply	Consumption	Self sufficiency (%)
Cereals	178	372	549	403	44.2
Wheat	0	272	284	188	0.0
Rice	46	95	134	118	39.0
Sorghum	116	2	112	81	143.2
Oil crops	5	0	5	3	166.7
Vegetable oil	1	29	33	25	4.0
Vegetables	11	23	33	32	34.4
Fruits	26	4	29	27	96.3

Source : FAO

### 2.3.5 Groundwater Demand Projection

National water demand for the year 2000 was projected to be about 1.7 billion m<sup>3</sup> and about 94% of which were for irrigation purpose, being concentrated during rainy and high temperature period from July to October. Water demand for the rest of the uses is consistent throughout the year with relatively small amount (Refer to **Table 2.3.9**).

**Table 2.3.9 National Water Demand for Year 2000**

(Million m<sup>3</sup>)

Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Domestic	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	31.0
Livestock	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	78.0
Irrigation	5.9	5.9	5.9	5.9	5.9	5.9	392.0	392.0	392.0	392.0	5.9	5.9	1617.0
Total	15.0	15.0	15.0	15.0	15.0	15.0	401.0	401.0	401.0	401.0	15.0	15.0	1726.0

Source: Processus de Réflexion, Concertations et Propositions sur la Maîtrise de l'eau pour une agriculture Productive et durable au Sahel, Bilan- Diagnostic & Stratégies de Gestion de Ressources en eau - MDRE

## 2.4 Society

### 2.4.1 Outline of the Society

Major social indicators in the country are shown in **Table 2.4.1**.

Since 1990, the government expenditure on education, medical care, and poverty alleviation measures has increased. As a result, several indicators such as life expectancy, infant mortality, illiteracy rate, poverty rate, etc. showed slight improvement. However, these figures still remain at low levels.

**Table 2.4.1 Main Social Index**

	1990	1995	1996
Health			
Life expectancy (years)	48.6	51.4	51.8
Female	49.6	52.4	52.8
Male	47.5	50.5	50.9
Infant mortality (per thousand)	128.7	116.3	113.7
Population per physician (per thousand)	15.8	9.0	-
Education			
Primary gross enrollment (in percent)	48.0	78.0	83.0
Female	41.0	76.0	-
Male	56.0	88.0	-
Secondary gross enrollment (in percent)	14.0	15.0	17.0
Illiteracy rate (% of males 15 +)*	-	-	49.5
(% of females 15 +)*	-	-	70.3
Urban unemployment (in percent)	-	-	26.0
Poverty (percent of the population)	57.0	50.0	-
Government expenditure			
in Social Sector (in percent of GDP)			
Total	4.7	7.4	7.8
Education	3.5	4.3	4.3
Health	1.2	2.0	1.8
Poverty alleviation	0	1.1	1.7

Source : Social Indicators of Development (World Bank), Mauritanian authority

\* World Development Indicators database, July 2001

## 2.4.2 Gender Issues

### (1) National Policy

Redressing the social disparity and inequality between sexes has been one of the focal policies of the Government of Mauritania. **Table 2.4.2** shows an outline of the national plan for the promotion of women's status prepared in 1995. The plan was made for the purpose of improving the socio-economic conditions for women.

The plan especially focuses on social development of women to boost their productivity and quality of the products aiming at realizing higher incomes. It also encourages women's active contribution to social and economic activities through strengthened roles of women's groups and cooperatives (development of potential ability), extended access to markets and creation of women's networks. All these activities are considered to foster effective participation of women in the development of their communities.

