

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF ENVIRONMENT AND NATURE PROTECTION
DEPARTMENT OF WATER, FOREST, HUNTING AND SOIL CONSERVATION
REPUBLIC OF SENEGAL

**THE STUDY ON SUSTAINABLE MANAGEMENT
OF
THE MANGROVE
IN
THE PETIT-CÔTE AND SALOUM DELTA
IN
THE REPUBLIC OF SENEGAL**

SUSTAINABLE MANAGEMENT PLAN FOR MANGROVE FORESTS

FINAL REPORT

FEBRUARY, 2005

**JOINT VENTURE FOR THE STUDY ON SUSTAINABLE
MANAGEMENT OF THE MANGROVE IN THE PETIT-CÔTE AND
SALOUM DELTA IN THE REPUBLIC OF SENEGAL
JAPAN FOREST TECHNOLOGY ASSOCIATION
IC NET CO., LTD.**

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PREFACE

In response to a request of the Government of Senegal, the Government of Japan decided to conduct a study on Sustainable Management of the Mangrove in the Petite Cote and Saloum Delta (hereinafter referred to as “the study”) and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the study team headed by Mr. Tadao OHARA of Japan Forest Technology Association and consists of Japan Forest Technology Association and IC-Net Co., LTD. between Jan 2002 and Dec 2004.

The team held discussions with the officials concerned of the Government of Senegal and conducted field surveys at 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 this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Senegal for their close cooperation extended to the study.

February 2005

Etsuo KITAHARA,
Vice President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Etsuo KITAHARA

February, 2005

Vice President : Japan International Cooperation Agency

Dear Mr. KITAHARA

The Study on Sustainable Management of Mangrove Forests in The Petit-Côte and Saloum Delta in the Republic of Senegal has now been completed and the Final Report for the Study is submitted herewith.

This Report compiles the Master Plan together with the findings of various surveys and analyses conducted in the period from December, 2001 to March, 2005 by a joint venture formed by the Japan Forest Technology Association and IC Net Co., Ltd. in accordance with the contract concluded with the Japan International Cooperation Agency. Through the Study, the Master Plan has been formulated along three key axes, i.e. (i) utilisation and rearing of forest resources for the sustainable management of mangrove forests, (ii) utilisation and management of marine resources and (iii) utilisation and conservation of tourism resources. Publicity, education and environmental education in connection with the implementation of the Master Plan are also planned. Some of the planning items were actually implemented as the Pilot Project in 10 villages in a participatory manner. Efforts were made throughout the Pilot Project implementation process to enhance the awareness of local residents of the importance of mangrove forests. The Final Master Plan incorporates the lessons and important points learned from the Pilot Project.

It is sincerely hoped that the Sustainable Management Plan (Master Plan) will be put into practice with the conscious efforts of the Government of Senegal and others concerned in Senegal, thereby contributing to the enhancement of mangrove forests in the Saloum Delta and the development of local communities.

On behalf of the Study Team members, I would like to express my heartfelt gratitude for the useful guidance and assistance provided by officials of the Japan International Cooperation Agency, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries throughout the study period. The Study Team members greatly appreciate the valuable advice and assistance they received in Senegal from officials of the JICA-Senegal Office, the Embassy of Japan and the Department of Water, Forest, Hunting and Soil Conservation of the Senegalese Ministry of Environment and Nature Protection.

Tadao OHARA

Team Leader

The Study Team for Sustainable Management of
The Mangrove in The Petit-Côte and
Saloum Delta in the Republic of Senegal



1. Explanation and Discussion of the Inception Report



2. Mangrove forest near Toubakouta



3. Interview with local inhabitants



4. Mangrove forest survey (*Rhizophora*)



5. Mangrove firewood used by local residents



6. Participatory Workshop (Mar Fafako, Pilot Project)



7. Planting of *Rhizophora* seedlings (Djirnda, Pilot Project)



8. Planting of *Avicennia* seedlings (Dassilame Sérère)



9. Creation of a village forest (teak, Dassilame Sérère, Pilot Project)



10. Improved smoking kiln (Bassoul, Pilot Project)



11. Oyster culture Guirlandes (Sokone Oyster Producers' Union, Pilot Project)



12. Heavy cloth shoes and gloves and face masks made by local inhabitants (Moundé, Pilot Project)



13. Improved oven for home cooking (Bangalère, Pilot Project)



14. Horse carriage for eco-tourism (Moundé, Pilot Project)



15. *Avicennia* nursing and planting experiment (Somone Nursery)



16. Technical Transfer Seminar

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ABBREVIATIONS

- ANCAR : Ministère de l'Agriculture et de l'Hydraulique Agence Nationale de Conseil Agricole et Rural
(National Agricultural and Rural Development Agency of the Ministry of Agriculture and Water Supply)
- ASC : Association Sportive and Culturelle
(Association for Sports and Culture; a youth organization)
- BHB : Besoin Humain de Base (Basic Human Needs: BHN)
- CAC : Cellule d'Animation et de Concertation (Liaison Cell for Village Promotion)
- CAREM : Coordination des Associations pour la Restauration de l'Écosystème de Mangrove
(Coordination Committee of Associations for Restoration of Mangrove Ecosystem)
- CC : Cadre de Concertation (Inter-Village Consultation Council; UICN)
- CERP : Ministère de l'Intérieur Centre d'Expansion Rural Polyvalent (Rural Villages Development Centre of the Ministry of Home Affairs)
- CFA : Franc Communauté Financière Africaine (CFA franc: common currency for FCFA)
- CIDA : Canadian International Development Agency
- CILSS : Comité nationale du Comité Inter-Etats de Lutte contre la Sécheresse dans le Sahel
(Permanent Committee to Combat Desertification of Sahel)
- CM : Commune
- COVRCE : Comité Villageois de Réhabilitation de l'Ecosystèmes et de Conservation de l'Environnement
(Ecosystem Rehabilitation and Environmental Conservation Committee)
- CP : Comité de Plage (Beach Committee)
- CR : Communauté Rurale (Rural Community)
- CRODT : Centre de Recherche Océanographique de Dakar Thiaroye
(Dakar Thiaroye Oceanographic Research Centre)
- CVRM : Comité Villageois pour la Réhabilitation de la Mangrove
(Villagers' Committee for Mangrove Rehabilitation)
- DEFCCS : Ministère de Environnement et de la Protection de la Nature Direction des Eaux, Forêts, Chasse et de la Conservation des Sols
(Department of Water, Forest, Hunting and Soil Conservation of the Ministry of Environment and Nature Protection)
- DOPM : Ministère de l'Economie maritime Direction de l'Océanographie et des Pêches Maritimes
(Department of Oceanography and Fisheries of the Ministry of Economy and Fisheries)

DPN	: Ministère de Environnement et de la Protection de la Nature Direction des Parcs Nationaux (Department of National Parks of the Ministry of Environment and Nature Protection)
DPS	: Ministère de l'Economie et des Finances Direction de la Prévision et des Statistiques : (Department of Forecast and Statistics of the Ministry of Economy and Finance)
EPEEC	: Equipe Pluridisciplinaire d'Etude des Ecosystèmes Cotières (Interdisciplinary Team for Coastal Ecosystem Study)
FAO	: Food and Agriculture Organization
FEM	: Fonds de l'Environnement Mondial (Global Environment Facility: GEF)
FIDA	: Fonds International pour le Développement de L'Agriculture (International Agricultural Development Fund)
FIOD	: Fédération Intervillageoise des Organisations pour le Développement Durable (Intervillage Federation of Organizations for Sustainable Development)
GIE	: Groupement d'Intérêt Economique (Economic Interest Group: producers' group with the status of a juridical person)
GPF	: Groupement de la Promotion Féminine (Female Promotion Group: group to promote the activities of women)
GTZ	: Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency)
IDEN	: Ministère de l'Education Inspection Départementale de l'Education Nationale (Departmental Inspectorate of National Education of the Ministry of Education)
IPCC	: Intergovernmental Panel on Climate Change
MARP	: Méthode Active de Recherche Participative (Participatory Rural Survey Method)
MAS	: Miel Apiculteur Senegal (Union of Apiculturalists in Senegal at Toubakouta)
PAE	: Plan d'Action Environnementale (Environmental Action Plan)
PAGERNA	: Projet Autonome pour la Gestion des Ressources Naturelles (Autonomous Project for Management of Natural Resources at Sine Saloum)
PAGT	: Plan d'Aménagement et de Gestion du Terroir (Land Development and Management Plan)
PCM	: Project Cycle Management
PFIE	: Programme de Formation-Information pour l'Environnement (Environmental Education Programme)
PLD	: Plan Local de Développement (Local Development Plan)
PNDS	: Parc National du Delta du Saloum (Saloum Delta National Park)
PROCR	: Projet Allemand de Promotion des Communautés Rurales (German Project for Promotion of Rural Communities)
PRODEFI	: Projet Communautaire de Développement Forestier Intégré (Community Project for Integrated Forestry Development)

- PROMER : Projet de Promotion des Micro-Enterprises Rurales
(Rural Micro-Enterprises Promotion Project)
- RBDS : Réserve de Biosphère du Delta du Saloum (Saloum Delta Biosphere Reserve)
- SAPAD : Structure d'Appui pour l'Aménagement et le Développement du delta du Saloum
(Supporting Structure for Sakoum Delta Improvement and Development)
- UCAD : Université Cheikh Awa Diop-Dakar (Dakar University)
- UICN : Union Mondiale pour la Nature (World Conservation Union)
- UNESCO : Organisation des Nations-Unies pour la Science, l'Éducation et la Culture
(United Nations Educational, Scientific and Cultural Organization)
- VC : Vacances Citoyennes
- WAAME : West African Association for Marine Environment
- WTP : Willingness to Pay

The foreign exchange rates used as

1 Euro = 655.957 FCFA (fixed) and ¥1 = 4.8 FCFA (as of September, 2004).

SUMMARY

SUMMARY

1. Outline of the Study

(1) Background of the Study

Mangrove forests growing in Senegal mark the northern limit of the zone where mangrove can grow in West Africa and have created a precious ecosystem maintaining biological diversity. In particular, the main areas of the southern lagoons, estuaries and deltas form a mangrove zone of some 200,000 ha.

However, the degradation and depletion of these mangrove forests due to the decline of rainfall since the 1970's and illegal cutting by local residents, etc. are now causing grave concern in regard to (i) negative impacts on local resources (forestry, fisheries and tourism) which are essential for the livelihood of local residents and local industries and (ii) worsening of the environment. To improve the situation, the Government of Senegal requested the Government of Japan's provision of assistance for a study on the sustainable management of mangrove forests in the Thiès Region and Petit Côte and the Saloum Delta in the Fatick Region in the central western part of the country. In response, the Government of Japan dispatched a study team to conduct the present Study.

(2) Objectives of the Study

The Study has the following objectives.

- ① To formulate a sustainable management plan for mangrove forests which takes into consideration the multiple functions of these forests, i.e. ecosystem, forestry resources, fisheries resources, tourism resources and prevention of coastal erosion, for the Petit Côte and Saloum Delta areas for the purpose of ensuring the conservation and sustainable use of mangrove forests which have been showing a declining tendency in recent years.
- ② To implement a pilot project for the capacity building of local residents/organizations which play the most important role in the conservation of mangrove forests as the main actors.
- ③ To transfer the relevant techniques/skills through OJT to the Senegalese counterparts during the study period.

2. Present Conditions of the Study Area

(1) Natural Conditions

1) Location and Topography

The Study Area covers an area of 617,500 ha, consisting of a coastal area called Petit Côte in the Thiès Region and the Saloum Delta in the Fatick Region in the central western part of the country. The Study Area contains 20 RCs and five communes selected from Mbour Department in the Thiès Region and Foundiougne Department and Fatick Department in the Fatick Region. The Study Area is almost entirely coastal lowland, the elevation of which is less than 5 m. The catchment area is as large as 90,000 ha. Dry beaches have developed along the coastline of the delta and shallow sea spreads beyond these beaches. Numerous tidal waterways have developed in a dendritic manner inside island groups dotted around the delta and mangrove forests have grown along both sides of these waterways. Huge areas of ooze and dense diverse vegetation have formed an important ecosystem to maintain biological diversity. Mangrove forests also exist in low, swampy areas on the inland side of the delta and acidic sulphate soil called tanne spreads behind these swampy areas. (See Fig. 1.1-1 – Location Map of the Study Area)

2) Climate

The Study Area is characterised by a semi-arid tropical climate with a rainy season lasting from July to October and a dry season lasting for the remainder of the year. In the dry season, areas along the Atlantic coast in the north and central parts of the country are cool because of the trade wind from the north which is cooled by the Canarian current (cold current) in the Atlantic. In the rainy season, a wet wind blowing from the sea towards the Sahara Desert brings sultry weather and rain throughout Senegal.

The Study Area is situated between the isohyetal lines of 700 mm and 900 mm. According to annual rainfall data for the period from 1918 to 1993, the annual rainfall has shown a declining trend since 1968, reaching a low level of 400 mm – 600 mm for the decade from 1980 to 1990. However, there have been signs of a recovery to the average annual rainfall level since 1999.

3) Water Systems

Three rivers, i.e. Saloum, Dion Bos and Banjara, run through the Saloum Delta. The phenomenon of an inward flow of sea water towards the inland to replenish evaporated river water in the inland is observed with these rivers as there is no constant flow of fresh water

from inland rivers to them. For this reason, the level of salinity in the Saloum Delta increases from the river mouth to the inland in the dry season.

4) Land Use

The area by type of land use in the RBDS which covers most of the Study Area based on images taken by the SPOT satellite is 84,800 ha of water bodies, 58,300 ha of mangrove forests (high and low), 14,500 ha of tanne, 38,000 ha of forests, 23,700 ha of savannah, 400 ha of plantations, 4,000 ha of farmland and 8,700 ha of other types of land use.

5) Vegetation

The Study Area is located in the transitional zone from the Sudan-Guinea model of vegetation to the Sahel-Sudan model of vegetation. The typical vegetation in the flood areas is mangrove, mainly consisting of six species belonging to *Rhizophoraceae*, *Verbanaceae* and *Combretaceae*. Forests in the Study Area show a belt-like structure where pure mangrove forests of *Rhizophora spp.* are found at the river mouth and river banks while *Avicennia africana* with a higher salt resistance is found in inland areas.

(2) Socioeconomic Conditions

1) Local Administrative Structure

The local administrative structure in Senegal is made up of regions, communes and rural communities, each of which has the status of a juridical person for financial independence. The respective local public bodies are freely run by councillors who are elected through a popular election. Meanwhile, the central government appoints governors, chief administrators and heads who act as the agents for national interests at the regional, departmental and district levels respectively to protect national interests, to supervise the compliance of local public bodies with the law and to ensure public order. These appointees by the central government monitor the legality of the actions and budget of local public bodies within the framework set forth by the laws and regulations relating to these bodies.

2) Population

The 1988 census puts the total population of Foundiougne Department and Fatick Department of the Fatick Region and Mbour Department of the Thiès Region where the subject 20 rural communities and five communes of the Study are located at 625,452, consisting of 307,822 males (49.2%) and 317,630 females (50.8%). The number of households was 68,339 with an average number of persons per household of approximately nine.

3) Industries

Agriculture is the key industry for rural communities in the Study Area and the main crops are peanuts as a cash crop and millet as the staple food. Sorghum, maize and rice, etc. are also grown for self-consumption. Because of the extensive rainwater-fed farming, the production volume is highly dependent on the rainfall level, making local agriculture a less than reliable economic activity.

Stock raising is the second-most important local industry in the Study Area, providing a means of dispersing the economic risks for farming households. Fishery is the main industry in island as well as coastal areas. Large-scale fishery using power boats is conducted along the coast while artisanal fishery and the processing of marine products are conducted in island areas with limited access to markets.

4) Natural Resources Management Systems

① Land

The Government of Senegal enacted a law concerning national land in 1964, clearly establishing land ownership under a statutory law. Land of which the owner, regardless of it being the government or a private individual, which was not registered on the day of enforcement of this law is regarded as national land. Despite this, the customary land tenure system still remains today.

The above law classifies national land into four zones: urban zone, designated national land zone, rural zone and development zone.

The management authority for natural resources, including land and forests in the three zones other than the designated national land zone, has been transferred to local public bodies at the regional, commune and rural community levels as a part of decentralisation.

② Fisheries Resources

The Government of Senegal introduced restrictions on the mesh size of fishing nets and fishing gear in 1976 and enforced the new Fisheries Act in 1998 for the purpose of managing fisheries resources in a more effective manner. These comprise part of the government's efforts to ensure the modern management of fisheries resources in the Saloum Delta through the introduction of outboard engines to fishing boats, expansion of the geographical area subject to fishing activities due to the use of improved fishing gear and extension of the fishing season to the entire year.

③ Forest Resources

Forest resources in Senegal are managed under the Forest Act and the Enforcement Ordinance of the Forest Act. More specifically, management activities include the development of and production at some forests, conservation of national forests, law enforcement against illegal cutting and sale of confiscated wood and creation of coastal windbreak forests.

The Government of Senegal revised the Forest Act in 1993 and in 1998, legally upholding the right of local residents to participate in forest resources management and transferring the management authority to local public bodies. Under these new statutory arrangements, a forest improvement project may be implemented at a forest managed by a commune or rural community in particular if the relevant forest management plan prepared by the local public body concerned is approved by the DEFCCS.

5) Village Organizations

Traditional groups described as village organizations include those based on age, those based on Islam, mutual financing groups and committees for traditional wrestling. In addition, official organizations, such as a GIE (producers' organization), GPF (women's group) and ASC (youth group for sporting and cultural activities), are active in almost all villages.

In the field of natural resources management, there are intra-village and inter-village organizations of villagers corresponding to assistance provided by donors (such as the GTZ) and NGOs (UICN and WAAME, etc.) as well as a federation of villagers' organizations which has been voluntarily established by these organizations (around Fimla).

6) Socioeconomic Infrastructure

The existing socioeconomic infrastructure in Fatick Department, Foundiougne Department and Mbour Department in the Study Area includes medical facilities (clinics), educational facilities (primary and secondary schools and literacy centres), water supply facilities (boreholes and shallow wells) and commercial facilities (permanent and periodic markets). Local residents of Fatick Department generally have better access to these facilities than those of Foundiougne Department. In the case of the latter, those living in island areas enjoy better access to medical care, education and water than those living inland.

3. Outline of Study Findings

(1) Mangrove Forest Resources

1) Present Distribution of Mangrove Forests

① Species

Six species of mangrove belonging to three families and four genera are found in the Study Area. In general, *Rhizophora spp.* is distributed in areas at a lower elevation which are flooded for a long time among tidal areas while *Avicennia* is distributed in the upper parts of tidal areas and in areas at a high elevation which are flooded irregularly. *Languncularia* and *Conocarpus* are occasionally found in areas with a higher elevation than areas of *Avicennia* and which are flooded only at the time of a flood tide.

② Distribution

The distribution of mangrove in the Study Area shows an overwhelming presence of *Rhizophora* in island areas around Saloum Island and Betenti Island. *Avicennia* beings to appear in transitional areas from rivers to inland, creating mixed areas of *Rhizophora* and *Avicennia*. The inner areas of land around islands have *Rhizophora* along rivers and both *Rhizophora* and *Avicennia* towards inland. *Avicennia* is more dominant in the upper reaches beyond Foundiougne and Fimla but the quantity is extremely small. In the Petit Côte area, *Rhizophora* is found near Somone and Joal while *Avicennia* is found in areas subject to less flooding.

③ Causes of Decline of Mangrove Forests

There are several main causes of the decline of mangrove forests, such as ‘a’ increased salinity due to drought, ‘b’ cutting of mangrove by local residents, ‘c’ progress of sedimentation and ‘d’ construction of roads.

a. Increased Salinity Due to Drought

Decline of the rainfall means a smaller supply of fresh water from the upstream. In the Saloum Delta, the phenomenon of the backward flow of river water from the sea towards the upstream occurs. The higher level of evaporation than the level of rainfall causes an increase of the salinity.

b. Cutting of Mangrove by Local Residents

Although the cutting of live mangrove trees is prohibited, they are actually cut by local residents for use as building logs for roof structures, firewood for cooking and firewood for the smoking of fish and the processing of shellfish.

c. Sedimentation

The sedimentation of soil discharged from cultivated land has raised the elevation of growing sites of *Rhizophora* and the resulting shortening of the flooding period is causing the death of *Rhizophora*. Moreover, the solidification of the ground makes the natural regeneration of mangrove difficult.

d. Construction of Roads

Roads running through mangrove areas are almost always constructed by banking, making the creation of cross culverts to allow water flow necessary. These cross culverts are narrow and their number is small. To make matters worse, the bed of the waterways is higher than the bed of the cross culverts, making the outflow of sea water at the upstream side across the road insufficient. The salinity of such residual sea water increases through evaporation, causing the death of mangrove.

2) Quantity of Mangrove Forest Resources

① Area

The total area of mangrove forests in the Study Area is estimated to be some 64,000 ha, consisting of 16,300 ha of high forests (6 – 14 m in height) and 48,000 ha low forests (2 – 6 m) based on (i) the analysis results of images taken by the SPOT satellite in terms of the area by land use in the RBDS and (ii) the measurement results of mangrove forest areas outside the RBDS using existing aerial photographs and topographical maps (scale of 1 to 50,000).

② Estimation of Quantity of Resources

The results of the sample site survey (involving 10 sample plots of which the size varies from 10 m² to 100 m²) show that the mean stand volume of high mangrove forests with a mean upper story tree height of 10 m is 88 m³ and that the mean stand volume of low mangrove forests with a mean upper story tree height of 4 m is 12 m³ based on correlation between the mean upper story height (mean height of four tall trees) and the volume (trunk and branches).

Based on the low mangrove forest (mean upper story tree height of 4 m) area of 48,020 ha and the high mangrove forest (mean upper story tree height of 10 m) area of 16,266 ha in the Study Area, the total quantity of mangrove resources in the Study Area is 2.01 million m³, consisting of 1.43 million m³ in high forests and 0.58 million m³ in low forests.

③ Estimation of Increment, etc.

Rhizophora forming high mangrove forests in the conservation zone in the Study Area has a mean volume of 88 m³/ha with a mean upper story tree height of 10 m. The stand age for a mean upper story tree height of 10.0 m is 29 years based on the survey results for existing mangrove forests. The estimated increment in the Study Area based on such data is shown below.

Item		Value
Mean Upper Story Tree Height (m)		10.0
Mean DBH (cm)		6.0
Mean Base Diameter (cm)		8.0
Volume (Trunk + Branches) (m ³ /ha)		88.0
Volume (Trunk + Branches) Increment (m ³ /ha/year)		3.0
Quantity of Biomass of Woody Parts (Trunk + Branches) Above Ground (tons/ha/year)	Dry Weight	73.9
	Green Weight	114.4
Increment of Biomass of Woody Parts (Trunk + Branches) Above Ground (kg/ha/year)	Dry Weight	2,548.0
	Green Weight	3,945.0

* Specific gravity Air dried specific gravity : 0.84

Green specific gravity : 1.30

* Stand age (tree age) : 29 years old

④ Increment of Mangrove Forests

The estimated annual increment (increment of biomass of woody parts above ground) of high mangrove forests (*Rhizophora*) by rural community to which the responsibility for the management of natural resources has been delegated is shown in the table below.

Increment of High Mangrove Forests

Rural Community	Area of High Mangrove Forests (ha)	Estimated Annual Increment	
		Volume (m ³)	Dry Weight of Woody Parts Above Ground (tons)
Djirnda	329	987	838
Bassoul	558	1,674	1,422
Dionouar	6,081	18,243	15,494
Others	3,344	10,032	8,521
Toubakouta	4,966	14,898	12,653
Fimla	76	228	194
Djilor	312	936	795
Diossong	600	1,800	1,529
Total	16,266	48,798	41,446

3) Planting of Mangrove

With the assistance of such NGOs as the UICN, WAAME, CAREM and FIOD, *Rhizophora* was planted in the six years from 1995 to 2001 over an area of some 420 ha in 49 villages. The survival rate and stage of growth of the planted trees at these sites suggest that these efforts have so far been generally successful. However, the survival rate and growth have been less favourable at those plantations of which the elevation is relatively high, have been subject to sedimentation or where the salinity level is high, suggesting the unsuitability of these sites for further planting.

4) Utilisation Situation of Mangrove Forests

While the cutting of live mangrove trees is prohibited by law, local residents still use mangrove forests to obtain wood and non-wood forest products. As wood, mangrove is used to produce the beams for houses and fencing posts around houses and firewood for cooking, smoking of fish and processing of shellfish. The use of forests for non-wood products include as a source of honey and as a source of traditional medicines.

- Management Situation of Mangrove Forests

The treatment of mangrove forests by the DEFCCS is the same as that of ordinary forests made up of timbre trees. If a mangrove forest is situated outside a national forest area, any use of such mangrove forest land must obtain the approval of the related local public body.

The use of mangrove forests in national forest areas is regulated in the form of, in principle, a total cutting ban. Right of use is afforded to local residents regarding the cutting of poles for house repairs and the collection of such forest products as dead trees, fruit, leaves, roots and bark for their own use as food or for medicinal purposes. In reality, however, the provisions of the Forest Act are not strictly observed as cut-over areas of mangrove can be found at, for example, the far end of minor waterways.

Under the new Forest Act, it is possible for local residents and local public bodies to legally utilise forest resources by means of formulating a forest improvement plan. The relevant provisions offer a legal basis for the participation of local residents and local public bodies in forest management, indicating a concrete path to be followed.

(2) Fisheries resources

Important fisheries resources for economic activities done by the people living in Saloum Delta are shrimp, ethmalose, mullet, tilapia, sea catfish, sole, mangrove oyster and ark, etc.

Shrimp resource is important as income generating source particularly for the people living at inland of the delta. Shrimp production has been increasing in recent years because cold storages make up shrimp production and delivery networks through middlemen. Ethmalose, which often fluctuates annual catch, is delivered to neighboring countries including Guinea after smoking. Smoking furnaces for ethmalose are increasing in Saloum Delta, accordingly mangrove firewood is consumed more than before. Mullet, tilapia and sea catfish, which show stable annual catch, are provided for oneself or sold within the area.

Shellfish resources such as mangrove oyster and ark are important fisheries resources for women living in Saloum Delta. The shellfishes are boiled, dried, and sold in isled of the delta. Mangrove oyster is delivered with fresh product from Sokone and Joal to Dakar for consumptions of foreign tourists.

According to IUCN study, 114 species of fish are observed in Saloum Delta among which 50 species including ethmalose, mullet, tilapia and sea catfish spawn or grow up in the delta. Likewise, mangrove forests work as breeding and growing grounds for fisheries resources.

(3) Nature Conservation and Ecotourism

1) Status of Nature Conservation

The Project area, which includes the bio-diversity protection area established by the Department of the National Park, is significantly important from the view point of bio-diversity. Recognizing the importance of nature conservation and remaining keen on nature conservation, Senegal government has ratified international treaties, including the Ramusar Treaty adopted in 1971 to protect important wetlands and the Convention on Biological Diversity adopted in 1992. The Saloum Delta was designated as an internationally important wetland.

2) Ecotourism

The tourism sector is one of the important sub-sectors in Senegal, boasting to be a big foreign currency earner, second only to the fishery sector. Major tourism assets in the Project area constitute abundant nature and bio-diversity in the Sin Saloum Delta.

Development of large-scale tourism commenced in 1972, and a number of big tourist hotels were constructed in Petite-Cote. It has been a typical tourism promotion of developing countries to attract tourists from developed countries for 3S (Sea, Sand and Sky). The tourism industry significantly contributes to the national economy. At the same time, local residents passively accept foreign tourists without receiving much benefit.

(4) Utilisation Situation of Mangrove Forests

A questionnaire survey was conducted to clarify the utilisation situation of mangrove forests by local residents in the Study Area. The survey results indicate the use of mangrove wood, mainly as building logs and firewood for home cooking, processing of shellfish and smoking of ethomaroze. The annual consumption of mangrove wood is shown below.

Purpose of Use	Annual Consumption (tons)
Construction Logs	328.3
Fencing Posts	45.8
Firewood for Cooking	12,638.0
Firewood for Shellfish Processing	6,497.0
Firewood for Smoking of Ethomaroze	3,426.0
Total	22,935.1

(5) Empowerment activities and environmental education

At the school level, the Environmental Education Program (PFIE: Programme de Formation Information pour l'Environnement) was implemented from 1990 to 2000. In the schools targeted by PFIE, an Environmental Action Plan (PAE: Projet d'action environnementale) was set, spelling out solutions and specific actions for regional environmental issues. PAE was implemented in the form of combination of classroom sessions, activities outside schools and practical training.

In Foundiougne prefecture, there were 17 PFIE schools and they carried out such activities as planting in schoolyard. However, no school has implemented a mangrove-themed class or extracurricular or activity on its own.

In addition, some NGOs and JOCV volunteers carry out environmental education activities in primary schools within the study area.

(6) Oceanographic Condition and Coastal Erosion Survey

1) Oceanographic Condition Survey

① Flow Regime

The flow directions at the time of both high tide and low tide during the flood tide periods show similar tendencies in both the dry season (observed in February and June) and the rainy season (observed in August and November). The observed flow velocity of the river water of each river was 0.1 – 1.2 m/sec for the section from the lowerstream to the midstream and 0 – 0.5 m/sec for the section from the midstream to the upstream, showing a slower velocity in the upstream. The flow direction depends on the change of the tide.

② Salinity

The salinity of the surface layer (0.5 m below the water surface) and bottom layer (0.5 m above the river (sea) bed) at the time of both high tide and low tide during the flood tide periods in the dry season (observed in February and June) and the rainy season (observed in August and November) was 40 ppt at the some 20 km point from the mouth of Saloum River, 103 ppt at Kaolack located some 110 km from the river mouth and 131 ppt at Fatick located some 80 km from the mouth of a north tributary. The level of salinity in the rainy season is lower than that in the dry season. The actual figures recorded were 40 ppt at a point some 40 km from the mouth of Saloum River, 70 ppt at Kaolack and 65 ppt at Fatick.

③ Dissolved Oxygen

The timing of a survey or the location of a survey appears to have hardly any effect on the level of dissolved oxygen. The oxygen saturation ratio is 9.7 – 127% (average of 69%) in February and 30 – 96% (average of 70%) in June in the dry season and 32 – 98% (average of 65%) in August and 31 – 146% (average of 73%) in November in the rainy season. The state of anoxia at the bottom layer is not found at any site.

④ Base Materials

The principal base material is mud or mud mixed with sand at places where mangrove grow or sand at nearby places where mangrove do not grow. The base materials near places of mangrove growth show an anaerobic environment below several centimetres from the bed surface and a sulphurous odour can be observed.

⑤ Tide Level

The tide level observation results using a staff gauge at three points in February in the dry season and November in the rainy season show that the tide level changes at roughly a half day cycle in both February and November. The difference between the tide levels during the flood tide period is 1.65 m (0.25 – 1.90 m) in February and 1.57 m (0.45 – 2.02 m) in November at Djifere near the sea, 1.87 m (0.10 – 1.97 m) in February and 1.99 m (0.09 – 2.08 m) in November at Toubakouta and 0.75 m (0.25 – 1.00 m) in February and 0.80 m (0.30 – 1.10 m) in November at Foundiougne located some 45 km from the river mouth. Compared to changes of the tide level at Dakar, those at the local observation points are delayed by approximately one hour at Djifere and Toubakouta and by approximately three hours at Foundiougne.

2) Coastal Erosion Survey

In regard to the situation of coastal erosion at Petit Côte stretching from Mbour to the mouth of Saloum River in the Study Area, coastal erosion due to the collection of sea sand is prominent in the northern part of Petit Côte, causing such damage as the collapse of houses and the loss of farmland. In the south, damage, including the loss of houses, trees and farmland, is occurring due to coastal erosion caused by waves and strong wind. The shore line from Palmarin to Betenti has generally receded by more than 100 m in the last 30 years (based on 1972 and 2003 LANDSAT satellite images).

(7) Socioeconomic Value of Mangrove Forests

Mangrove forests have a wood (including non-wood forest product) production function and other various functions which are of public benefit. The entire mangrove forests in the Saloum Delta area are considered to constitute “a single entity of environmental goods” in this Study in order to evaluate the socioeconomic value of wood, fisheries and tourism. The total value is estimated to be between 6,332 million FCFA and 6,717 million FCFA.

Wood/non-wood forest products	: 485 million FCFA
Fisheries	: 1,857 – 2,241 million FCFA
<u>Tourism</u>	<u>: 3,991 million FCFA</u>
Total value	: 6,332 – 6,717 million FCFA

As the GDP of Senegal as of 2003 is 3.4 million FCFA, the above evaluated value of mangrove forests accounts for approximately 0.2% of the GDP.

Although the total value does not include the CO₂ absorption effect, the value of this effect is estimated to be US\$ 2.79 million (based on a mangrove forest area of 64,286 ha, an annual CO₂ absorption volume of 278,759 tons and a CO₂ value per ton of US\$ 10).

4. Sustainable Management Plan for Mangrove Forests (Master Plan)

(1) Basic Planning Policies

Mangrove forests play a critical role for the local natural environment and biological diversity and are also essential for the livelihood of local residents. Here, the Sustainable Management Plan for Mangrove Forests (hereinafter referred to as the Master Plan) is formulated from the medium to long-term viewpoint based on a multi-faceted approach, including (i) the promotion of forestry, fisheries and tourism and (ii) the improvement and stabilisation of the livelihood of local residents, to achieve the primary objectives of conserving mangrove forests which show a trend of depletion and degradation due to natural and man-made factors and of rehabilitating mangrove forests which have already disappeared. The Master Plan for the conservation and sustainable use of mangrove forests will be formulated along three main axes: ① rearing and use of forest resources, ② management and use of marine resources and ③ conservation and use of tourism resources. General education on mangrove forests and an environmental education programme will also be formulated. As local residents are closely related to mangrove forests in terms of forestry, fisheries and tourism, the implementation of the Master Plan and the management of mangrove forests will be conducted in a participatory manner.

(2) Zoning

Given the priority objectives of the Master Plan for the Project Areas, i.e. the conservation and rehabilitation of mangrove forests which have been depleted or degraded or which have disappeared due to natural and man-made factors, areas for mangrove forest conservation (Conservation Zone) and areas for mangrove forest rehabilitation/restoration (Rehabilitation Zone) have been set up to fulfil these objectives. The actual zoning is based on the distribution situation of *Rhizophora* and *Avicennia*, the situation of forest damage, including the state of depletion, and such natural conditions as the sea conditions (salinity, etc.) and others.

The Conservation Zone aims at sustaining and even expanding mangrove forests in areas where many mangrove trees have survived without much adverse impacts on the natural conditions. The Conservation Zone is established on Saloum Island, Betanti Island and the southern inland area.

The Rehabilitation Zone aims at the rehabilitation (restoration) of mangrove forests in the coming years in those areas where mangrove forests have been depleted or have disappeared due to

natural and/or man-made factors. The Rehabilitation Zone is mainly located in the inland area to the north of the Conservation Zone.

(3) Improvement Policies by Zone

The improvement policies by zone (sub-zone) are described in the table below.

Zone	Sub-Zone	Improvement Policies
Conservation Zone	I	<ul style="list-style-type: none"> • Protection of mangrove forests • Natural regeneration without human interference
	II	<ul style="list-style-type: none"> • Conservation of mangrove forests • No human interference but those sites degraded due to human interference will be subject to planting for the urgent recovery of mangrove forests
	III	<ul style="list-style-type: none"> • Conservation and utilisation of mangrove forests • Preservation or planting, if necessary, for those stands to be conserved
Rehabilitation Zone	I	<ul style="list-style-type: none"> • Planting of mainly <i>Avicennia</i> to rehabilitate/restore mangrove forests • Planting of <i>Rhizophora</i> in suitable places
	II	<ul style="list-style-type: none"> • Planting of mainly <i>Rhizophora</i> to rehabilitate/restore mangrove forests

(4) Planning Items for Sustainable Management

The degradation, depletion and disappearance of mangrove forests are progressing in the Project Areas because of man-made factors and natural factors. As mangrove forests are essential to maintain not only forest resources but also fisheries resources and tourism resources, the proper management of mangrove forests in the Project Areas is essential.

The following items are planned for the Master Plan, the primary objectives of which are the conservation and rehabilitation of mangrove forests, in accordance with the improvement policies for each zone.

1) Planning Items Relating to Forests and Forestry

- ① Planting of *Rhizophora* : rehabilitation of mangrove forests
- ② Planting of *Avicennia* : rehabilitation of mangrove forests
- ③ Management of natural mangrove forests
- ④ Creation of village forests : supply of alternative wood to mangrove wood
- ⑤ Apiculture : rehabilitation/conservation of mangrove forests as supply sources of honey

2) Planning Items Relating to Fisheries

- ① Introduction of improved smoking kilns:
reduction of the firewood consumption, resulting in a reduction of the cutting of mangrove trees to obtain firewood

- ② Introduction of management techniques for natural mangrove oysters:
management of oyster resources and conservation of mangrove forests
 - ③ Spread of ocean culture of natural mangrove oysters:
management of oyster resources and conservation of mangrove forests
 - ④ Improved added value of processed shellfish products:
establishment of a fund to finance the creation of village forests to produce alternative
firewood for shellfish processing
 - ⑤ Self-supply of protective gear for shellfish collection (making of heavy cloth shoes and
gloves):
rehabilitation/conservation of mangrove forests
 - ⑥ Support for beach committees:
management of marine resources and rehabilitation/conservation of mangrove forests
 - ⑦ Strengthening of the management of prawn resources:
improvement of fishing grounds and rehabilitation/conservation of mangrove forests
 - ⑧ Making of life jackets:
rehabilitation of mangrove forests and establishment of a fund to finance the creation of
village forests
 - ⑨ Judgement on an increase of marine resources as a result of mangrove forest
rehabilitation:
improvement of fishing grounds and rehabilitation/conservation of mangrove forests
- 3) Planning Items Relating to Tourism
- ① Eco-tourism using eco-routes
- 4) Planning Items Relating to Education
- ① Introduction of environmental education mainly featuring mangrove forests in primary
schools
 - ② Mangrove seminars and workshops for RC councillors
 - ③ Study visits to model villages of the sustainable management of mangrove forests
(spread of the use of improved ovens for home cooking, spread of the making of heavy
cloth shoes and gloves and spread of the making of protective face masks for
apiculture)

- ④ Educational activities linked to local sporting and cultural activities
- ⑤ Extension of techniques/skills with villagers acting as instructors

(5) Application Areas for Planning Items

The planning items in the forest/forestry, fisheries and tourism sectors for the conservation and/or rehabilitation of mangrove forests are mutually linked and will not be implemented individually.

The planting of mangrove seedlings aims at the rehabilitation of forest resources and environmental resources and should be combined with other economic activities so that the money required to meet the cost of planting is disbursed from economic activities to an environment fund. Such economic activities as the smoking of fish and processing of shellfish in the fisheries sector which will require firewood will necessarily be combined with the planting of mangrove seedlings and the creation of village forests.

The likely combinations of the planning items in the forest/forestry sector and those in the fisheries sector to achieve positive effects on the sustainable management of mangrove forests are shown in the table below.

Fisheries Forest/Forestry	Introduction of Improved Smoking Kilns	Processing of Shellfish	Management and Culture of Oyster Resources	Making of Life Jackets	Making of Heavy Cloth Shoes and Gloves
Planting of <i>Rhizophora</i>	O	O	O	O	O
Planting of <i>Avicennia</i>	O/Δ	Δ	Δ	O	Δ
Village Forests	O	O		O	

Note: O = strongly linked; Δ = occasionally linked

The target villages for each planning item in the forest/forestry, fisheries and tourism sectors are determined based on the type of zone, distribution and existing environment for the growth of *Rhizophora* or *Avicennia*, types of local fishing activities and natural conditions, etc.

(6) Utilising and Rearing of Forest Resources

1) Contents of Planning

① Planning Items

The planning of the utilisation and rear of forest resources based on the improvement policies for each sub-zone involves four items (activities), i.e. “planting of mangrove”, “natural mangrove forest management”, “creation of village forests” and “production of secondary mangrove forest products: apiculture”. The target sub-zones for the above planning items are shown below.

Planning Item (Planned Activity)		Target Sub-Zone(s)
1. Planting of mangrove	<i>Rhizophora</i>	Conservation II and III Rehabilitation I and II
	<i>Avicennia</i>	Conservation II Rehabilitation I and II
2. Creation of village forest		Conservation III Rehabilitation I and II
3. Production of secondary mangrove forest products: apiculture		Conservation III

② Programme Implementation Period

While it is necessary to consider the creation of sustainable man-made mangrove forests as a long-term prospect, a programme implementation period of 10 years is currently adopted to allow realistic forecasting for the planting programme for the sole purpose of forest rehabilitation and conservation. A programme period for village forest creation of 10 years is set as in the case of the mangrove planting programme and planting and cutting in this period are planned.

③ Classification of Planting Areas (Man-Made Forests)

Land for the planting of mangrove (*Rhizophora* or *Avicennia*) and the creation of village forests will be classified as forest land and must be clearly indicated on the map. Each village conducting planting must record the planting species, number of seedlings planted, planting area, i.e. size of the land, and year of planting in a register.

2) Mangrove Planting Programme

In Rehabilitation Sub-Zones I and II, suitable species will be planted at suitable sizes in a strict manner. At sites with relatively low salinity, *Rhizophora* will be planted to create mangrove forests for sustainable use. At sites with high salinity, *Avicennia* will be planted to create conservation mangrove forests. Conservation Sub-Zones II and III are mainly dominated by natural *Rhizophora* forests and planting for rehabilitation will be conducted around villages. The growth situation of man-made mangrove forests will be monitored to allow examination of the possibility of their utilisation in the future.