**Table 2.4.2 Main National Policy on Gender Issues**

Target till 2000	Contribution to fair and continuous development by realizing women's participation in socio-economic activities.
Direction 1994-1997	Raise of socio-economic condition of women for contribution to stable household and women's self-edification
Basic Policies	<ul style="list-style-type: none"> <li>- Raising productivity and efficiency of work</li> <li>- Enforcement for women's participation and women organization with decision-making system</li> <li>- System enforcement of SECF</li> </ul>
Major Activities	<ul style="list-style-type: none"> <li>- Promotion of quality and productivity of products made by women</li> <li>- Establishing mutual cooperation system among women association</li> <li>- Promotion of products sales network by women</li> <li>- Raising fund</li> <li>- Support for women's participation network</li> <li>- Developing women's ability and organizations</li> <li>- Basic research on family</li> <li>- Promotion of house-hold based measures</li> <li>- Creation of network for family protection</li> <li>- Basic research on women and family</li> <li>- Implementation of interaction programs</li> <li>- Organization enforcement for promoting public awareness on SECF</li> <li>- Sufficiency of support facilities</li> </ul>

Source : National Development Policy

The three-year investment program of the government (1999 - 2001) mainly targets projects on redressing living standard of the extreme poverty strata, improvement of agricultural service and redevelopment of existing basic infrastructure. The category of "human resources utilization and poverty alleviation" as a component of these projects includes education, public hygiene, poverty alleviation and women's participation in development. (Source: Document Cadre Politique Economique, 1999-2000/PNUD).

To reach the goals of promoting women's status and improvement of their living standard, nationwide efforts have been made to facilitate women's participation in the development process. However, the proportion of female officers in governmental organizations and administrative bodies remains at such low level as 10%, and most of them are working in SECF (described below).

(2) SECF (Secretaria d'etat à la Condition Feminine )

SECF was established in 1992 as a governmental body in charge of basic research and planning on the improvement of social and economic status of women. As part of its activity, 20 centers for improvement of women's status were established throughout the country. The centers aim at providing women the following services: unofficial education, occupational training, subsidies to women's associations and

cooperatives. Thanks to the measures taken by these centers, the illiteracy rate was improved and income level was slightly raised. However, the general environment surrounding women still remains unfavorable. SECF holds the following problems to be redressed:

- Poverty
- Increased number of female household heads
- High illiteracy rate (70%)
- Low school enrolment rate
- Improper sanitary conditions
- Lack of information on available services
- Participation in the decision making process

SECF has set out action targets for the period 2000 – 2005 as follows:

- To raise female primary school enrolment rate to 100%.
- To raise female secondary school enrolment rate from 7.3% to 20%.
- To strengthen vocational and technical education for women.
- To establish measures for poverty alleviation of women.
- To organize national fund to support women.

### (3) Existing Situation

Existing situation for gender issues in Mauritania is summarized in **Table 2.4.3**. Although Islam is a state religion in the Republic, social disparities and inequality between sexes in such indicators as: school enrolment rate, employment opportunities, income and the right to vote are less outstanding than the rest of Islamic countries. The government does not enforce the population to be an Islam as an obligatory condition for acquiring nationality.

On the other hand, marriage, divorce and inheritance are still under religious control. To improve the situation, a personal status code (code de statut personnel) was enacted in 2001. This law encourages gender equality and equity for facing with the said matters, which had been always decided by men before enacting the law; in addition, it is forbidden to marry before 18 years old for protection of women. Furthermore, legal clinics (TEYARET) have been established to rescue women who are victims of domestic violence.

**Table 2.4.3 Existing Situation for Gender Issues**

Items	Situation in Mauritania
Selection of partner	Self-determination
Marriage ceremony	According to Islamic law (Family arrangement)
Divorce	The man has the right to repudiate his wife but women can ask for dissolution of marriage. Women usually have custody of her child and men should pay food allowance for the child.
No equal treatment regarding employment	Equal treatment
Voting rate of women	Less than 10%
Age at first marriage	17.5 years old in urban areas and 16.8 in rural areas.
Fecundity synthetic index	4.7 children per woman
Primary school enrollment	84.2% for female and 86% for male
Employment	Equal right to work, same as male
Salary	Same as male

Sources : HDS(Health and Demographic Survey)  
Direction de la Planification et de la Coopération  
Personal Status Code, October 2001

## **2.5 National Development Policy**

According to the HORIZON 2010, one of the major national policies of the country is poverty alleviation. A study conducted in 1996 revealed that about a half of the country's population lives in poverty and one-third are in extreme poverty. It also showed that three-quarters of such poor population lives in rural areas.

In order to cope with the situation, the government has forged a poverty alleviation plan with short (2004), medium (2010) and long (2015) term targets. The targets are listed in **Table 2.5.1**. The following are the major goals of the plans:

- 1) Promoting economic growth and competitiveness which constitute the most fundamental factors and alleviating dependency on foreign aid and investment.
- 2) Developing growth potential and productivity of population in poverty.
- 3) Developing human resources and improvement of access to basic infrastructure.
- 4) Capacity building of organizations by participation of all those who are concerned with poverty alleviation.

The long term target of the poverty alleviation plan is to reduce poverty strata in rural area by half by 2015. In order to attain this target, the following strategic measures shall be taken:

- Fostering of agricultural sector based on diversification and improvement of quality of agricultural products by means of enhancement in productive factors and access to agriculture-related supporting services.
- Development of basic infrastructure in the rural areas.
- Organizational and institutional capacity building.
- Conservation of sustainable natural resources.

As for agricultural and livestock production of in the regions, low productivity stemmed from immature cropping technology, lack of infrastructure for storage and transportation, rudimentary marketing conditions in addition to change in climate are associated with high degree of poverty in rural area.

To cope with the said unfavorable situation, enhancement of unit yield of agricultural production strengthening of market channel between supply and demand and management of water resources are considered essential factors. Furthermore, as more concrete measures for enhancement of unit yield of agricultural production, the government's policy targets the following:

- 1) Application of appropriate agricultural techniques
- 2) Extension of knowledge and skills on food preservation
- 3) Formulation of basic research and extension services plans suitable to arid farming
- 4) Strengthening of marketing condition and promotion for organization of markets
- 5) Construction of preservation facilities in major cities

And, for the management of water resources management, a construction of dam is envisaged.

It is estimated that the incidence of poverty as a whole improved from 56.6% in 1990 to 46.3% in 2000. This decrease was not made uniformly but was unbalanced between urban and rural areas. This fruit is attributable to the sustained economic growth since 1992 and the shift in public spending towards social sectors and poverty alleviation programs. There have also been significant improvements in social indicators; in particular, primary school enrollment rates increased from 49% in 1987 to 88% in 2000 and access to primary health care has increased from 30% in 1990 to about 70% in 2001.