① Planned Planting Area

The standard annual planting area per village is set at 0.25 ha for *Rhizophora* and 0.1 ha for *Avicennia* to avoid disruption to the livelihood of the participating villagers during the dry season. In total, the planting of 142.5 ha (127.5 ha for *Rhizophora* and 15.0 ha for *Avicennia*) in 10 years or an annual planting area of 14.3 ha (12.75 for *Rhizophora* and 1.5 ha for *Avicennia*) per year is planned for the 51 target villages.

② Planting Method

a. *Rhizophora*

- a) The suitable timing for seed collection is from July to October when a large quantity of seeds mature. The best time is August and September during the rainy season when the salinity is low. The collected viviparous seeds should be planted immediately.
- b) The planting sites should have a soft bed and should be flooded to a depth of some 50 cm at the time of high tide.
- c) The planting area per village will be 0.25 ha with a planting distance of 50 cm x 50 cm. 10,000 viviparous seeds will be planted.

b. *Avicennia*

- a) In principle, the suitable timing for *Avicennia* seed collection is the same as that for *Rhizophora*. However, because of the higher susceptibility of *Avicennia* than *Rhizophora*, it is preferable to collect *Avicennia* seeds as early as possible so that they can be planted during the period of the dry season when the salinity is low. If the seeds are collected in July, the planting of seedlings can be conducted in early September after nursing in pots for 1.5 months to better adapt to the new environment.
- b) Sites where natural *Avicennia* trees grow should be selected on the inland side of the *Rhizophora* planting side.
- c) The planting area per village will be 0.10 ha with a planting distance of 50 cm x 50 cm. 4,000 seedlings will be planted.
- d) As the young buds of *Avicennia* are often eaten by fish, the planned planting sites should be encircled by fine netting to prevent the incursion by fish.
- e) Each seedling should be nursed in a pot for 1.5 months. A site which is flooded by the neap tide during the period of high tide, i.e. flooded twice a day, in the dry season should be selected for the setting up of a nursery and the nursing beds should be shaded.

③ Costs

The total direct cost for planting activities over a period of 10 years will be 2,244,000 FCFA for *Rhizophora* and 1,260,000 FCFA for *Avicennia*, totalling 3,504,000 FCFA.

The personnel cost is not considered because of the fact that the necessary work will be voluntarily conducted by participating villagers free of charge.

3) Natural Mangrove Forest Management Programme

The primary aim is the conservation of existing natural *Rhizophora* and *Avicennia* forests in both the Conservation Zone and the Rehabilitation Zone. The management programme is designed to achieve this aim.

- a. Control of the illegal use of natural mangrove forests by local residents and provision of education for local residents on the importance of mangrove forest protection and conservation
- b. Categorization of natural mangrove forests in Conservation Sub-Zones II and III as conservation forests where regeneration is, in principle, conducted by means of natural regeneration while enrichment is conducted for degraded sites in need of urgent restoration
- c. Conservation of natural mangrove forests through the creation of alternative forests, such as village forests, on the mainland to replace the use of mangrove wood

4) Village Forest Creation Programme

At present, mangrove forests are illegally cut to produce firewood and building timber (logs). Mangrove wood is heavily used in the island area as firewood for the processing of marine products. Village forests will be created on common land as a source of alternative wood. Planting on privately owned land will be included in this programme.

① Area of Village Forests

Village forests will be created in Conservation Sub-Zones II and III and Rehabilitation Sub-Zones I and II. The target villages will be 42 villages with a population of 500 or more and planting over an area of 0.5 ha/year is planned for six years. The planting of 3.0 ha of land by each village over a period of six years means a total village forest area of 126.0 ha with an annual total planting area of 21.0 ha by 42 villages.

② Planting Method

a. Species

Eucalyptus will be the primary species to produce firewood and logs. *Tectona grandis*, *Gmelina arborea* and *Cassia siamea* will also be planted in areas with high rainfall. *Melaleuca leucadendron* may be used at wet or swampy sites.

b. Planting

The planting distance should be 3 m x 3 m and 1,100 seedlings should be planted per ha.

c. Cutting and Regeneration

The rotation period is six years and clear cutting will be conducted. Regeneration by sprouting will be repeated three times and new planting will subsequently be conducted for regeneration.

③ Costs

a. Yield

The available volume at the time of cutting will be 33 m³ per ha (888 surviving trees with a tree height of 8.0 m and a DBH of 10.0 cm). The yield will be 16.5 m³ per village or 693.0 m³ for the 42 villages.

b. Income

Assuming that 30% of the yield is sold as firewood with the remaining 20% being sold as logs, the income per village in the seventh year onwards will be 261,360 FCFA, i.e. 83,160 FCFA from 19.8 lots of firewood and 178,200 FCFA from 89.1 logs.

c. Expenditure

The direct cost of planting in six years will be 141,000 FCFA per village. No personnel cost is considered for planting or cutting because of the participatory nature of the activities.

5) Apiculture Programme

Apiculture is planned as a secondary source of income for local residents in three selected villages in Conservation Sub-Zone III.

- ① Five villagers will be selected in each village to form an apiculture group to which the necessary tools, etc. will be distributed. Training on apiculture techniques and practical training will be conducted by means of sending these villagers to the training organized by the UICN.

② Costs

a. Direct Cost

The required expenditure per village is 816,500 FCFA, consisting of 666,500 FCFA for initial investment in tools, etc. and 150,000 FCFA for training.

b. Income

The first year will be used for the distribution of tools, etc. while the second year will be used for training. Honey will be produced from the third year. The production volume of honey from 25 wooden beehives in each village will be 187.5 kg (187,500 FCFA) in the third year, 250.0 kg (250,000 FCFA) in the fourth year, 312.5 kg (312,500 FCFA) in the fifth year and 375.0 kg (375,000 FCFA) in the sixth year onwards).

(7) Fisheries Resources Utilization and Management

1) Planning Details

Mangrove forests and fisheries resources are closely connected. Accordingly, we concentrate on the fisheries resources that are important to economic activities at Saloum Delta in accordance with the rehabilitation and conservation zones in this plan.

Zone	Resource	No.	Planning Items	Priority Subject
Conservation	Shellfish/ Ethmalose	1	Conversion to the improved smoking furnace	Controlling mangrove cutting and firewood consumption
		2	Introduction of a new system for mangrove oyster resource management	Mangrove oyster resource management, mangrove conservation
		3	Mangrove oyster culture extention	Mangrove oyster resource management, mangrove conservation
		4	Value added with shellfish processing	Establishment of a fund to plant village forest as substitution for mangrove firewood
		5	Self-production of shellfish harvest protectors (glove and boots)	Mangrove conservation and rehabilitation
		6	Support to the beach committees	Fisheries resources management, mangrove conservation and rehabilitation
Rehabilitation	Shrimp	7	Reinforcement of shrimp resource management	Fishing ground equipment, mangrove rehabilitation and conservation
		8	Establishment of life jacket workshop	Mangrove rehabilitation, establishment of fund for village forest
		9	Fisheries resources enhancement judgement due to mangrove rehabilitation	Fishing ground equipment, mangrove rehabilitation and conservation

Among the nine items mentioned above, those directly connected with mangrove forests are “Conversion to the improved smoking furnace” and “Introduction of a new system for mangrove oyster resource management”.

2) Conversion to the Improved Smoking Furnace

We will reduce mangrove firewood consumption with the improved smoking furnace. This smoking furnace has better heat and work efficiencies than the former type. Therefore, the conversion to the improved furnace will decrease firewood consumption. At the same time, CR should control the total number of units of smoking furnace to reduce mangrove firewood consumption in Saloum Delta. We also plan to set up environmental funds from profits of the smoking business for the rehabilitation and conservation of mangrove forests.

① Conversion Units

There are 132 units of smoking furnace at 14 villages in the delta as of April 2002. We aim to convert 50% of the total number, i.e. 66 units, within 10 years.

② Firewood Consumption

We calculate that there will be 7 operations a month for 3 months a year. If we convert 66 units to the improved smoking furnace, we can save 237 tons of firewood per year.

③ Economic Superiorities

It has been found that the improved smoking furnace reduces firewood consumption by 56% and increases the quantity of final products by 4%. Based on these figures, smoking business with the improved furnace is more profitable at 14,107 Fcfa per operation per unit than one using the former type. If we operate 7 times per month, 3 months a year, the profit will reach 296,247 Fcfa per year.

3) Introduction of a New System for Mangrove Oyster Resources Management

We aim to conserve mangrove forests and assure sustainable fishing ground utilization through introduction of the fishing ground management system for the mangrove oyster.

① Natural Mangrove Oyster Resource Management

a. To assure an enough period for growth

The closed season for oysters should be extended to 1.5 years from the present 0.5 year. It will enable resource rehabilitation through protection of oysters throughout their lifetime.

- b. To manage fishing grounds in a region-wide fashion

It makes sense to manage fishing grounds in a region-wide fashion through formulating a consensus at an oyster resource conference with the participation of all the stakeholders.

② Oyster Culture Extension

- a. Juvenile Collection and Cultivation

The Sokone Fresh Oyster Association carries out juvenile collection by settling the *guirlandes* in the water. The collected juvenile should be taken care of until they reach 70 mm long.

- b. Extension

- Selling of cultivated oysters will become regular work at the Sokone Fresh Oyster Association within 5 years. It will become more than 50 % of the total sales within 10 years.
- Cultivation sites will extend in two more villages in the delta in the 4th year and in two additional villages in the 8th year.
- Mangrove conservation and rehabilitation through village economic development.

Fisheries activities targeting shrimp and shellfish are vital economic activities for the people in the delta as they will help the people earn profits that they can use in the mangrove and village forest plantation.

- a) Value Added with Shellfish Processing
- b) Self-Production of Shellfish Harvest Protectors (Gloves and Boots)
- c) Establishment of a Life Jacket Workshop

(8) Utilization of tourism assets

Two villages Dassilamé Sérère and Moundé in the Saloum Delta were selected for an ecotourism pilot project, and another village is envisaged to initiate ecotourism.

- 1) Eco-route

An eco-route will be organized with the appropriate combination of natural and tourism resources of interest to tourists such as mangrove forests, small streams, bolons, historic remains near the village to decide with travel time between 2 and 3 hours.

2) Training of eco-guides

A minimum of 2 to 3 candidates for eco-guides, who are an essential component in the ecotourism, will be selected from a village, and will be trained on details of each eco-route, tourist safety, related rules and regulations, ethics of the eco-guide and other practical knowledge.

3) Environmental fund

For the purpose of the continued conservation of environment, including mangrove forests, certain portion of sales proceeds from eco-tourism will be reserved and put into an “Environment Fund”. As money from also needs to be retained for the future replacement of the equipment, the Fund shall be built up at an early stage.

4) Equipment

Major equipment required to initiate ecotourism comprises life-vest, horse carriage, kayak, pirogue and mobile phone. Training of eco-guides and production of promotion brochures are also prerequisite. Assistance from outside is necessary to finance these costs.

(9) Plans for extension, empowerment and environmental education

Plans for extension and environmental education consist of the following five items:

1) Introduction of mangrove-centered environmental education in elementary schools

Mangrove-centered environmental education is to be introduced at elementary schools in the project area, and mangrove and environmental protection activities are to be disseminated in a partnership between elementary schools and local communities.

2) Seminars and workshops on mangrove for CR legislators

Rural communities (CR) can be legal and practical entities to implement natural resource management. Seminars and workshops for CR legislators and village leaders are to be held and mangrove resource management is to be implemented by incorporating sustainable management plans of mangrove forests in the CR-formulated Local Development Plan (PLD).

3) Visits to model villages of sustainable management of mangrove forests

Mounde, Dassilame Serere, and Mbam are to be designated as model villages of sustainable management of mangrove forests. Residents of these villages are to introduce their activities

and how they are implemented (e.g. environment fund and organization) to visitors from government agencies, CR, resident organizations, NGOs and donors.

- 4) Implementation of empowerment activities in partnerships with local sports and cultural activities

Taking advantage of football and traditional wrestling matches that attract a large number of residents of the villages where the events are held and those from other villages, activities, issues, and countermeasures on mangrove and environmental protection are to be publicized through such folklore forms of entertainment as theater, dance and songs. This way, residents will be educated and empowered on the importance of the mangrove ecosystem in their daily lives.

- 5) Implementation of technology extension by resident lecturers

Resident lecturers are designated residents with technical knowledge on effective means for mangrove protection, i.e. improved furnace for household use, protective gloves and footwear, and improved furnace for ethmalose smoked fish. They are to help disseminate their knowledge through visits to or from neighboring villages.

(10) Implementation System for Sustainable Management of Mangrove Forests

The Master Plan will be implemented by local residents who will formulate a management implementation plan for each village in a self-reliant manner and who will also establish a controlling body as well as bodies responsible for individual activities. The DEFCCS will lead the administrative assistance for the formulation of the village-level management implementation plans and monitoring during the plan implementation period.

The implementation of the Master Plan will incur some expenditure. While it may be necessary to rely on external assistance for the initial investment, the creation of a mechanism whereby each village introduces an income-generating activity (or activities) to use the income from this activity (or activities) to finance natural resources management activities is aimed at in the long term to reduce the reliance on external assistance.

(11) Financial and economic analysis

- 1) Financial analysis

Profitability and feasibility has been examined for revenue-generating enterprises. In forestry related activities, bee-keeping is expected at the FIRR of 23.5%. In fisheries, FIRR of life-vest production, improved ovens and oyster culture is calculated at 14.5%, 33.2% and 8.9%, respectively. Ecotourism is computed to produce FIRR at 22.3%.

2) Economic analysis

All the activities, whether revenue-generating or not, are taken into account, to evaluate their impacts on the national economy. Evaluation has been carried out under the 2 scenarios, With and Without Project, with all the economic costs and benefits on an incremental basis.

CHAPTER 1 OUTLINE OF THE STUDY

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1. Outline of the Study

1.1 Background of the Study

The Republic of Senegal is a West African country with most of its national land located in the Sahel Region. Senegal represents the northern most area in West Africa for mangrove forests and the local mangrove forests create a precious ecosystem to preserve biological diversity. V-shaped lagoons, estuaries and deltas, the main parts of which constitute mangrove areas of a total of some 200,000 ha, spread along the coastline of Senegal, particularly in the south.

These mangrove areas have traditionally been used by local residents as sources of wood (firewood and construction logs), fishing grounds and farmland. More recently, they have become tourist areas. However, the decline of the rainfall since the 1970's and illegal cutting by local residents, etc. have accelerated the degradation as well as depletion of the mangrove forests, causing serious concern in regard to negative impacts on the essential resources for local life and industries (forestry, fisheries and tourism) and worsening of the environment.

To address the situation, the Government of Senegal included the appropriate management of natural resources in its Socioeconomic Development Plan for 1996 – 2001 and has also prioritised the improvement of mangrove forests in local activity programmes under the Forest Action Plan.

For the conservation of mangrove forests, it has become essential to formulate a sustainable utilisation and management plan based on a comprehensive approach incorporating the promotion of fisheries, tourism and local livelihoods from the medium to long-term perspective in addition to the more conventional approach from the viewpoint of forests and forestry.

Under these circumstances, the Government of Senegal made an official request to the Government of Japan in August, 2000 for the implementation of a study regarding the sustainable management of mangrove forests in Petit Côte and Saloum Delta areas. In response to this request, the Government of Japan dispatched the Preliminary Study Team to Senegal and the Scope of Works (S/W) was signed by this Study Team and the Government of Senegal in July, 2001. The present Study has been conducted based on this S/W.

1.2 Objectives of the Study

The Study has the following objectives.

- ① To formulate a sustainable management plan for mangrove forests which takes into consideration the multiple functions of these forests, i.e. ecosystem, forestry resources, fisheries resources, tourism resources and prevention of coastal erosion, for the Petit Côte and Saloum Delta areas for the purpose of ensuring the conservation and sustainable use of mangrove forests which have been showing a declining tendency in recent years.
- ② To implement a pilot project for the capacity building of local residents/organizations which play the most important role in the conservation of mangrove forests as the main actors.
- ③ To transfer the relevant techniques/skills through OJT to the Senegalese counterparts during the study period.

1.3 Study Area

The Study Area covers 617,500 ha, consisting of areas belonging to 20 rural communities and five communes which are selected from the Mbour Department, i.e. province, of the Thies Region and the Foundiougne Department and Fatick Department of the Fatick Region.

The Sustainable Management Plan for Mangrove Forests, which is to be formulated as a result of the Study, will target villages and communes with mangrove forests and/or some type of relationship with mangrove forests in the Study Area (see Fig. 1.1-1 for the Study Area and Target Areas of the Plan).

1.4 Implementation of the Study

The Study is from December, 2001 to February, 2005 and the activities in each year are listed below.

(1) First Year (2001/2002)

- ① Gathering and analysis of existing data and information
- ② Fact-finding survey on mangrove forests and socioeconomic survey
- ③ Sea conditions survey and coastal erosion survey (both were also conducted in the second year)

(2) Second Year (2002/2003)

- ① Evaluation of mangrove planting and conservation activities
- ② Survey on the utilisation situation of mangrove forests

- ③ Estimation of the social and economic value of mangrove forests
- ④ Nursing and planting test of *avecennia* (implemented in the third and fourth years)
- ⑤ Formulation of a sustainable management plan for mangrove forests (Master Plan)
- ⑥ Workshops for local residents
- ⑦ Selection of target villages for the pilot project

(3) Third Year (2003/2004)

- ① Workshop to plan the pilot project
- ② Implementation of the pilot project
- ③ Workshop to conduct interim evaluation of the pilot project
- ④ Review of the activity plan for the pilot project

(4) Fourth Year (2004/2005)

- ① Evaluation of activities under the pilot project and final overall evaluation
- ② Review of the sustainable management plan for mangrove forests
- ③ Seminar to transfer techniques/skills

The flow of the Study is shown in Fig. 1.4-1.