**Table 2.5.1 Poverty Reduction Target (1/2)**

Priority Objectives and Performance Indicator:	Reference Situation		Target Figures		
	Year	Value	2004	2010	2015
<b>Reduce Poverty</b>					
Number of poor (in thousands)	1996	1,175	1,202	850	478
Incidence of poverty (%)	1996	50.0	38.6	26.6	16.9
Incidence of extreme poverty (%)	1996	32.6	21.8	11.7	4.6
Depth of poverty (%)	1996	18.3	11.2	4.8	1.0
Severity of poverty (%)	1996	9.1	4.7	1.8	1.0
Gini coefficient* (%)	1996	38.0	35.3	33.3	32.4
<b>Accelerate economic growth</b>					
Annual GDP growth rate (%)	1999	4.1	7.0	7.0	7.3
Per capita annual GDP growth rate (%)	1999	1.2	4.0	4.4	4.7
Investment rate ( % of GDP)	1998	15.4	25.0	23.0	22.0
<b>Preserve macroeconomic stability</b>					
Rate of inflation (%)	1999	4.1	7.0	7.0	7.3
Current accounts balance (% of GDP)	1999	2.2	-3.0		
Current balance of payments deficit excluding official transfers ( % of GDP)	1998	11.4	14.7	10.0	10.5
Gross reserves (in month of importation)	1998	5.9	6.0	6.0	6.0
Debt/GDP ratio ( %)	1998	215			
<b>Improve overall level of education</b>					
Gross rate of primary enrollment (%)	1999	86	100	100	100
Gross rate of enrollment for girls (%)	1999	81	97	100	100
Percentage of children who complete the basic cycle (%)	1999	55	67	78	100
Percentage of girls who reach the 6th year of basic education (%)	1999	50	60	78	100
New enrollees in the 1st year of secondary education	1999	18,344	28,666	34,878	50,000
Pupil/teacher ratio in the first three years of secondary school	1999	36.0	30.6	26.0	26.0
Adult illiteracy rate (%)	1996	42.0	20.0	13.0	1.0
Education expenses as a percentage of GDP (%)	1999	3.7	4.2	5.0	5.4
<b>Improve overall health situation</b>					
Life expectancy at birth (years)	1998	54	56	59	62
Overall fertility rate	1998	5.4	5.0	4.0	3.0
Infant mortality rate (0/00)	1998	105	90	50	40
Child mortality rate(0/00)	1998	140	130	103	55
Maternal mortality rate(100,000)	1998	930	700	450	250
Rate of HIV prevalence among pregnant women (%)	1998	1	2	1	1
Rate of coverage (by a US) within a 5 Km radius (%)	1998	70	80	90	100
Rate of malnutrition (weight-for-age) among children <5 years (%)	1999	23	18	14	10
<b>Increase access to drinking water</b>					
Rate of connection to water system (%)	1998	35	45	54	60
Price per m3 of water (US dollars)	1997	1.03	1.03	1.07	1.10

\*: The Gini coefficient, which is measured for expenses, should not experience significant evolution as the consumption patterns of Mauritians do not change very much from one income level to the next

Source : Poverty Reduction Strategy Paper, Government of IRM - World Bank - IMF

**Table 2.5.1 Poverty Reduction Target (2/2)**

Priority Objectives and Performance Indicator:	Reference Situation		Target Figures		
	Year	Value	2004	2010	2015
<b>Increase incomes and improve living conditons in rural settin</b>					
Incidence of rural poverty (%)	1996	68.1	52.7	44.0	34.0
Incidence of extreme rural poverty (%)	1996	56.2	40.8	33.8	24.0
Gini coefficient* in rural setting (%)	1996	33.0	31.7	30.8	30.0
Agricultural GDP growth rate (%)	1998	6.2	10.0	10.0	10.0
Yield from irrigated rice (tons/hectare, with out-of-season growing)	1998	4	9	10	12
Livestock health coverage rate (compulsory vaccines) (%)	1999	60	70	77	85
Yield from arid food crops (tons/hectare)	1999	0.4	0.8	1.0	1.0
<b>Increase incomes and improve living conditons in the shanty towns of large and secondary cities</b>					
Target population (thousand)	2000	540	266	540	700
working population with access to micro-credit (thousand)			20	40	80
Cumulative volume of micro-credits (UM millior	2000	200	2,500	5,000	6,000
Number of regularized land titles in poor district:	2000		16,000	30,000	40,000
Number of new lands developet			8,000	20,000	35,000
Access to subsidized housing in poor districts (families)	2000	300	10,000	20,000	35,000
Drinking water consumption (l/day)per inhab. in poor districts	1997	10-20	20-30	40	50
Rate of access to drinking water in poor districts (%)	1997	35	40	50	60
Price per m3 of water (US dollars) in poor districts	1997	2-3	<1	<0.5	<0.5
Price per m3 of water in poor districts as compared to other districts (times)	1997	5.0	1.0	0.8	0.8
Rate of access to sanitation in poor district (**) (%)	2000	10	15	26	36

\*\* : This involves operations financed in the context of public urban program

Source : Poverty Reduction Strategy Paper, Government of IRM - World Bank - IMF