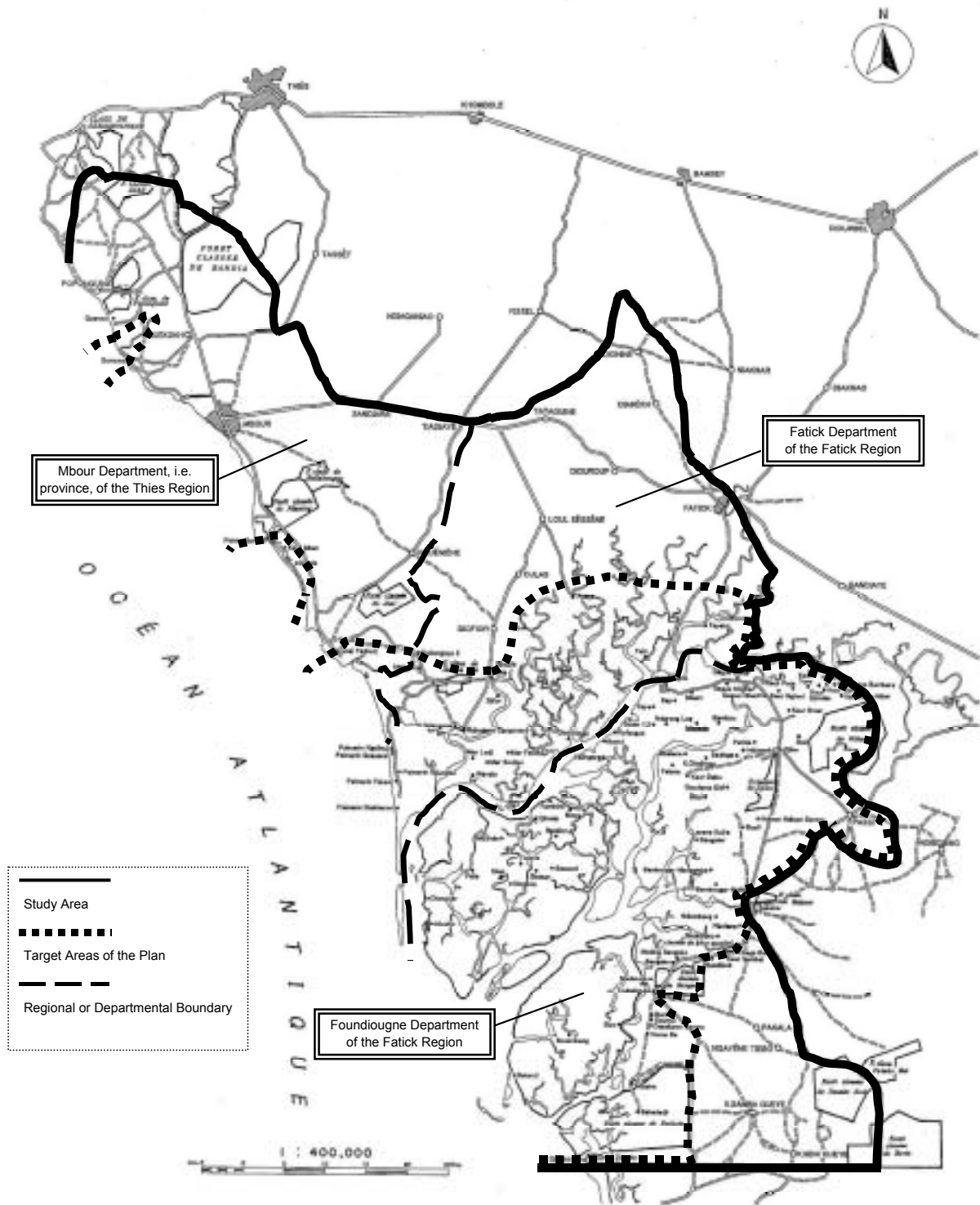


Fig. 1.1-1 Study Area and Target Areas of the Plan

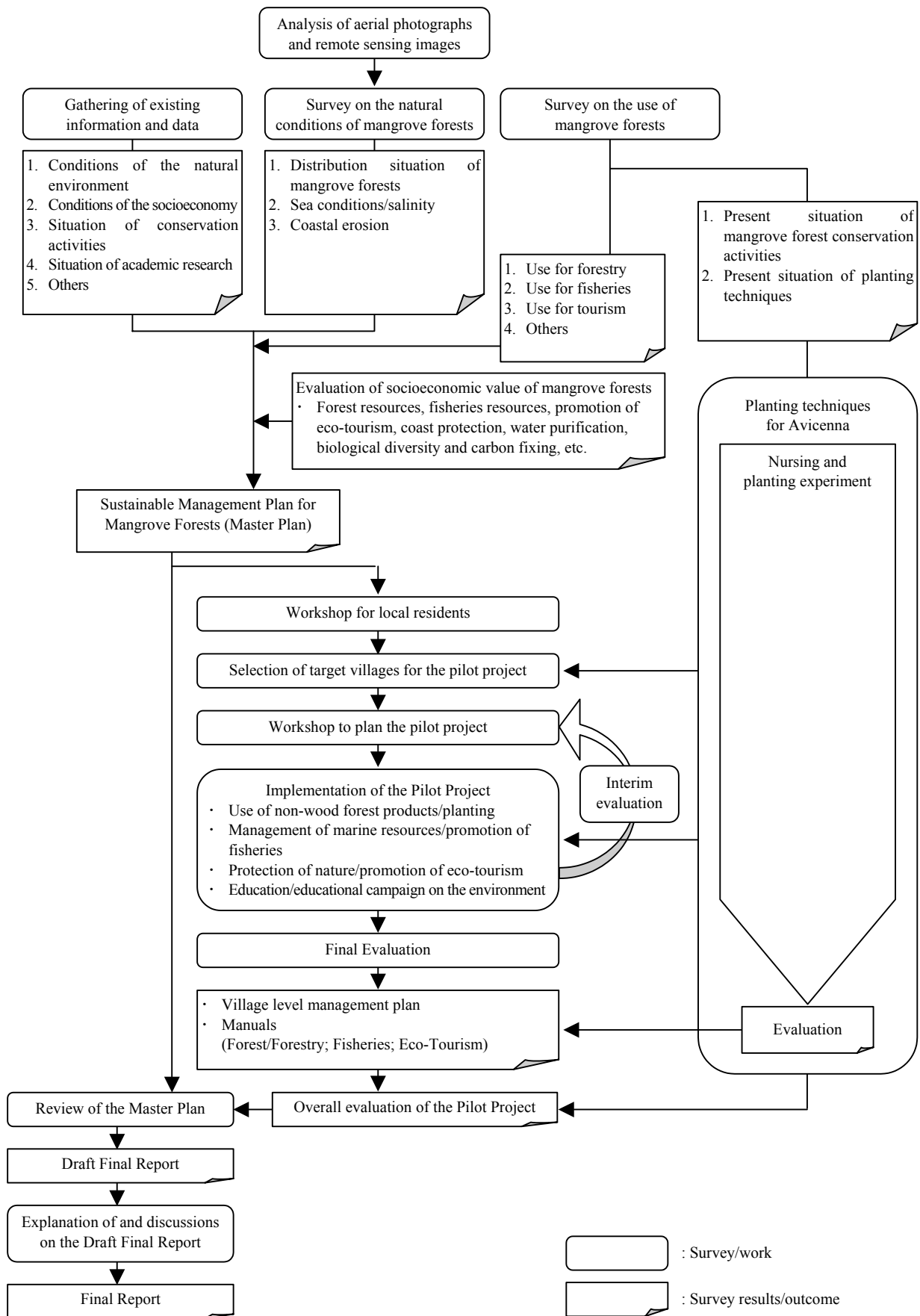


Fig. 1.4-1 Flow Chart of the Study

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

CHAPTER2 PRESENT CONDITIONS OF THE STUDY AREA

2. Present Conditions of the Study Area

2.1 General

2.1.1 Natural Conditions

(1) Location and Topography

The Study Area consists of a coastal section called Petit Côte in the west central part of Senegal and to the south of Dakar, the capital, with the Saloum Delta spreading to the further south. While Petit Côte is a linear sandy beach, the Saloum Delta is a coastal area around a river mouth, forming an estuary where the end section of a river valley has been submerged due to the advancement of the sea. The Study Area is almost entirely coastal lowland, the elevation of which is less than 5 m, and is flat with a very gentle inclination. The catchment area is as large as 90,000 ha. Dry beaches have developed along the coastline of the delta and shallow sea spreads beyond these beaches. Numerous tidal waterways have developed in a dendritic manner inside island groups dotted around the delta and mangrove forests have grown along both sides of these waterways. Huge areas of ooze and dense diverse vegetation have formed an important ecosystem to maintain biological diversity. Mangrove forests also exist in low, swampy areas on the inland side of the delta and acidic sulphate soil called tanne spreads behind these swampy areas.

(2) Climate

The Study Area is characterised by a semi-arid tropical climate with a rainy season lasting from July to October and a dry season lasting for the remainder of the year. In the dry season, areas along the Atlantic coast in the north and central parts of the country are cool because of the trade wind from the north which is cooled by the Canarian current (cold current) in the Atlantic while the temperature in inland areas is much higher because of the dry prevailing wind called the Harmatan blowing from the Sahara Desert to the northeast. In the rainy season, a wet wind blowing from the sea towards the Sahara Desert brings sultry weather and rain throughout Senegal.

The annual rainfall level is 1,600 mm – 1,700 mm in Ziguinchor Province in the south and 400 mm in St. Louis in the north, indicating a decline from the southeast to the north of the country. The Study Area is situated between the isohyetal lines of 700 mm and 900 mm. According to annual rainfall data for the period from 1918 to 1993, the annual rainfall has shown a declining

trend since 1968, reaching a low level of 400 mm – 600 mm for the decade from 1980 to 1990. However, there have been signs of a recovery to the average annual rainfall level since 1999.

(3) Water Systems

Three rivers, i.e. Saloum, Dion Bos and Banjara, run through the Saloum Delta. The phenomenon of an inward flow of sea water towards the inland to replenish evaporated river water in the inland is observed with these rivers as there is no constant flow of fresh water from inland rivers to them. For this reason, the level of salinity in the Saloum Delta increases from the river mouth to the inland in the dry season. The actual value for Saloum River in the dry season is around 36 – 37 mg/litre near its mouth and more than 900 mg/litre near Kaolack. The highest salinity value ever recorded at Kaolack in 1942 and 1982 exceeds 110 mg/litre.

(4) Land Use

The area by type of land use in the RBDS (the Saloum Delta is designated as the RBDS by the DPN with the assistance of the UICN) which covers some 38% of the target areas based on images taken by the SPOT satellite is shown in Table 2.1-1.

Table 2.1-1 Area by Land Use Category in Saloum Delta Biosphere Reserve (RBDS)

Category		Area (ha)	%
1	Water body	84,806	36.47
2	Low mangrove forest	42,051	18.09
3	High mangrove forest	16,266	7.00
4	Tanne	14,494	6.23
5	Forest land	36,496	15.70
6	Riparian forest	1,245	0.54
7	Open forest	357	0.15
8	Savanna with trees	13,242	5.70
9	Savanna with shrubs	10,448	4.49
10	Low swampy land with acacia seyal	472	0.20
11	Plantation	394	0.17
12	Cultivated land	4,021	1.73
13	Bushes of <i>Dichrostachys cinerea</i>	220	0.09
14	Palophilic grassland	7,206	3.10
15	Recent ooze land	266	0.11
16	Sandy beach	540	0.23
Total		232,524	100.00

Source: Carte d'Occupation du Sol, Reserve de la Biosphere du Delta du Saloum, Ministere de l'Environnement, Direction des Parcs Nationaux. Based on SPOT images taken in 1993 and 1997.

Note: The demarcation height for low and high mangrove forests is 2 m.

In the RBDS, water bodies cover 84,800 ha (37%) and mangrove forests comprising high and low mangrove forests cover some 58,300 ha (25%), indicating that more than 60% of the total RBDS area is related to water. Apart from these two categories, tanne covers some 14,500 ha (6%) while forest land and savanna with shrubs cover some 62,000 ha (27%). Some minor categories include some 400 ha (0.2%) of plantations and some 4,000 ha (1.7%) of cultivated land.

According to the reference materials for A. Ndiaye, 59,000 ha of mangrove forests existed in 1985. In contrast, the land use map for the Biosphere Reserve (based on SPOT satellite images taken in 1993 and 1997) indicates a mangrove forest area of 58,300 ha, suggesting the depletion of mangrove forests by 700 ha in just over 10 years.

(5) Vegetation

The Study Area is located in the transitional zone from the Sudan-Guinea model of vegetation to the Sahel-Sudan model of vegetation and the local vegetation can be classified into two types: (i) vegetation observed in flood areas of the Saloum Delta and (ii) vegetation observed in sandy areas at Petit Côte and non-flood areas inland. The typical vegetation in the flood areas is mangrove, mainly consisting of four species, i.e. three species of *Rhizophora spp.* and *Avicennia africana*. Two other species, i.e. *Laguncularia racemosa* and *Conocarpus erectus*, are also found. Mangrove forests in the Study Area show a belt-like structure where pure mangrove forests of *Rhizophora spp.* are found at the river mouth and river banks while *Avicennia africana* with a higher salt resistance is found in inland areas.

2.1.2 Socioeconomic Conditions

(1) Local Administrative Structure

The local administrative structure in Senegal is made up of regions, communes and rural communities, each of which has the status of a juridical person for financial independence. The respective local public bodies are freely run by councillors who are elected through a popular election. Meanwhile, the central government appoints governors, chief administrators and heads who act as the agents for national interests at the regional, departmental and district levels respectively to protect national interests, to supervise the compliance of local public bodies with the law and to ensure public order. These appointees by the central government monitor the legality of the actions and budget of local public bodies within the framework set forth by the laws and regulations relating to these bodies.

The relationship between the local administrative structure and local public bodies is shown in Fig. 2.1-1.

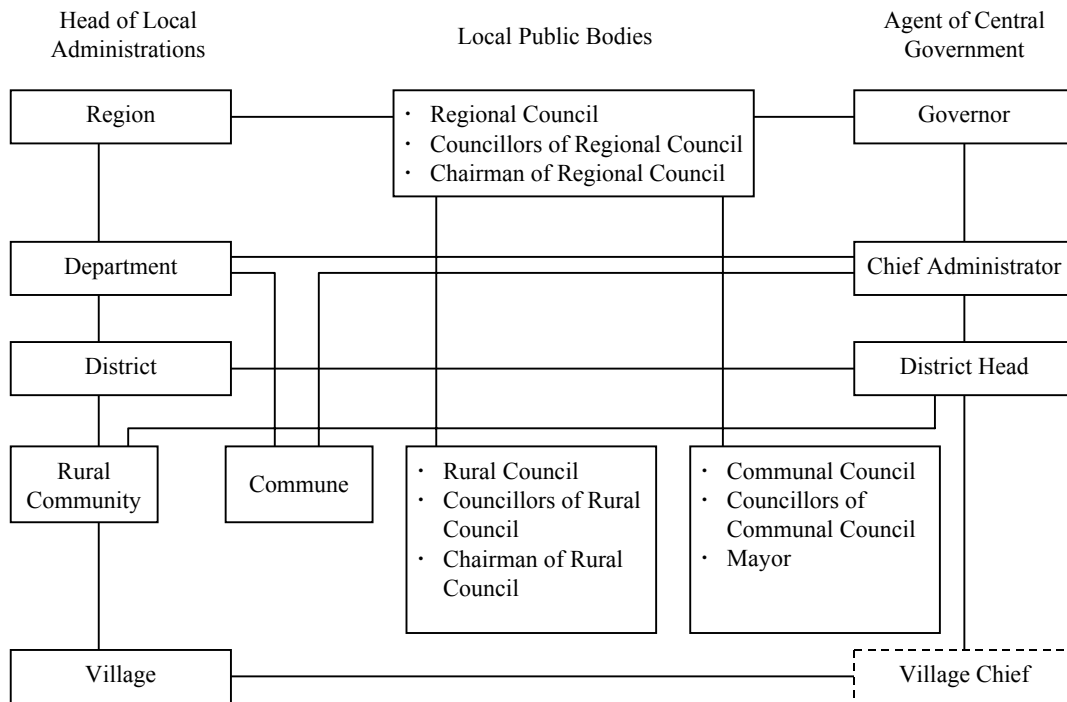
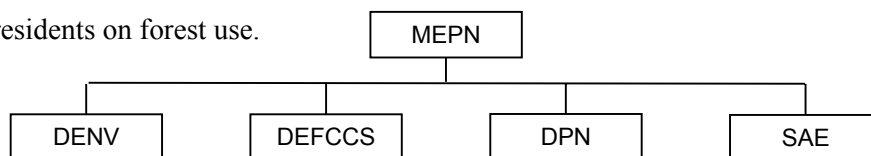


Fig. 2.1-1 Hierarchy of Local Administrations and Local Public Bodies

(2) Organizational Structure of the DEFCCS

The organizational structure of the DEFCCS, which is in charge of matters relating to forestry in Senegal and which is the counterpart organization for the Study, is shown in Fig. 2.1-2. While the main business of the DEFCCS is the management of designated national forests in Senegal, it also handles permits for the use of forests other than national forests together with education for local residents on forest use.



- MEPN : Ministère de l'Environnement et de la Protection de la Nature
(Ministry of Environment and Nature Protection)
- DENV : Direction de l'Environnement et des Etablissements classés
(Department of ENvironment and Designated Enterprises for Pollution Control)
- DEFCCS : Direction des Eaux, Forêts, Chasses et de la Conservation des Sols
(Department of Water, Forests, Hunting and Soil Conservation)
- DPN : Direction des Parcs Nationaux (Department of National Parks)
- SAE : Service de l'Administration générale et de l'Équipement
(Office of General Administration and Equipment)

Fig. 2.1-2 Administrative Structure of the MEPN

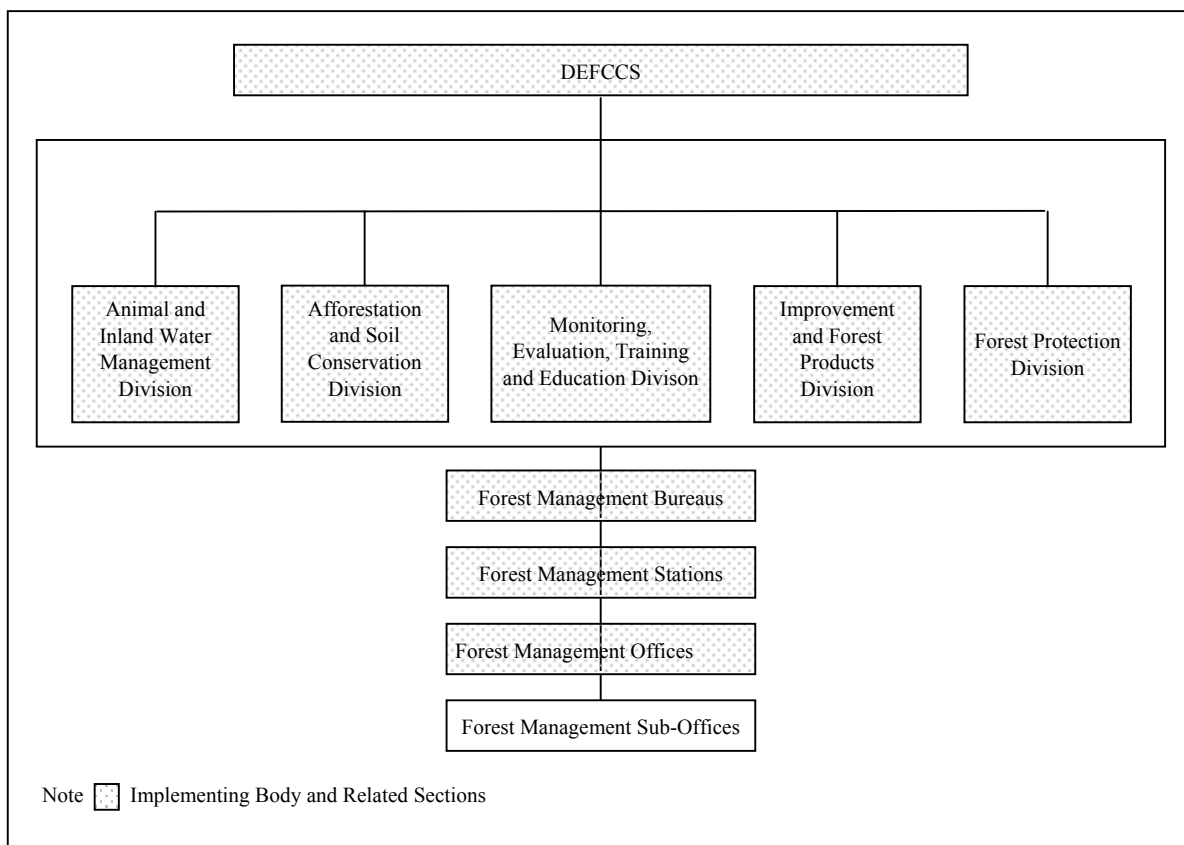


Fig. 2.1-3 Administrative Structure of the DEFCCS

(3) Population

The 1988 census puts the total population of Foundiougne Department and Fatick Department of the Fatick Region and Mbour Department of the Thies Region where the subject 20 rural communities and five communes of the Study are located at 625,452, consisting of 307,822 males (49.2%) and 317,630 females (50.8%). The number of households was 68,339 with an average number of persons per household of approximately nine. The population by department recorded in this census is shown in Table 2.1-2.

Table 2.1-2 Population of the Study Area

Region	Department	Number of Households	Male (persons)	Female (persons)	Total (persons)
Fatick	Foundiougne	13,870	70,613	71,651	142,264
	Fatick	23,617	99,921	104,727	204,648
Thies	Mbour	30,852	137,288	141,262	278,550
Total		68,339	307,822 (49.2%)	317,630 (50.8%)	625,452 (100%)

Source: DPS (Direction de la Prévision et de la Statistique): 1988 Population Census

(4) Industries

Agriculture is the key industry for rural communities in the Study Area and the main crops are peanuts as a cash crop and millet as the staple food. Sorghum, maize and rice, etc. are also grown for self-consumption. Because of the extensive rainwater-fed farming, the production volume is highly dependent on the rainfall level, making local agriculture a less than reliable economic activity.

Stock raising is the second-most important local industry in the Study Area, providing a means of dispersing the economic risks for farming households. Fishery is the main industry in island as well as coastal areas. Large-scale fishery using power boats is conducted along the coast while artisanal fishery and the processing of marine products are conducted in island areas with limited access to markets.

In general, the situation of local economic activities in the Study Area appears to be changing to reduce the dependence on the cultivation of peanuts, the production volume of which has been unfavourable in recent years. Taking into consideration the usable natural resources, labour, economic strength and market demands, etc., local residents have been striving to achieve the diversification of farming through a shift to the production of food crops and the introduction of vegetable cultivation and also the diversification of income sources through the planting of fruit trees and fishing activities. The practice of working in urban areas among the younger generation also plays an important role in boosting the household income.

(5) Natural Resources Management Systems

1) Land

The Government of Senegal enacted a law concerning national land in 1964, clearly establishing land ownership under a statutory law. Land of which the owner, regardless of it being the government or a private individual, which was not registered on the day of enforcement of this law is regarded as national land. However, the customary land system still remains today. (According to the local custom, the person first arriving at unoccupied land possesses ownership of such land as well as its surrounding area as the primary occupier and late-comers seek the allocation of land from this primary occupier). This law classifies national land into the following four zones.

- Urban zone : area located in the territory of a commune
- Designated national land zone : designated area of some kind, such as national forest land or a reserve
- Rural zone : area constantly used for residential, cultivation or stock raising purposes by the rural populace

- Development zone : area other than those belonging to any of the other three zones

The management authority for natural resources, including land and forests in the three zones other than the designated national land zone, has been transferred to local public bodies at the regional, commune and rural community levels as a part of decentralisation.

The laws relating to natural resources are listed in Table 2.1-3.

Table 2.1-3 Laws Relating to Natural Resources

Subject Matter	Date and Law No.	Contents
National land	Law No. 64-66 of 17 th June, 1964	This statutory law clearly establishes the ownership of land.
Administrative organizations of national land	Law No. 72-02 of 1 st February, 1972 Law No. 96-10 of 22 nd March, 1996 which revised Law 72-02	This law stipulates the introduction of regions, departments, communes, RCs and villages, etc., all of which have their own jurisdiction over the relevant parts of the national land.
Local public bodies	Law No. 96-06 of 22 nd March, 1996	This law clearly establishes the legal status of local public bodies and stipulates that part of the authority of the national government is transferred to local public bodies.

2) Fisheries Resources

The traditional management method employed by non-migratory fishermen based in the Saloum Delta has been the introduction of an off season. However, the mounting of outboard engines to fishing boats, expansion of the geographical area subject to fishing activities due to the use of improved fishing gear and extension of the fishing season to the entire year have made it difficult to properly manage fisheries resources with the traditional method of suspending fishing activities in and around local fishing grounds for a certain period of time. In the face of such a situation, the Government of Senegal introduced restrictions on the mesh size of fishing nets and fishing gear in 1976 to modernise its management of fisheries resources. The new Fisheries Act was enforced in 1998 for the purpose of managing fisheries resources in a more effective manner.

3) Forest Resources

Forest resources in Senegal are managed under the Forest Act and the Enforcement Ordinance of the Forest Act. More specifically, management activities include the development of and production at some forests, conservation of national forests, law enforcement against illegal cutting, sale of confiscated wood and creation of coastal windbreak forests. Cutting, farming and grazing are, in principle, prohibited inside national

forests and local residents are only permitted to collect dead wood and fruit for self-consumption.

Following the trend of participation by local residents and local public bodies in the rational management of forest resources, a principle confirmed at the Environmental Summit held in Rio de Janeiro in 1992, the Government of Senegal revised the Forest Act in 1993 and the Local Public Bodies Act in 1996. The Forest Act was further revised in 1998, legally upholding the right of local residents to participate in forest resources management and transferring the management authority to local public bodies. Under these new statutory arrangements, a forest improvement project may be implemented at a forest managed by a commune or rural community in particular if the relevant forest improvement plan prepared by the local public body concerned is approved by the DEFCCS.

(6) Village Organizations

Traditional groups described as village organizations include those based on age, those based on Islam, mutual financing groups and committees for traditional wrestling. In addition, the following official organizations are active in almost all villages.

- ① GIE : producers' organization with the status of a juridical person
- ② GPF : women's group to promote the active participation of women in development
- ③ ASC : youth group for sporting and cultural activities

Both the GIE and GPF often function as the front village bodies to receive micro-credit or external assistance. In the field of natural resources management, there are intra-village and inter-village organizations of villagers corresponding to assistance provided by donors (such as the GTZ) and NGOs (UICN and WAAME, etc.) as well as a federation of villagers' organizations which has been voluntarily established by these organizations (around Fimla).

(7) Socioeconomic Infrastructure

The existing socioeconomic infrastructure in Fatick Department, Foundiougne Department and Mbour Department in the Study Area includes medical facilities (clinics), educational facilities (primary and secondary schools and literacy centres), water supply facilities (boreholes and shallow wells) and commercial facilities (permanent and periodic markets). Local residents of Fatick Department generally have better access to these facilities than those of Foundiougne Department. In the case of the latter, those living in island areas enjoy better access to medical care, education and water than those living inland.

2.2 Mangrove Forest Resources

2.2.1 Present Distribution of Mangrove Forests

(1) Species

Six species of mangrove belonging to three families and four genera are found in the Study Area. In general, *Rhizophora spp.* is distributed in areas at a lower elevation which are flooded for a long time among tidal areas while *Avicennia* is distributed in the upper parts of tidal areas and in areas at a high elevation which are flooded irregularly. *Languncularia* and *Conocarpus* are occasionally found in areas with a higher elevation than areas of *Avicennia* and which are flooded only at the time of a flood tide.

Table 2.2-1 Mangrove Species Found in the Study Area

Family	Genus	Species
<i>Rhizophoraceae</i>	<i>Rhizophora</i>	<i>racemosa</i>
		<i>mangle</i>
		<i>harisonii</i>
<i>Verbenaceae</i>	<i>Avicennia</i>	<i>africana</i>
<i>Combretaceae</i>	<i>Laguncularia</i>	<i>racemosa</i>
	<i>Conocarpus</i>	<i>erectus</i>

(2) Distribution

The distribution of mangrove in the Study Area shows an overwhelming presence of *Rhizophora* in island areas around Saloum Island and Betenti Island. *Avicennia* begins to appear in transitional areas from rivers to inland, creating mixed areas of *Rhizophora* and *Avicennia*. The inner areas of land around islands have *Rhizophora* along rivers and both *Rhizophora* and *Avicennia* towards inland. *Avicennia* is more dominant in the upper reaches beyond Foundiougne and Fimla but the quantity is extremely small. In the Petit Côte area, *Rhizophora* is found near Somone and Joal while *Avicennia* is found in areas subject to less flooding.

(3) Causes of Decline of Mangrove Forests

Interviews conducted with various stakeholders, including villagers, found that there are several causes of the decline of mangrove forests, such as ① increased salinity due to drought, ② cutting of mangrove by local residents, ③ progress of sedimentation and ④ construction of roads.

① Increased Salinity Due to Drought

Decline of the rainfall means a smaller supply of fresh water from the upstream. In the Saloum Delta, the phenomenon of the backward flow of river water from the sea towards

the upstream occurs with local rivers for a period of nine months of the year. The higher level of evaporation than the level of rainfall causes an increase of the salinity.

② Cutting of Mangrove by Local Residents

Although the cutting of live mangrove trees is prohibited, they are actually cut by local residents for use as building logs for roof structures and firewood for cooking. (The Forest Law stipulates the prohibition of the cutting of trees in national forests in principle. The cutting of trees in forests other than national forests requires the presence of a forest improvement plan. Actual cutting also requires a permit issued by the DEFCCS. The cutting of live trees in mangrove forests is prohibited by the DEFCCS.) In addition, a huge quantity of mangrove is consumed as firewood for the smoking of fish and the processing of shellfish.

The target species for cutting are almost exclusively *Rhizophora* species and *Avicennia* is hardly used. In island areas, commercial cutting using small boats is conducted in places located far from villages or by outsiders coming from distant areas.

③ Sedimentation

The sedimentation of soil discharged from cultivated land has raised the elevation of growing sites of *Rhizophora* and the resulting shortening of the flooding period is causing the death of *Rhizophora*. Moreover, the solidification of the ground makes the natural regeneration of mangrove difficult.

④ Construction of Roads

Roads running through mangrove areas are almost always constructed by banking, making the creation of cross culverts to allow water flow necessary. These cross culverts are narrow and their number is small. To make matters worse, the bed of the waterways is higher than the bed of the cross culverts, making the outflow of sea water at the upstream side across the road insufficient at the time of low tide. The salinity of such residual sea water increases through evaporation, causing the death of mangrove.

2.2.2 Quantity of Mangrove Forest Resources

(1) Area

Mangrove forests in the Study Area are either high forests of *Rhizophora* or low forests of *Rhizophora* and *Avicennia*. The total area of these mangrove forests in the Study Area is estimated to be some 64,000 ha based on (i) the analysis results of images taken by the SPOT

satellite (conducted by the DPN and UICN) in terms of the area by land use in the RBDS and (ii) the measurement results of mangrove forest areas outside the RBDS using existing aerial photographs and topographical maps (scale of 1 to 50,000). The areas of high mangrove forests, low mangrove forests and tanne by district in the Study Area are shown in Appendix A-2-2-1.

Table 2.2-2 Area of Mangrove Forests in the Study Area

	High Mangrove Forests (6 – 14 m) Area (ha)	Ratio (%)	Low Mangrove Forests (2 – 6 m) Area (ha)	Ratio (%)	Total
Saloum Delta	16,300	28	42,000	72	58,300
Petit Côte area (Somone and Joal)	—	0	6,000	100	6,000
Total	16,300	25	48,000	75	64,300

(2) Estimation of Quantity of Resources

1) Mean Stand Volume

A sample site survey was conducted by setting up six sample plots and four sample plots (the size of which varied from 10 m² to 100 m²) in high mangrove forests and low mangrove forests respectively to establish the stand volume of *Rhizophora* used by local residents. Based on the results of this survey, the correlation between the mean upper story tree height (mean height of four tall trees) and the volume (trunk and branches) was examined and the following regression equation was obtained.

① High Mangrove Forest

$$\text{Log}V = 0.05543319 \times H + 1.388412877$$

(correlation coefficient $r = 0.8624$)

The mean stand volume tariff by mean upper story tree height for high mangrove forests based on the above regression equation is shown in Table 2.2-3.

Table 2.2-3 Mean Stand Volume (V) by Mean Upper Story Tree Height (H) for High Mangrove Forests

Mean Upper Story Tree Height (m)	Mean Stand Volume (m ³ /ha)
4	41
6	53
8	68
10	88
12	113
14	146
16	189
18	243

② Low Mangrove Forest

$$\text{LogV} = 0.140685173 \times H + 0.532595017$$

(correlation coefficient $r = 0.7194$)

The mean stand volume tariff by mean upper story tree height for low mangrove forests based on the above regression equation is shown in Table 2.2-4.

Table 2.2-4 Mean Stand Volume (V) by Mean Upper Story Tree Height (H) for Low Mangrove Forests

Mean Upper Story Tree Height (m)	Mean Stand Volume (m ³ /ha)
2	7
4	12
6	24
8	46

2) Estimated Quantity of Resources

In the Study Area, high mangrove forests with a mean upper story tree height of 10 m (6 m – 14 m) cover an area of 16,266 ha while low mangrove forests with a mean upper story tree height of 4 m (2 m – 6 m) cover an area of 48,020 ha. Based on the above-mentioned mean stand volume tariff for high mangrove forests (Table 2.2-3), the mean stand volume per ha for upper story trees with a height of 10 m is 88 m³. Meanwhile, the mean stand volume per ha for upper story trees with a height of 4 m in low mangrove forests is 12 m³ based on the corresponding volume tariff (Table 2.2-4). Based on these estimations, the total quantity of mangrove resources in the Study Area is inferred to be 2.01 million m³ with a volume per ha of 31 m³.

Table 2.2-5 Quantity of Mangrove Resources in the Study Area (Estimated Stand Volume)

Upper Story Tree Height (m)	Area (ha)			Quantity of Resources (m ³)	
	Low Mangrove Forests	High Mangrove Forests	Total	Volume per ha	Total Volume
4	48,020		48,020	12	576,240
10		16,266	16,266	88	1,431,408
	48,020	16,266	64,286		2,007,648
m ³ /ha					31

(3) Estimation of Increment, etc.

1) Estimation of DBH

The regression formula for the DBH (diameter breast height) corresponding to the mean upper story tree height in the case of high mangrove forests is shown below.

$$\text{LogD1.3} = 0.050137576 \times H + 0.285970213 \quad (r = 0.3587)$$

Table 2.2-6 DBH (D1.3) by Mean Upper Story Tree Height (H) of High Mangrove Forests

Mean Upper Story Tree Height (m)	DBH (cm)
4	3
6	4
8	5
10	6
12	8
14	10
16	12
18	15

2) Estimation of Base Diameter

The regression equation for the base diameter corresponding to the mean upper story tree height in the case of high mangrove forests is shown below.

$$\text{LogBD} = 0.041226839 \times H + 0.472862636 \quad (r = 0.8591)$$

Table 2.2-7 Base Diameter (BD) by Mean Upper Story Tree Height (H) of High Mangrove Forests

Mean Upper Story Tree Height (m)	Base Diameter (cm)
4	4
6	5
8	6
10	8
12	9
14	11
16	14
18	16

3) Mean Increment/ha

Rhizophora forming high mangrove forests in the conservation zone in the Study Area has a mean volume of 88 m³/ha with a mean upper story tree height of 10 m. The DBH and base diameter corresponding to this mean upper story tree height is 6.0 cm and 8.0 cm respectively based on their respective regression equations. Meanwhile, the stand age for a mean upper story tree height of 10.0 m is 29 years based on the survey results for existing mangrove forests. The estimated increment in the Study Area based on such data is shown in Table 2.2-8.

1) Planting as Educational Effort by Administrative Organizations

Planting is conducted under the guidance of the DEFCCS and the DPN, mainly in the island area. While a planting campaign can mobilise many villagers, it tends to be a single event.

2) Voluntary Planting by Local Residents

The women's group in Djirnda has voluntarily conducted the direct planting of viviparous seeds over an area of 0.5 ha in view of the situation of the natural regeneration of *Rhizophora*. After some 13 years, the tree height has now reached some 2 m, indicating that this plantation has achieved good growth. During this period, some of the women have voluntarily conducted planting near the village although the actual planting areas are small.

3) Planting Led by NGOs

From 1997 to 2001, the FIOD planted some 240 ha in three villages using the supply of goods as an incentive. While this provision of goods can mobilize villagers, there is a problem that villagers will not participate unless they receive goods.

4) Planting Assisted by NGOs

The UICN, WAAME and CAREM, etc. have been assisting the planting of *Rhizophora* by villages. The UICN and CARIM provided assistance for 19 villages, mainly in the island area, for the planting of an area of some 110 ha from 1995 to 2000. Meanwhile, the WAAME provided assistance for 27 villages for the planting of an area of some 70 ha from 1997 to 2001. These NGOs also provide guidance on the establishment of villagers' organizations and planting techniques to develop a sense of self-reliance among villagers.

The total planted area with the involvement of NGOs from 1995 to 2001 was some 420 ha involving 49 villages.

In addition to those NGOs mentioned above, the YUNGAR has been conducting the experimental planting of *Rhizophora* at Mar Lodji, etc. since 1993. The PAGERNA has also planted mangrove at Sadioga, etc. for the prevention of salt damage.

Table 2.2-10 Advantages and Problems of Various Types of Mangrove Planting Activities

Type of Planting	Advantages	Problems
Education by Administrative Organizations	<ul style="list-style-type: none"> Planting campaigns by an administrative organization can work on village leaders, making it easier to mobilise villagers for planting. Many local residents can be made aware of the planned activities and their necessary through radio broadcasting and other means. 	<ul style="list-style-type: none"> Follow-up after planting is not necessarily conducted, resulting in a lack of continuity. The continuity tends to depend on the quality and willingness of local forestry officials. Forestry officials do not necessarily have detailed knowledge of the planting of mangrove.
Voluntary Planting by Local Residents	<ul style="list-style-type: none"> As this is based on the empirical knowledge of problems shared by local residents (for example, the depletion of marine products), local residents are fully aware of the importance of mangrove forests. The initiative taken by local residents means a high level of continuity. 	<ul style="list-style-type: none"> Activities are not regularly conducted because of insufficient funding and means of implementation. Activities tend to be confined to a small number of local residents with a strong willingness to conduct activities. The lack of external technical advice runs the risk of failure.
Led by NGOs	<ul style="list-style-type: none"> As such goods as oil and millet are supplied to local residents in exchange for their labour for planting work, it is relatively easy to mobilise local residents. In the short-term, a large planting area can be achieved. 	<ul style="list-style-type: none"> Activities stop once the supply of goods stops. The supply of goods increases the dependence of local residents on external aid, creating an obstacle to the long-term continuity of planting activities.
Assisted by NGOs	<ul style="list-style-type: none"> Activities tend to start following an initiative taken by local residents, indicating awareness of the subject among them. The prospect of the continuity of activities is relatively high. It is relatively easy for local residents to organize themselves. It is relatively easy to obtain technical assistance. 	<ul style="list-style-type: none"> Despite a claim for self-reliance, the existence of external assistance may breed a sense of dependence among local residents. Unless financial self-reliance is established, activities could eventually diminish once the external assistance is withdrawn.

(2) Village Organizations Engaged in Planting of Mangrove

A number of village organizations are involved in the planting of mangrove. Those described below are presented here as typical examples based on their close relationship with two NGOs operating in the Study Area.

1) Beach Committee (Comité de Plage)

Beach committees are village organizations established mainly in villages in island areas with the assistance of the UICN, a NGO, since the second part of the 1990's. Although the activities vary from one village to another, the principal purpose is the conservation of marine resources. In some villages which are already active, an off season and reserves have been established and the enforcement of these arrangements to eliminate illegal fishing in collaboration with DOPM officers is planned subject to approval under a decree by the head of the district. Beach committees are also engaged in other activities, including conservation of mangrove forests where marine resources

are reared, conservation of forest resources on land, protection of endangered species in the sea and on land and village cleaning.

When a beach committee is established, training is provided on the Forest Act and the Fisheries Act in advance and the committee is officially recognised only after the issue of a relevant decree by the head of the district. The establishment of beach committees is gradually making progress while their activities have just begun. The composition of beach committee members varies from one village to another. In some villages, women form the majority of the committee while there is hardly any representation of women in other villages.

2) Villagers' Committee for Mangrove Rehabilitation
(CVRM: Comité Villageois pour la Réhabilitation de la Mangrove)

A CVRM is a villagers' organization for which the WAAME, a NGO, has been providing assistance for establishment in villages which are mainly in the catchment area of Saloum River since the mid-1990's. A CVRM has so far been established in 35 villagers.

The main activities of the CVRM range from the management of mangrove forests, environmental management, improvement of the physical distribution of prawns and the creation of income opportunities (provision of micro-credit and the production and marketing of seedlings for timber trees and fruit trees by villagers) to education and training. The WAAME has adopted an approach of training at least one facilitator among villagers with a view to organizing other villagers around this facilitator. A CVRM is the outcome of such organization efforts.

While CVRMs were originally established for the sole purpose of saving mangrove forests from their ongoing destruction, the scope of their activities has since expanded as described above.

The existing CVRMs in 35 villages have jointly formed the Network of Village Facilitators for Rehabilitation and Conservation of Mangrove as a body to promote inter-village collaboration for various activities.

In regard to the activities to plant mangrove by the village (villagers') organizations described so far, efforts are made to make the best use of the villagers' own initiative, including decisions on planting days in consultation with villagers. However, such activities are not financially independent as fuel oil, etc. for the boats which are jointly

used to collect mangrove is partly funded by, for example, a NGO. In the technical aspect, there are still unsolved problems, including the incomplete study of the ecology of mangrove species, lack of firmly established planting techniques, limited number of technicians/engineers and lack of a reliable follow-up system.

(3) Planting Results

1) Planting of *Rhizophora*

A survey on the survival rate and growth situation, etc. at village plantations of mangrove (*Rhizophora*) was conducted at such RCs as Fimla (four sites), Djilor (nine sites), Dionouar (three sites), Bassoul (one site), Djirnda (seven sites) and Toubakouta (one site), totalling 25 sites (see Appendix A-2-2-3 – Survey on Planting Situation of Mangrove (*Rhizophora*) for the survey findings).

Although the tree vigour and survival rate, etc. of the planted trees vary from one plantation to another, the planting at these sites has so far generally been successful. The survival rate and growth have been less favourable at those plantations of which the elevation is relatively high, have been subject to sedimentation or where the salinity level is high, suggesting the unsuitability of these sites for further planting.

2) Planting of *Avicennia*

In 2001, the DPN produced potted seedlings of *Avicennia* at Bagadaji and planted 50 pots at Bagadaji and 150 pots at Dinack. Although these seedlings grew to a height of some 10 cm, they all died thereafter. The WAAME also produced and planted several potted seedlings at Bassoul in 2000 but these also died. The cause(s) of death is unknown in both cases. At Moundé, local residents have planted several seedlings but only one seedling currently survives. At Soukouta, village women have transplanted saplings from large *Avicennia* trees (tree height of 3 – 4 m and DBH of 10 – 15 cm) under the guidance of the UICN but it is now impossible to distinguish them from naturally regenerated *Avicennia* trees.

At Roh, 500 potted seedlings were planted in 2000 under the guidance of the FIOD and some 50 have so far survived. The water quality, current and bed materials survey found that the salinity of this planting exceeds 7% or is higher than 6% in the middle of the dry season. The surviving *Avicennia* trees are rather vigourless although they have somehow managed to survive.

2.2.4 Utilisation Situation of Mangrove Forests

(1) Mangrove Forests

The cutting of live mangrove trees is prohibited by law and local residents are only allowed to collect dead trees/branches. However, there appear to be many cases where live trees are cut for collection after they have died. Local residents utilise mangrove trees mainly for the following purposes.

- Building logs for beams for roves and fencing posts around hoses
- Firewood for cooking
- Firewood for the smoking of fish and processing of shellfish

(2) Mangrove Wood

As mangrove wood, poles of *Rhizophora* (3 – 4 m in length, 5 – 8 cm in butt-end diameter and 2 – 3 cm in small end diameter) are marketed. These poles are transported by islanders to the market in Kaolack and are sold there by market dealers.

(3) Non-Wood Forest Products

Honey is the most popular non-wood product from mangrove forests. *Avicennia* is used as a medicine by traditional clinics and a minor quantity is also used by some local residents as a medicine through decoction. In the past, it was used as a dye.

(4) Apiculture

Hollowed palm tree trunks have traditionally been used as beehives to obtain honey for home consumption. Modern apiculture commenced when the UICN distributed purpose-built wooden beehives. In 1995, the Toubakouta Apiculture Union was established and a factory equipped with a centrifuge and ripening apparatus was constructed.

1) Toubakouta Apiculture Union

170 people in three villages (Toubakouta, Skouta and Bani) around Toubakouta where high mangrove forests of *Rhizophora* exist produce 1.5 tons of honey a year using 200 beehives. For this purpose, the Union was established in 1995.

2) Apiculture Programme of the UN

The UICN is currently distributing apiculture equipment to individual islanders as well as pilot villages of its apiculture programme. There are six pilot villages, i.e. Falia, Moundé, Siwo, Thialane, Basaar and Diogane on Saloum Island. Ten trialists in each pilot village

were selected at a general meeting of residents and these trialists received the necessary equipment for apiculture from the UICN.

At Niombato, there are seven pilot villages of the apiculture programme, i.e. Betanti, Soukouta, Bagadadji, Sandicol, Médina Sangako, Dassilamé Sérère, Djinack and PND Eco Guardman, which have received the necessary equipment for apiculture from the UICN.

In addition, the UICN constructed an apiculture centre in Sokone in 2004 and began the collection and refining of honey produced by the pilot villages.

(5) Situation of Forest Use Other Than Mangrove Forests (Village Forests, etc.)

Many more mangrove forests are distributed in villages in the island area than villages in the inland area. Villages in the inland area mainly obtain building logs and firewood from a village forest or stand created for self-consumption. Many villages in the inland area have their own village forests. In the case of inland villages, eucalyptus or melaleuca is often planted at grassland situated in the zone where the beach gradually changes to tanne, grassland and farmland towards the inland. Acacia and other species are often planted on privately owned land.

2.2.5 Evaluation of Conservation and Planting Activities for Mangrove Forests

(1) Conservation Activities for Mangrove Forests

The treatment of mangrove forests by the DEFCCS is the same as that of ordinary forests made up of timber species. If a mangrove forest is situated outside a national forest area, any use of such mangrove forest land must obtain the approval of the related local public body.

The use of mangrove forests in national forest areas is regulated in the form of, in principle, a total cutting ban. Right of use is afforded to local residents regarding the cutting of poles for house repairs and the collection of such forest products as dead trees, fruit, leaves, roots and bark for their own use as food or for medicinal purposes. In reality, however, the provisions of the Forest Act are not strictly observed as cut-over areas of mangrove can be found at, for example, the far end of minor waterways.

Under the new Forest Act, it is possible for local residents and local public bodies to legally utilise forest resources by means of formulating a forest improvement plan. The relevant provisions offer a legal basis for the participation of local residents and local public bodies in forest management, indicating a concrete path to be followed, and village organizations with the assistance of NGOs and others have so far commenced the formulation of improvement plans for the sustainable use of mangrove forests.

(2) Evaluation of Planting Activities for Mangrove Forests

1) Survival Rate

The main planting activities are those assisted by NGOs. Even though no NGO can be described as having firmly established detailed planting techniques, the survival rate of the planted trees is generally high.

In terms of the survival rate, planting sites can be classified into those with a 2 – 3% survival rate and those with an 80 – 90% survival rate. The causes of death of the planted trees at the former are listed below.

- High elevation of the ground and resulting short duration of flooding
- Sedimentation site (inflow of sediment from inland)
- Firm sandy land (lack of oxygen in the ground)
- High salinity level
- Eating damage by domestic animals, fish and crabs

It has been found that the tree height in natural mangrove forests is generally high when they are located in places with a low elevation and long flooding duration and is low when they are located in places with a high elevation due to the sedimentation of sand. The growth of both *Rhizophora* and *Avicennia* is significantly affected by the elevation, conditions of the base materials and level of salinity.

2) Selection of Plantation Sites

In general, the total area of failed planting sites is small, suggesting general success in the selection of planting sites. The actual planting is conducted under the guidance of the DEFCCS or a NGO and the selection of the planting sites is partly based on the preference of local residents. In principle, the selection of the following sites as planting sites should be avoided.

- Sites with a high elevation
- Sedimentation sites
- Sites with firm ground
- Sites with a high level of salinity

As far as the ground elevation is concerned, those sites which are flooded to a depth of more than 50 cm at the mean high tide in the dry season are suitable for the planting of mangrove.

3) Seeds

The fact that local residents collect seeds and plant them under the guidance of a NGO constitutes positive progress. In many cases, floating seeds on running water are collected. As these seeds may adversely affect the overall survival rate and growth after planting, however, it is recommended that mature seeds or viviparous seeds be collected directly in forests. Given the fact that larger seeds tend to show favourable initial growth after planting, efforts should be made to collect large seeds where possible.

4) Planting

Planting is often conducted on the day of seed collection or on the day after. This practice is best suited to viviparous seeds which cannot be preserved for a long period of time. While the planting distance employed by the UICN and WAAME, etc. is approximately 2 m x 1 m, a planting distance of 50 cm x 50 cm or 25 cm x 25 cm is recommended to facilitate crown closure.

5) Tending

At some plantations which have been damaged by domestic animals, fencing to deter animals from approaching the planted trees and monitoring, etc. are necessary. In addition, the education of local residents should be considered.

2.3 Fisheries Resources

2.3.1 An Overview of Fisheries Resources

(1) Fisheries Production in Senegal

The Senegalese small-scale fisheries sector produced 310,000 tons of fish in 2002. The production trend in the last ten years is as follows: an increase from 290,000 tons in 1992 to 320,000 tons in 1996, and stabilizing between 310,000 tons and 340,000 tons from 1998 to 2002.

Among the regions of Senegal, Thies region accounts for about 70% of the total production as it has many big fish landing sites on the Atlantic coast such as Joal and Mbour. Thies is followed by St. Louis and Dakar in the production quantity. Fatick region covering Saloum Delta makes up only 1.8 to 5.8% of the total Senegalese fisheries production.

In respect to the objective of this report that is the sustainable utilization and management of fisheries resources for mangrove conservation, we shall focus several important fisheries

resources (shellfishes, shrimp, ethmalose, etc.), which are useful for the people living in mangrove delta. Accordingly the followings are mentioned mainly on Saloum Delta.

(2) Fish and Shrimp Resources at Saloum Delta

1) Annual Production Trends

85 species appear on the fisheries production statistics of Fatick region in 2002. They include 76 fishes, 3 crustaceans and 6 mollusks. Among 18,023 tons of the total fisheries production in Fatick region (5.8% toward the whole country), the major 5 species make up 76% of the total quantity: they are ethmalose (63%), cuttlefish (4%), tilapia (3%), mullet (3%), and shrimp (3%). The production trends of these 5 species in Fatick region in the years 1992-2002 are as follows:

① Ethmalose

The production of ethmalose has annual fluctuations. It was around 2,000 tons between 1992 and 1994, decreased to 1,000 tons between 1995 and 1998, rose to 3,500 tons in 1999, 2,000 tons in 2000, 4,400 tons in 2001, and jumped to 11,300 tons in 2002. These fluctuations reflect a characteristic of pelagic species like ethmalose.

Since the Sangomar sandbank broke open in 1987, ethmalose has inhabited along Saloum River and its branches. According to an IUCN report, ethmalose is one of the species constantly spawning in Saloum Delta (Diouf, 1996). Landed ethmalose has been smaller in recent years and stock deterioration is a real concern. Accordingly, IUCN and CRODT (Centre de Recherche Océanographique de Dakar Thiaroye) have started a joint research project to assess ethmalose stock. Action is needed to protect the reproduction cycle of the ethmalose.

② Mullet

The production of mullet was 3,000 tons in 1992, 1,500 tons in 1994, 700 tons in 1995, and has fluctuated between 570 tons and 970 tons since 1996. Most of the mullets caught at Saloum Delta are small in size, indicating that the Delta may function as a nursery for mullet juveniles. The decrease in the mullet production hurts the people who catch adult mullets around the coastal area.

③ Shrimp

The Shrimp production was 236 tons in 1992, 564 tons in 1995, 912 tons in 1999 and 1,883 tons in 2000. This increasing trend is due to the shrimp distribution network

organized in these years by cold storages in Saloum Delta. After these years, the shrimp production decreased to 785 tons in 2001 and 536 tons in 2002.

④ Other Species

The production of the 4 other species, i.e. sea catfish, tilapia, flounder, and cuttlefish, is stable.

2) Seasonal Production Trends

Among the 5 major species, ethmalose and shrimp have pronounced seasonal fluctuations. Ethmalose is caught from January to June, with the production peak in April. The production gradually decreases from July to December. Shrimp is caught mainly from August to December with the production peak from September to November. In other words, ethmalose is caught in the dry season, and shrimp is caught in the rainy season. The other 3 species has stable production levels with no obvious seasonal fluctuations.

(3) Shellfish at Saloum Delta

Important shellfish resources are 4 species including oyster, ark, giant hairy melongena and volutes in Saloum Delta. These are targeted species for women's economic activities in Saloum Delta.

1) Oyster

① Annual Production Trends

Senegal's annual oyster production is about 100 tons, 70 to 90% of which is in Ziguinchor region and 20% in Fatick region.

② Seasonal Production Trends

Oyster production is concentrated between January and June with 10.9 to 16.6 tons per month in Ziguinchor region, while in Fatick region it increases from November to May and decreases from June to October.

③ Annual Production Trends of Fresh Oyster

Fresh oyster production continues for 7 months a year from the end of November to May and stops during the rainy season. Since 1991, annual fresh oyster production from Sokone area has been 20,000 to 25,000 dozen per year.

2) Other Shellfish

① Ark

Ark is produced about 100 tons annually in Senegal. It is Fatick region that the most quantity (74 to 100%) of ark is landed on. It can be said that Saloum Delta is the production center of ark in Senegal. A sales and distributing promotion for ark should be considered for Saloum Delta.

② Giant hairy melongena and Volutes

Senegal produces about 1,500 tons of giant hairy melongena annually, in which Thies region is the production center covering more than 90% of it. The annual production of volutes is about 5,000 tons in Senegal, 90% of which is from Thies region. Boats with nets catch these two species at offshore fishing ground while women gather ark on foot at Saloum Delta.

2.3.2 Fisheries Resources Utilization in the Mangrove Ecosystem

The three following areas are described in relation to the mangrove ecosystem: (1) inland area; (2) islets area; and (3) coastal area.

(1) Inland Area

1) Fisheries Resources

Here the inland area refers to the Saloum River upstream locality around Foundiougne. In this area, the population utilizes such fisheries resources as shrimp, mullet, tilapia, barracuda, and threadfins. The most economically important resource among them is the shrimp (*Penaeus notialis*). Under these circumstances, the increasing catching effort threatens shrimp resources. The Fatick regional government has proclaimed shrimp fisheries regulations with respect to the duration of the fishing season, mesh size of the gear, permissible size of shrimp to catch, and introduced a shrimp fishermen registration system in the 1990s. Nevertheless, the local fishermen do not necessarily respect the fishery regulations, and the number of fishermen in the registration system decreased in 2000 and 2001. It is necessary to reconsider how to utilize these systems.

2) Production Trends

Shrimp is caught by either *killi* (a type of dragnet with 3.8 m wide and 3.5 m in length) or *moudiasse* (a type of small scale stake net). According to IUCN's report, the average catch with the *killi* per day per unit is 14.4 kg in September and October 1993, 20kg in 2000/2001

and 5kg in 2001/2002. The shrimp catch has been decreasing in recent years. Once the shrimp fishing season has begun, even inland people who cannot swim well rush to catch shrimps. Those people sometimes meet accidents in waters because they dip themselves in the water and drag a net at night.

3) Processing, Distribution and Sales

Middlemen for shrimp have existed in Senegal since 1974. Typical middlemen own several refrigerated cars and are on contract with cold storages with several hundred tones of shrimp. If they can't fulfill their contracted volume until the end of the fishing season, they will either collect shrimp in The Gambia or extend the contract to the next year. When they deliver a certain volume of the shrimp to the cold storages, they can receive the same volume of ice.

Middlemen place their assistants at many shrimp fishing villages. The assistants collect landed shrimp and measure the weight, then deliver it to the middlemen. The middlemen pay commissions in accordance with the volume of the shrimp delivered to them. Middlemen also keep in touch with skillful fishermen by giving them advanced payment to maintain a sustainable volume in the shrimp business.

(2) Islets Area

The islets area means a center of Saloum Delta marked with three channels of Saloum, Diombos and Banjala. Fisheries resources are very important for the people in the area. The most important resources are shellfish and ethmalose. Below are details on them.

1) Shellfish

① Species

Most of the oysters harvested at Saloum Delta are *Crassostrea gasar*. This species is distributed along the African west coast from Senegal to Angola. It grows on roots of *Rhizophora spp.*, the major species at Soloum Delta, and it is thus called the mangrove oyster. Other important resources for the people's economic activities are arks (*Senilia senilis*, etc.), giant hairy melongena (*Hexaplex duplex*, *Pugilina morio*, *Murex cornutus*, *Thais coronata*, etc.) and volutes (*Cymbium pepo*, *Cymbium cymbium*, etc.).

② Production Trends

i. Natural Shellfish

Shellfishes are important resources for women in Saloum Delta because they are relatively easy to harvest with limited production means. They harvest mangrove oyster and other shellfishes at ebb tide on tidal flats, particularly in the dry season (October to May), because they are busy with agriculture during the rainy season.

However in recent years, the resources sustainability is in apprehension because the fishing grounds move farther from villages and oysters turn smaller in size. An effective resource management system should be introduced. At the same time, shellfish collectors often get injured during the harvest, accordingly they usually cut mangrove roots to avoid it.

ii. Cultured Oyster

Oyster culture is carried out in Joal, Somone and Sokone. Cultured oyster makes up 90% of all the sales in Joal. Although the endeavors for oyster culture began in the 1950s, they have been successful only since 1992.

Oyster juveniles imported from France (about 10,000 pcs.) have been cultured at Somone since 2000, and they are about to go on sale. Meanwhile, Japanese volunteers have tried to culture the mangrove oyster for many years. However, their effort has not been commercially successful as there is still abundance of natural oysters around Sokone.

③ Processing, Distribution and Sales

Shellfish distribution has two different ways: one is for fresh oysters, and the other is for processed ones.

Fresh oysters produced in Joal and Sokone are delivered to Dakar, and are purified, examined and then finally sold at restaurants. When hotels and restaurants near Somone and Joal require fresh oysters, they purify them at their own sites. Their customers are very cautious about the safety of oysters, and put more priority on the safety and quality of oysters rather than prices.

Many local people are engaged in shellfish processing and deliver products throughout the country. The processing of oysters and arks consists of boiling and drying. Fermentation and drying are the means for giant hairy melongena and volutes. These

processed products are sold either through middlemen or by processors themselves in Foundiougne, Kaolak, Dakar and other market towns.

The present processed shellfishes, which are mixed with mud and sand, are cheap in quality and price. It is required to exert efforts to add value through the processing improvement, which makes women's life improve.

④ Organization

i. Joal Fresh Oyster Association

A Frenchman dispatched to Joal as a marine fisheries inspector founded the Joal Fresh Oyster Association in 1957. There were originally 72 members, and the number increased to 119 in 1982 and has remained unchanged since then. Since 1992, organization activities have drastically shifted from natural oyster collection to oyster culture. All members have their own concession to collect natural juveniles and culture them. They deliver their products to Dakar and around Joal.

ii. Sokone Fresh Oyster Association

The Sokone Fresh Oyster Association was organized in 1985 with members in villages including Bambougar El Hadji, Medina Sangako, Sandikoly and Soucota. There were 46 members composed of 24 males and 22 females as of July 2002.

There are only two fresh oyster associations in Joal and Sokon, both of which handle all the work from production to sales. On the other hand, there are many GIE for shellfish processing mostly organized only by women. However, most of them are inactive except a few such as the one at Mounde village.

2) Ethmalose

① Species

Ethmalose (*Ethmalosa fimbriata*) belongs to *Clupeidae*, and is distributed along the African west coast from West Sahara to Angola. The body is wide and flat. It grows up to 35cm long and inhabits in coastal, brackish and inland areas. It feeds on plant plankton.

② Production Trends

Senegal produced 26,000 tons of ethmalose in 2002, of which 44% was produced in Thies region and 43% in Fatick region. Therefore, there are two fishing grounds, i.e. along the Atlantic coast and upstream of Saloum River. Ethmalose migrates into rivers such as the Saloum and the Diomboss from December to September. The best fishing season is February to April along Saloum River. After that, ethmalose is caught near Foundiougne or Kaolak.

③ Processing, Distribution and Sales

Although some of the ethmalose are consumed in the domestic markets, most of them are sold to the neighboring countries, i.e. Guinea, Burkina Faso and Ivory Coast, in the smoked products. Smoking furnace has been recently increasing in Saloum Delta, which has brought about an increase in mangrove firewood consumption. There are 132 units of smoking furnace in 14 villages in Saloum Delta as of April 2002. We observed more units of smoking furnace under construction during our study. These smoking furnaces have poor heat efficiency, because they are open type placing raw fish on single layer and burning firewood below.

Ethmalose is smoked, had the head and skin removed and dried up. That is the original processing method for ethmalose in Saloum Delta where mangrove forests are used for firewood.

Here is the standard division of labor in ethmalose processing: (1) village men catch and sell the fish to Guineans who smoke the fish; (2) village women remove the head and skin, and (3) the Guineans pack the products. Ethmalose processing is a business subject to frequent fluctuations due to the market and biological stock conditions. The ethmalose stock doesn't ensure a stable annual catch and the smoking furnace has a short life span of just a few years.

④ Organization

Guineans are the main actors in this business. However, it has been observed that groups organized by village people take action to participate in this business like the ones in Bassoul and Djirnda.

Federation Nationale de GIE Peche supported the women's group in Djirnda village in 2000 to construct 3 units of smoking furnace and a warehouse. They also received

credit from the Credit Mutual to purchase raw materials. The 15 members split responsibilities among 3 subgroups for business operations.

(3) Coastal Area

1) Species

Important species in the coastal fisheries resources include ethmalose), sea catfish (*Arius Heudeloti*), groupers (*Epinephelus aeneus*, *E. guaza*, etc.), guitarfish (*Rhinobatos sp.*), dusky jack (*Caranx chrysos*), silver grunt (*Pomadasys jubelini*), croakers (*Pseudolithus senegalensis*, *Argyrosoums regius*), barracudas (*Sphyraena guachancho*, *S. afra*), and mullets (*Liza sp.*, *Mugil sp.*).

2) An Overview of Fisheries Activities

Details of fishing practiced in Betanti are as follows:

① Drift Net Fishery

Villagers catch croaker and threadfin bream throughout the year, barracuda from June to September, Spanish mackerel from June to August and another species of croaker from March to April off the coast of Sangomar.

② Bottom Gill Net Fishery

Villagers catch ray over the year, croaker and silver grunt from December to February, dorade grise (*Plectorhinchus mediterraneus*) from March to May and sea catfish from June to August with this fishery.

③ Surrounding Gill Net Fishery

Ethmalose is the main target species in this fishery from October to May, with March and April as particularly good months for catching it.

④ Mullet Gill Net Fishery

Mullet is the main target species with this fishery throughout the year, and the months from June to December are a particularly good period. There are several fishing grounds off Betanti including a channel near Soukouta and Missira, and internal streams of Bakous and Ansoukala.

⑤ Bottom Long Line Fishery

Villagers catch guitarfish at the fishing ground between Betanti and the Bird Island from December to February as well as June to September in this fishery.

⑥ Beach Seine Fishery

Villagers catch dusky jack, mullet and croaker all around the year, particularly during the rainy season (June to September) in this fishery.

⑦ Shrimp Net Fishery

The better shrimp season is from March to July around Betanti. The regional government has enforced a closed season for shrimp that covers the entire Fatick region including Betanti.

3) Processing, Distribution, and Sales

Djifer is a fisheries product distribution center in Saloum Delta where 33 middlemen and 2,500 fishermen with 600 boats are working. It receives 3,600 tons of fish annually to be distributed as frozen products, fresh fishes, salted and dried products for domestic and foreign markets. It also processes 1,200 tons of salted and dried fish, 5 tons of dried fish and 6 tons of smoked products.

4) Organizations

Beach committees have recently increased in many villages in Saloum Delta due to environmental deterioration around them. They aim to protect and manage natural resources. The activities of beach committees in Betanti and Niodior are as follows:

① Betanti

Residents of Betanti used to stop fisheries activities during the rainy season. However, this practice of no-fishing season ended in the 1970s. They established a watch committee in 1980 to patrol illegal fishing practices and mangrove cutting. After that, a beach committee was established with 12 members in 1995, carrying out patrols over mangrove areas 4 times a week. They decided to implement the no-fishing season in the 5 following fishing grounds: Soukota, Ansoukala, Basaja, Bangurus and Kososu for 4 months.

② Niodior

A beach committee was established with 7 members in 1998. The authorities approved the movement as part of the decentralization process. The committee patrols over its environmental resources 3 times a month and communicates with the authorities. Although IUCN and FEM supported the activity from December 1999, their support ended in August 2002.

The beach committee has decided to establish protected zones both for all kinds of fish and for shellfish to stop harvesting them during the rainy season to maintain reproduction of the fisheries resources around Niodior.

(4) Relations between Fisheries Resources and Mangrove Forests

Mangrove forests supply spawning and growing nurseries for various kinds of fisheries stocks. According to an IUCN report, 114 species of fish have been observed at Saloum Delta, among which 36 species are spawning there constantly, 14 species grow in the delta then spawn at sea. In short, 50 out of the 114 species are either grown or spawned in the delta. Ethmalose, mullet, tilapia, sea catfish are among the 50 species. Shellfish stocks such as oyster, ark, giant hairy melongena and volutes are deeply connected to the mangrove forests in Saloum Delta.

Relations between fisheries resources and mangrove, and their problems are shown in the table 2.3-1:

Table 2.3-1 Relations between Fisheries Resources and Mangrove

Species	Production Trends	Relations with Mangrove	Problems
Shrimp	<ol style="list-style-type: none"> 1. Production reached 2,000 tons in 2000. 2. Fishing season: Sept.-November. 3. Distribution network is established and relations between fishers and middlemen have been made closer. 	<ol style="list-style-type: none"> 1. Mangrove forest supplies feeds and growing sites for young shrimps. 2. <i>Penaeus notialis</i> in Saloum Delta seems the same population as the one caught in Casamans district. 	<ol style="list-style-type: none"> 1. Although shrimp fishing regulations have been enacted, they are not effective. 2. Shrimp fishing ground is in poor condition due to mangrove disappearance. 3. Sea accidents are frequent.
Ethmalose	<ol style="list-style-type: none"> 1. Production fluctuates between 1,000 and 3,500 tons. 2. Fishing season is from January to June. 3. Smoking business is all over the delta, run by Guineans. Products are exported to neighboring countries. 	<ol style="list-style-type: none"> 1. It goes upstream from January to June, then downstream after the end of dry season. 2. IUCN report says it is one of the species to spawn in the delta constantly. 3. Mangrove wet land may offer feeds and spawning sites to this species. 	<ol style="list-style-type: none"> 1. Recently size has been getting smaller. 2. Smoke processing business consumes a lot of mangrove firewood. 3. The present smoking furnace units are poor in heat and work efficiency.
Other fish	<ol style="list-style-type: none"> 1. Mullet, tilapia, sea catfish, flounder and cuttlefish are important species. 2. Mullet, tilapia and sea catfish are for domestic consumption; flounder and cuttlefish are for export. 3. Mullet is for dried as a whole; sea catfish, salted and dried; and tilapia is consumed as fresh fish. 	<ol style="list-style-type: none"> 1. Mullet and tilapia are among species spawned in the delta. 2. Sea catfish grows in the delta and spawns at sea, except a few in the stock spawn in the delta. 	<ol style="list-style-type: none"> 1. Mullet production has been decreasing in recent years.
Shellfish	<ol style="list-style-type: none"> 1. Important shellfish stocks at the delta are oyster, ark, giant hairy melongena and volutes. 2. These stocks are important for women's economic activities in particular. 3. For consumption, oyster is either fresh or processed. 4. Oyster and ark are boiled and dried, and giant hairy melongena and volutes are fermented and dried. 	<ol style="list-style-type: none"> 1. Oyster grows attached to mangrove roots, which is one of the most dependent stocks in mangrove throughout its life. 2. Ark grows in sand banks in the channels. It depends on mangrove partially in its life history. 3. Giant hairy melongena is distributed near mangrove forests. It eats the mangrove oyster. 	<ol style="list-style-type: none"> 1. Fishing grounds for oyster have become farther from villages and the size has become smaller. 2. Ark has become smaller in size. 3. There are sites where people can't harvest ark due to Sangomar breaking open. 4. Oyster culture has not been commercially successful in spite of many efforts at Sokone.

2.4 Conservation of nature and Ecotourism

2.4.1 Situation of the nature protection

Target area of this study includes the biological protected area established by Department of conservation of Environment and Nature (formerly, Department of Youth, Environment and Public Health), office of National Park. This is the valuable place because of its biodiversity.

Senegal Government has been understanding the importance of conservation of nature. The government ratified the international treaty (Ramsar Convention) concerning wetlands 1971 and the international regulation about biodiversity 1992. The Saloum Delta biological protected area has been designated as the important wetlands globally.

Regarding to the wild biology protection, office of National Park management of National parks and forest office is responsibility for that of national forest. They cooperate with each other in protection activities as to necessity.

Natural environment of Saloum Delta is extremely attractive place for visitors, especially foreigners. Natural environment is important tourism resources as you know that a lot of visitors from other countries come to Saloum Delta every year. However many visitors coming on the tourism promotion causes a risk to task the nature resources. In the management plan of biological protected area, an ecotourism promotion activity was proposed with the subject to enjoy the natural resources without giving a risk on them as possible.

2.4.2 Ecotourism

(1) Tourism industry and resources in Senegal

1) Tourism sector in Senegal

① General

The tourism sector is one of the important sub-sectors in Senegal, boasting to be a big foreign currency earner, second only to the fishery sector. The fishery sector earned hard currency of around CFA181 billion and the tourism sector earned it CFA 100 billion annually between 1998 and 2002, almost compensating the imports of rice CFA90 billion, national stable food.

② Tourist arrivals in Senegal

According to the Ministry of Tourism, about 430,000 non-resident tourists reached Senegal in year 2002, and their combined duration of stay was around 1.57 million days. Arrivals increased by 8% and duration by 5% over the previous year. Regarding major sources countries, over 50% of tourists come from France, 20% from African countries, 5% from Spain and Italy, and 4% from Benelux countries. Africans are considered to come to Senegal for business purpose as 90% of them stays at hotels in Dakar. Belgium is dominant among the Benelux. Tourists from Spain have increased notably in recent years, although their average stay is distinctly brief at 1.8 days. Moreover, Italians are also increasing in number greatly in 2001 to 02, exceeding the Benelux. Although halved from 17,000 in the peak year of 1998, German tourists conspicuously stay long with average duration of 8.1 days.

Although the negative impacts of the 9/11 incidents on tourism were felt globally, tourist arrivals in Senegal went up by 1.3% in 2001 and 6.9% in 2002. The industry sources interpret the surge as a result of significant diversion of European tourists to Sub-Saharan Africa from North African countries

③ Seasonal differences

Busy travel season in Senegal runs from November to April, just before the rainy season. It is more or less cold winter season in Europe, during which sun-seekers come to Senegal. Rainy season, which usually starts in June, is slow in tourism activities, and average rooms rates decline, which attracts young tour groups from Spain and Italy. Some of hotels and guesthouses close for preparation and refitting right before the travel season, and quite a few of them remain open throughout the year. The number of arrivals, March 2002 was bigger than the forward.

④ Accommodations

Ziguinchor has more hotels than other provinces, but the capacity of Thies and Dakar is larger because they have a lot of middle and large hotels.

The hotel industry of Senegal is apparently characterized by low room occupancy. average monthly occupancy ratios during the busy season in 2001 and 2002 reaches only around 50% at highest even in the peak months from January to March. Thies province boasts an annual average of over 50% while Saint Louis and Fatick provinces have achieve 20 to 25%.

In general, a break-even point for the hotel is said to be at an annual occupancy of between 60 to 70%. Many hotel facilities in the country continue operations in spite of the low occupancy ratios because of the following reasons:

- Some of them are shut down during off-seasons, which brings down countrywide annual occupancy ratios.
- Most hotels are composed of a number of one-story cottages, which would require relatively low initial investments and reduce subsequent depreciation.
- The share of miscellaneous receipts such as revenue from excursions is comparatively high at around 20%.
- Land rentals for hotels remain at moderate level.
- Labor costs for local employers are fairly low.
- Many small-scale campements are family-operated and their break-even points are low.

⑤ Types of tourists

Although tourists are not grouped statistically, they can be divided into two types.

Group travel (Circuit)-type : Tourists on a group tour, who make a 1- to 2-week circuit of the country, visiting a few popular spots. Saloum Delta, Saint Louis, Petite-Cote, Ziguinchor and Niokolo-Koba are typical sites for visit. Tour originators tours combine some of these places for group tours, and itineraries and destinations are fixed in advance.

Long stay (Sejour)-type : Tourists who stay at the same hotel for 1 or 2 weeks, fishing, hunting, swimming and going on day trip. In Petite-Cote, sejour-type tourists reportedly account for over 70% in season.

average duration of stay in major provinces during year 2001, Thies, which includes Petite-Cote, has a fairly long stay regardless of the season, and is hence believed to accommodate a number of sejour-type tourists throughout the year. Ziguinchor appears to have sejour-type as majority in season and group(circuit?) tour off-season. Dakar, business center of the country, shows a steady duration of stay all year round.

2) Tourism resources and activities in the Project area

Major tourism resources within the Project area is abundant nature and biodiversity in the Saloum Delta. After one travels from Dakar during the dry season, watching brownish savannas along the way, rich foliage and abundant water in the Delta will present striking difference. Villages, shell-mounds and old tombs that are scattered in the Delta can be considered as attractive resources.

Petite Cote area, which is located along sandy beaches in the north of Thies, is an important tourist spot, albeit much less natural abundance. Sali-Pordugal and Somone in Petite Cote are the largest tourist spot with heavy concentration of big hotels, campements and villas. Partly due to the proximity to Dakar, a large number of tourists stay there. Most of the tourists fly from Europe on charter or regular flight, seeking 3S (sea, sand and sky), and stay at large comfortable hotels for 1 to 2 weeks.

Tourist arrivals ratios of Thies and Fatick including Saloum Delta, excepting around metropolitan area, are 76.1% and 4.5%. They occupy about 80% of all arrivals to Senegal.

(2) Tourist flow in the Project area

1) Access to the Delta

Access is by land vehicle, from Dakar to the entry points into the Project area. It is about 80 km to Petite Cote and 120km up to Joal, connected by paved roads. From Dakar to Fatick for about 155 km, roads are mostly paved. Generally, road conditions will be deteriorated as one goes further south, but it does not appear to deter tourist movement much. One can reach an entry point after 3- to 3.5-hour drive (for about 200 km from Dakar). Entry points to the Delta are Fatick from the northeast, and Djifer and Ndangane (25 km from Joal) from the north.

2) Entry from Fatick

Most of the tourist entering the Delta area stay a few days on average at hotels or campements in Foundiougne or Toubacouta. They embrace Circuit and Sejour type. Quite a few of them go on to Ziguinchor through Gambia. During the tourism season, a fairly big cruise ship with the maximum capacity of 54 passengers in 27 cabins goes around in the Delta once a week.

3) Entry from Djifer

Most tourists originating from Djifer or Ndangane are on day trips to the Delta from Petite-Cote or Dakar. But there are also facilities in these two places, which accommodate

as much as 200 tourists in season, most of them are Sejour type and fairly of them are on day trips starting from Djifer and Ndangane.

4) Visitors to the national park

Information released by the Department of the National Park indicates about 1,000 fee-paying visitors annually, but the number of actual visitors must be much more than this. It is probably because the Saloum National Park includes only part of coastal lines and islands, and visitors arrive on the islands mainly by boat without going through tollgates, which are located only in a few places on the land. The park officials admit that annual visitors to the national park is over 10,000.

Considering that 20,000 tourists come to the Fatick region (estimate in 2002), and many day-trippers visit the Delta from Thies and Dakar, which host over 300,000 tourists annually between them, one can reasonably estimate that visitors and tourists to the Delta could be much more than 10,000.

(3) Ecotourism in Senegal

Ecotourism activities have just started in Senegal. An advisor to the minister of tourism on ecotourism was recruited from the private sector in late 2001 and initiated some programs.

Within the government, the ministry of tourism and the department of the national park are mainly involved in ecotourism. Being a new concept even internationally, a strict definition of ecotourism is yet to be shared with all the concerned organizations. But, the two major offices have agreed with the Team to a tentative definition that ecotourism shall create self-sustainable employment and additional income opportunities by active and direct participation of local residents and shall contribute the conservation of natural resources.

Recognizing the global importance of ecotourism, the United Nations designated the year 2002 as the International Year of Ecotourism. Member governments were requested to inform the World Tourism Organisation (WTO) and the United Nations Environment Programme (UNEP) of the ecotourism activities planned for 2002 at the national level. The Senegal government reported the following two activities as the example of the best practice ¹⁾:

- GIE “Samu Sunu Xewal” Iles de la Madeleine National Park Volunteers
- Women’s Group of Ponguine for the Nature Protection and Volunteers of Kër Cupaam ecotourism

1) “Sustainable Development of ecotourism - A Compilation of Good Practices in SMEs”, World Tourism Organisation, May 2003

2.5 Socioeconomy

2.5.1 Questionnaire Survey on Utilisation Situation of Mangrove Forests by Local Residents

A questionnaire survey was conducted to clarify the utilisation situation of mangrove forests by local residents in the Study Area. This survey was subcontracted to Senegrosol Consult, a local consultancy firm. The targets of the survey were 500 households in 22 villages (which have mangrove forests in their area or which have access to mangrove forests) in the subject areas of the sustainable management plan (master plan) to be formulated. Information on the 22 villages themselves was also obtained.

(1) Target Persons of Questionnaire Survey in Sample Households

The head (male or female) of each of the 500 sample households was selected as the target person for the questionnaire survey. In the case where the head of the household was a man, the senior wife playing a central role among several wives under the existing system of polygamy was also the target of the questionnaire.

(2) Interviews at the Village Level

Interviews were also conducted at the village level, featuring the head and senior people of each village, representatives of various village organizations, officials of administrative offices in the village and school teachers.

Table 2.5-1 Target Villages of Questionnaire Survey and Number of Sample Households

Region	Rural Community	Village	Planned No. of Sample Households	Selected No. of Sample Households	Head of Household		
					Male		Female
					Husband	Senior Wife	
Fatick	Toubakouta	Soucouta	20	20	16	(15)	4
		Sandikoli	25	25	24	(24)	1
		Médina Sangako	25	25	23	(23)	2
		Toubakouta	25	25	22	(22)	3
		Betanti	25	25	23	(21)	2
	Djilor	Kamatane Bambara	10	10	10	(10)	-
		Gagué Chérif	10	10	9	(9)	1
		Gagué Mody	25	25	23	(23)	2
		Félene	25	25	25	(25)	-
	Diossong	Bamboucar Malik Ndiaye	25	25	24	(24)	1
	Djilass	Faoye	25	25	25	(25)	-
	Fimela	Simal	25	25	23	(23)	2
		Mar Fafako	25	25	21	(20)	4
	Palmarin Fakao	Palmarin Ngallou	25	25	19	(18)	6
	Djirnda	Djirnda	25	25	21	(20)	4
		Diamniadio	25	25	25	(22)	-
		Rofangué	10	10	10	(10)	-
		Moundé	25	25	21	(17)	4
	Bassoul	Bassoul	25	25	25	(21)	-
	Dionouar	Niodior	25	25	22	(22)	3
		Falia	25	25	21	(20)	4
	Thiès	Nguèkokh	Guéréw	25	25	22	(22)
2	10	22	500	500	454	(436)	46

2.5.2 Questionnaire Survey Results

(1) Characteristics of Target Villages of Questionnaire Survey

One characteristic of the target villages of the questionnaire survey is that 20 out of the 22 target villages were originally formed more than 100 years ago. This fact suggests that the area has been relatively stable for a long period of time.

By ethnic background, the Serère account for 78% of the population, followed by the Sose (10%), Pru (4%), Worof (3%) and Bambara. The Study Area is largely classified into the island area and the mainland area. In the island area, the Serère Niominca who are mainly engaged in fisheries, are the dominant sub-group of the Serère. Fisheries are the main economic activities in the island area. While some villagers of the mainland villages are also engaged in fisheries, including prawn fishery, agriculture is the main productive activity. The dominant form of agriculture is rainwater-fed agriculture, producing such staple crops as millet, sorghum, rice and maize for self-consumption. Peanuts are the local cash crop but do not provide a stable source of income as the production volume considerably fluctuates from one year to another because of the

dependence on rainwater. Refer to 2.5.3 for a more detailed description of the current situation of villages.

(2) Characteristics of Target Households of Questionnaire Survey

It is a general practice in the Study Area for the oldest male to control the human as well as physical resources of the household and to supervise the work of the household members. In the case of households of which the head is a woman, accounting for some 10% of the target households in the area (45 out of 500 households), this woman is responsible for the management of the household. In the case of polygamy households, the first wife assumes the main responsibility for matters relating to women, for example, housework.

In regard to the roles of household members in productive activities, farming is basically conducted by all household members. In the case of cash crops, men are involved in all production processes while women and children are often involved in seeding and weeding. Women tend to play a central role in the production of staple crops for self-consumption. While the cultivation of rice and vegetables has traditionally been conducted by women, the involvement of men in vegetable production can now be observed because of the prospect of cash income. In the fisheries sector, the customary division of labour is for men to fish using a boat while women process the landed fish. In the case of the smoking of ethomaroise for example, the typical practice involves fishing by local men, smoking by Guineans and other foreigners and skinning of the smoked fish by local women. The collection, processing and sale of such shellfish as oysters and *Senilia senilis* are mainly conducted by women, providing them with an important source of income.

The demographic structure shows slightly more women than men. By age, the ratio of those up to 15 years of age of 46.2% is fairly high. The number of household members varies from 8 to 12.

As far as the educational standard is concerned, 46.8% of the household heads have no education while 35.8% and 13% attended an Islamic school teaching the Koran and a primary school respectively. In regard to other household members, 25.2% have no education, 22.6% have education on the Koran and 31% have a primary school education. Compared to the older generation of household heads, their children have better educational opportunities. However, improvement of the school enrolment ratio as well as the literacy ratio is still important.

(3) Utilisation of Mangrove Forests by Local Residents

1) Estimated Consumption of Wood Resources in Mangrove Forests

Based on the questionnaire survey results, the consumption of mangrove wood in the target area of the Master Plan (Master Plan Area) was estimated. The target materials originating from mangrove for estimation were construction logs, fencing posts, firewood for cooking, firewood for shellfish processing and firewood for the smoking of ethomaroze.

① Construction Logs

The average annual consumption of construction logs for each of two villages in each rural community in the Master Plan Area, i.e. one on the mainland and another in an island area, was estimated. This average value for villages located on the mainland was then multiplied by the number of these villages. The resulting sum was then added to the similar sum for villages situated in island areas to estimate the total annual consumption of construction logs in the Master Plan Area (see Appendix A-2-5-3 – Estimation of Consumption of Mangrove for Construction Logs). The estimated annual consumption of construction logs in the Master Plan Area is 234.5 m³. Assuming that one m³ of logs weighs 1.4 tons, the annual consumption of construction logs is estimated to be 328.3 tons.

② Fencing Posts

The consumption of mangrove for fencing posts was estimated in the following manner based on the questionnaire survey results. Firstly, the total length of fencing using mangrove poles was established for each village and the average length per village was calculated to determine the required number of posts per village. The average total weight of fencing posts per village was then calculated using the volume of a single post. The total weight of posts in the entire Master Plan Area was calculated by multiplying the average total weight per village by the number of villages. Assuming that fencing posts are replaced every two years, the total weight was divided by two to establish the annual consumption (weight).

Based on the above estimation process, the annual consumption of mangrove for fencing posts in the Master Plan Area is estimated to be 45.8 tons (see Appendix A-2-5-4 – Estimation of Consumption of Mangrove for Fencing Posts).

③ Consumption of Mangrove Firewood for Cooking

The consumption of mangrove for firewood for cooking in the Master Plan Area was estimated as {(average daily consumption of mangrove for firewood for cooking per

household) x (number of households) x 365 days} (see Appendix A-2-5-5 – Estimation of Consumption of Mangrove for Firewood for Cooking).

Based on the above estimation process, the annual consumption of mangrove for firewood for cooking in the Master Plan Area is estimated to be 12,638 tons.

The consumption of mangrove for firewood for cooking was also estimated as part of the basic study for the formulation of the Biosphere Reserve Management Plan. The results of this basic study are shown in Table 2.5-2.

Table 2.5-2 Estimated Consumption of Mangrove for Firewood for Cooking Based on Existing Report

Hypothesis	Two Meals a Day	Three Meals a Day
Low Consumption Level	4,085 tons/year	6,127 tons/year
High Consumption Level	8,169 tons/year	12,254 tons/year

Source: Gaëlle Leruse, “Estimation de la Consommation de Bois de Mangrove par les Populations de la Réserve de la Biosphère du Delta du Saloum (Sénégal) et Propositions de Méthodes de Gestions”, p. 51

The area in which mangrove is used for firewood for cooking in the biosphere reserve is believed to be practically the same as the Master Plan. When the estimate based on the questionnaire results is compared with the estimate in the existing report, the former is found to be comparable with the estimated high consumption level based on three meals/day in the existing report. Accordingly, the annual consumption of 12,638 tons based on the questionnaire results is used for the Master Plan

④ Firewood for Shellfish Processing

To determine the consumption of mangrove for firewood for shellfish processing, the volume of mangrove firewood used for the processing of oysters, which is dominant among the locally caught shellfish, was estimated.

The estimated annual consumption of mangrove for firewood for shellfish processing in the Master Plan Area is 6,497 tons.

⑤ Firewood for Smoking of Ethomarose

The consumption of mangrove for firewood for the smoking of ethomarose was estimated based on actual measurement data produced by the Study Team while

referring to the questionnaire results. The estimated annual consumption of mangrove for firewood for the smoking of ethomarose in the Master Plan Area is 3,426 tons.

A similar consumption of mangrove was estimated in the formulation process of the Biosphere Reserve Management Plan and the results were compiled in a report written by Baba Magoum N'Diongue as shown in Table 2.5-3.

Table 2.5-3 Firewood Consumption for Smoking of Ethomarose

Consumption per Kiln	No. of Kilns	Daily Consumption	Monthly Consumption	Consumption in One Season
0.386 tons	73	28.2 tons	845.3 tons	3,381.4 tons

Source: Baba Magoum N'Diongue, "Etude de la Filiere de Commercialisation du Bois de Chauffe de Mangrove Provenant de la Réserve de la Biosphère du Delta du Saloum (RBDS), Université Cheikh Anta Diop, 2000/2001, p. 81

It is confirmed that as far as the estimation of the consumption of mangrove for firewood for the smoking of ethomarose is concerned, the estimated volume under the present Study is similar to that of the existing report. Accordingly, the consumption of 3,426 tons based on the results of the Study is used for the Master Plan.

⑥ Annual Consumption of Mangrove Wood

The annual consumption of mangrove wood estimated in ① through ⑤ above is compiled in Table 2.5-4.

Table 2.5-4 Annual Consumption of Mangrove Wood in the Master Plan Area

(Unit: tons)	
Purpose of Use	Annual Consumption
Construction Logs	328.3
Fencing Posts	45.8
Firewood for Cooking	12,638.0
Firewood for Shellfish Processing	6,497.0
Firewood for Smoking of Ethomarose	3,426.0
Total	22,935.1

In addition to the purposes of use described above, mangrove wood is also used for firewood for the production of lime by burning shells and firewood for bread making at the bakery in every village. However, as the consumption for these purposes was considered to be very small based on existing data, etc., it was not estimated for the present purposes. In island areas, the use of cement as a building material is increasing. As a result, the consumption of mangrove for construction timber and for firewood for

lime production is expected to decrease in the coming years. In contrast, the consumption of mangrove for firewood for the smoking of ethomrose is expected to increase.

2) Use of Forest Products Other Than Mangrove Wood

Forest products other than mangrove wood include plant leaves and roots used for medicinal purposes, branches and leaves used for squid fishing and tannin from bark used as a dye. As shown in Table 2.5-5, the intensity of use of these non-wood forest products is not high.

Table 2.5-5 Utilisation of Non-Wood Products from Mangrove Forests

Nature of Utilisation	Utilisation Ratio by Gender	
	Male	Female
Leaves for medicinal purposes	21.4%	22.8%
Roots for medicinal purposes	11.6%	10.2%
Branches and leaves for squid fishing	0.8%	1.9%
Tannin from bark as a dye	4.8%	2.6%
Others	2.2%	1.6%

3) Apiculture

Although mangrove forests are used for apiculture, only 7.8% of male household heads and 2.7% of female household heads say that they conduct apiculture. Among these, 45.7% of male household heads and 16.7% of female household heads conduct modern apiculture, making it difficult to say that modern apiculture has been spread locally. The traditional collection of honey involves the use of a hollowed palm tree trunk as a beehive and burning of the branches and leaves of a tree trunk with a beehive to generate smoke to dispel the bees. The trees themselves are sometimes cut down. Trees are obviously damaged by such practices. In contrast, modern apiculture involves the setting up of wooden beehives in forests and the collection of honey from these beehives without damaging the trees. Accordingly, the extension of modern apiculture should be aimed at in the future to obtain cash income without causing tree damage. The reason for the slow extension of modern apiculture is that funding is required for such equipment as the wooden beehives, protective face masks and protective clothing. Nevertheless, local residents appear to understand that apiculture can be a source of cash income by word of mouth as 39.3% of male household heads and 31.8% of their wives who are not currently engaged in apiculture show an interest in apiculture using mangrove forests.

4) Cutting of Mangrove Forests and Sale of Wood

Even though the cutting of mangrove forests is, in principle, prohibited, the reality is that cutting by local residents is continuing. The average figure for those stating that they continue to cut mangrove trees in the target villages of the questionnaire survey is 39.2% for the male household heads and 36.1% for their senior wives, indicating continued cutting by many local residents. By rural community (RC), the ratio of those still conducting cutting in villages in island areas is high for both males and females. The actual figures for male household heads in RC Bassoul, RC Dionouar and RC Djirnda are 41.7%, 51.1% and 60.5% respectively. The corresponding figures for their senior wives are 55.0%, 43.9% and 60.9%.

The most popular reason cited for continued cutting is “for self-consumption”. However, 10.5% of the male household heads and 4.6% of their senior wives in the target villages of the questionnaire survey replied either “for sale” or “for self-consumption or for sale”, indicating the reality that cutting for the purpose of selling mangrove wood is still continuing.

In regard to the sales price, the mean volume per log was established to be 0.007 m³ by multiplying the radius calculated from the mean circumferential length by the mean log length. This volume was converted to a weight of 0.01 tons. According to the interview results, the price per log at the mangrove market in Kaolack is 600 FCFA – 800 FCFA/log and, for the purposes of this report, the price of a log weighing 0.01 tons is assumed to be 700 FCFA.

The price of mangrove used for firewood is calculated to be approximately 20 FCFA/kg of firewood based on the relevant questionnaire survey results. Accordingly, the price per ton is 20,000 FCFA.

(4) Perception of Mangrove Forests Among Local Residents

1) Perception of Changing State of Mangrove Forests

While mangrove forests are said to be gradually depleting, the perception of the changing state of mangrove forests since the 1970’s among local residents is shown in Table 2.5-6 in the form of statistics.

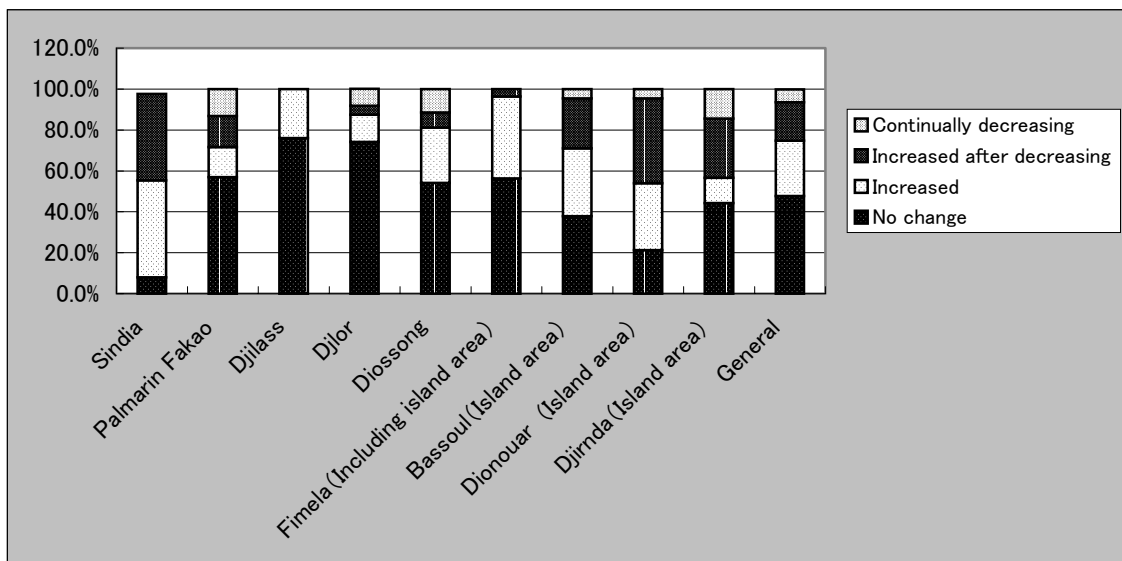


Fig. 2.5-1 Perception of Changes of Mangrove Forests Among Local Residents by RC

In general, nearly half of the respondents perceive mangrove forests to be continually decreasing. When divided into those in the island area and those in the mainland area, the ratios of such answers as “increased recently after decreasing” and “increased” are relatively high among the respondents in the island area. In contrast, the answer selected by the majority of the respondents in the mainland area is “continually decreasing” except for those in RC Sindia where mangrove forests still exist along the shoreline. These answers indicate the progress of the degradation of mangrove forests in villages in the mainland area and the full awareness of this situation among local residents.

The causes of degradation are firstly “decline of the rainfall” and secondly “cutting”. Even though “decline of the rainfall”, which is a natural phenomenon, is primarily responsible for degradation, local residents are fully aware of the fact that “cutting” as a man-made factor is also causing the degradation of mangrove forests.

In regard to the impacts of the depletion of mangrove forests, there is a gender difference on what impacts are recognised. Among male household heads, the largest impact is “decline of the catch” while female respondents point out “a decline of oysters and shellfish”. These answers reflect the fact that local residents empirically have a sense of familiarity of the impacts in question through their own productive activities.

The preferred measures to combat the depletion of mangrove forests are “planting” firstly and “the prohibition of cutting” secondly for both men and women.

2) Planting Activities

More than half of both the male and female respondents selected “planting” as a mangrove forest conservation measure. In contrast, only 26.3% of the male household heads and 21.1% of their senior wives have ever been involved in planting activities. Out of those with experience of planting, 40.8% of the male household heads have participated as individuals while 31.9% of their senior wives have participated as a member of a GPF with another 30.8% as individuals. These figures suggest that women are involved in planting activities as members of an organization as well as individuals.

The relatively low level of participation in the order of 20% implies that mangrove planting activities are not yet perceived as an issue for an entire village. The key point to translate the general interest in the planting of mangrove to real action is to find a way to make such planting a village-wide activity. Among those who have participated in the planting of mangrove in the past, 96.0% of the male household heads and 96.6% of their senior wives expressed a willingness to continue such activities. Meanwhile, both groups point out such problems as “lack of education for villagers”, “insufficient diffusion of skills” and “insufficient means of transportation of viviparous seeds”. Concrete measures to solve these problems must be found in the coming years.

3) Awareness of Importance of Mangrove Forests

98.8% of both male household heads and their senior wives consider mangrove forests to be important. The reasons given are “habitat for fish and shellfish” (51.7% of male household heads and 45.8% of their senior wives) and “supply source of logs and firewood” (34.7% of male household heads and 44.2% of their senior wives).

The questionnaire survey results indicate the present situation where local residents continue to utilise the resources of mangrove forests while recognising the degradation of these forests and being aware of the need for their conservation. The simple prohibition of the utilisation of mangrove forest resources, such as the collection of firewood, by local residents will not achieve a proper understanding among them, making the successful conservation of the mangrove ecosystem hardly likely. If the sustainable management of mangrove forests is to be conducted in a participatory manner, an effective approach is “to conserve mangrove forests as supply sources of the resources necessary for life” which have direct implications for the daily lives of local residents with a view to ultimately leading to the conservation of the entire ecosystem.

2.5.3 State of rural communities in the areas under study

Based on the result of the field study centered on rural communities (CR) that have mangrove resources or stand chances for mangrove planting, CR were divided into 5 categories according to their social and economic characteristics. A study on the CR at the community level was carried out as follows.

(1) Overview of the rural communities

- 1) Branch regions of the Saloum and Bagal rivers
(CR Djilor, the villages in No. 6 -14 in A-2-5-9)

Basically the residents are settled farmers whose main crops are peanuts and millets. However, in recent years, the main sources of income are shrimp fishing for men and vegetable cultivation and small shops for women, respectively. In the Saloum branch region, villages have different ethnic groups such as Pular, Serer, Bambara, and Wolof, and forming groups in each village or at the inter-village level would be difficult. In all villages, the WAAME project by NGOs and PAGERNA (Projet Autopromotion et Gestion des Ressources Naturelles au Sine Saloum, a GTZ project, support natural resource management activities including mangrove.

- 2) From Sokone to Missirah
(CR Dioussong and CR Toubakouta, the villages No. 15 and 26 -30 in A-2-5-9)

Compared to the villages in 1), the villages here have a higher portion of the fisheries industry (fishing, and gathering and processing of shellfish) in economic activities. The villages next to the Sangako national forest rely heavily on aquatic resources for economic activities as they have very limited arable land. On the other hand, villages between Bani and Nema Ba, with plenty of arable land and water resources, produce peanuts, grain and vegetables. This is an area that is increasingly engaged in beekeeping in mangrove forests with the support of UICN and PROMER (Projet de promotion des micro-entreprises rurales) and has a beekeeping center in Toubakouta. A majority of the population is of the Serer ethnic group, but some villages have Soce people.

- 3) Saloum island area (Niodior county, the villages in No. 16 – 25 in A-2-5-9)

It is home to the Niominka people, who among the Serer ethnic group engage in fisheries activities. Men engage in fishing that involves seasonal relocation while women undertake shellfish gathering and processing and aquatic resource processing. In areas with arable land and water resources, there is also agriculture, e.g. food production and vegetable cultivation.

In recent years, the making of smoked ethmalose by Guineans began with CR Djirnda as a center, increasing the pressure on mangrove resources.

4) Near Fimela (CR Fimela, CR Palmarin, the villages in No. 1 – 5 in A-2-5-9)

The basic industry is agriculture, with peanuts and millets as main crops. However, fisheries industry (especially in CR Palmarin) and tourism are also major sources of income. Access to basic social and economic infrastructures is in place and a relatively large number of villagers understand French. In this area, in addition to nursery plant fields through Japan's grant aid and other donor- and NGO-led activities, there is a community resident union that engages in environmental protection activities including ones on mangrove.

5) Bétanti island and inside the National Parks
(CR Toubakouta, the villages in No. 31 – 34 in A-2-5-9)

In this area, each village is geographically isolated and the density of villages is low. Most of the villages are in an island and greatly affected by tides. Physical access to these villages is poor and there are few involvements by aid organizations. The major sources of income are fisheries operation for men and shellfish gathering and processing for women, but the production activities shift to agriculture during the rainy season. The area is close to the Gambian border and has close social and economic ties with The Gambia.

(2) State of rural communities (CR)

As stated in "Chapter 2 2.1-2 Social and economic conditions (1) Local municipalities", the rural community (CR) is the key to decentralization that the government of Senegal is promoting and also the municipality that is closest to residents. CR has its own budget based on such sources as poll tax, fines, and other taxes and fees as well as the right to implement it. The development program of CR is called the "Local Development Plan" (PLD: Plan Local de Développement) and is set by field-specific commissions with the President of the Rural Council (Président du Conseil Rural) as head. The seven CRs (Djilor, Diossong, Toubakouta, Fimla, Palmarin, Bassoul, and Djirnda) within the plan area has already a PLD based on the support from such sources as PROCR (Projet de Promotion des Communautés Rurales) , a German project. Based on the needs of residents that were gathered through CR, this PLD is made in a bottom-up fashion. It has also CR's own financial resources and PROCR provides financial assistance to it that is proportional to the CR financial resources. It is hoped that the CR will formulate on its own a feasible development plan and implement it in the future.

With regard to natural resource management, led by the CR Environment Commission and supported by the Forestry Bureau and NGOs, tree planting is often carried out in villages within

the relevant area on an annual basis. These CR include between 100,000 to 300,000 CFA for such purposes as nursery plants and shipping as “tree planting expense” in their annual budget.

(3) Community resident organizations

1) Organizations at the village level

① Women’s groups and natural resource management activities

Women tend to head community activities that do not lead to income or power. Not only formal organizations such as GPF and GIE but also informal women’s groups are actively involved in natural resource management activities. Outside development assistance organizations often support these women’s groups by such means as microcredit and provision of tools and technologies needed for women’s production activities and promote women’s further participation in such activities as tree planting.

In addition to tree planting, in islands where the preservation of mangrove resources is important, UICN has begun involving women in safety and monitoring activities. These women are engaged in work such as shellfish gathering and collecting withered trees in mangrove areas.

② Contribution of youth groups to natural resource management

Many young people, especially female ones, leave the rural areas in the dry season to work in the cities. However, most of them return to their villages in the rainy season to engage in farm work. As the rainy season is also the season for tree planting, the provincial and prefectural forest bureaus provide, as part of Vacances citoyennes (VC), nursery plants to local youth and encourage them to take part in tree planting activities. Some young people plant trees on their own, but most as ASC members engage in the making of community forests and planting in mangrove. The villages where the ASC takes the lead in tree planting activities include Mar Fafaco (VC) , Mbam (VC) , Kamatan (VC) , Gague Cherif, Felane (PAGERNA) , and Niodior (VC) . ASC can be the main implementing agent of tree planting activities in the rainy season. However, it is important to strengthen a partnership between ASC and women’s groups.

ASC saves and manages compensation for labor, revenues from traditional wrestling matches and cultural activities and often invests both labor and funds to the construction of priority infrastructures for rural areas such as healthcare facilities (Case de Santé), elementary school classrooms, and sea embankments. In natural resource

management activities as well, ASC is an organization with potential to provide not only labor but also funds.

2) Local resident unions

Village organizations that share natural resources or problems associated with them often form a local resident union to engage in natural resource management. There are many local resident unions near Fimla in particular and engage in the following activities (cf. A-2-5-10):

① Yungar (including Ndangane, Djilor, and 3 villages in Mar Island):

An organization run by 138 local population groups in 64 villages. It is active in fields such as agriculture, environmental protection (e.g. mangrove planting and preservation, and measures for salt damage), fisheries and education.

② CAREM (Fimla, Djilor, and Simal):

A collective body of 39 women's groups and 2 educated-youth groups in 3 villages. It implements such activities as planting in mangrove, literacy classes, microcredit, and support to the cultivation and processing of vegetables.

③ FIOD (Diofior, Simal, and Roh):

A collective body of 30 GIE in 3 villages. It implements such activities as planting (community forests and mangrove), measures for salt damage, embankment construction (both in a Food-for-Work scheme), support to vegetable cultivation, and literacy classes.

④ ASPROVRECE (Mbam, and activities in 20 villages in vicinity):

A resident organization in Mbam village in Foundiougne district. In cooperation with residents in vicinity, it engages in Rhizophora planting and formation of community forests. The Rhizophora planting in 2004 adopted the technology for dense planting that was introduced by a Japanese-funded pilot project.

All of the organizations above are run by local educated people and youth on a voluntary basis and have people who play leadership roles in villages. Their activities are supported by the Global Environment Facility (FEM) and NGOs (UICN and Horizon 3000) but their sustainability is questionable as they tend to slow down and shrink with the end of outside support.

2.5.4 State of women and the issues they face

(1) Gender Policies on the National Level

1) Compilation of Women's Action Plans

In Senegal, women accounted for 52% of the projected population of 8,347,000 in 1995 and were involved in the national economy at all levels. However, in the social and cultural environment of that country, women are confronted with numerous difficulties that impede their activities and hold back enhancement of their standing in society.

It was against such a background that the Government of Senegal adopted the World Action Programme for Promotion of Women's Status (Programme d'action mondial pour la Promotion de la Femme), which was formulated in Peking in September 1995. Moreover, the government compiled a national plan for improving the standing of women (Plan d'action de la femme) in 1996, with the aims of 'clarifying the immediate and strategic needs of Senegalese women in cities and rural areas.'

This action plan was implemented from 1997 to 2001, and following its compilation, the Senegalese Ministry of Women, Children and Households (Ministere de la Femme, de l'Enfant et de la Famille) took the initiative in coordinating and following up on activities aimed at improving the status of women.

The action plan contained the following five major objectives:

- Raising the economic standing of women;
- Improving the school attendance rate of girls and raising the education standard of women;
- Improving the health status of women and girls;
- Enhancing the role and status of women in society and promoting female participation in economic management and politics; and
- Raising the status of women and reinforcing loan accommodation mechanisms.

2) Gender Policy in the Forest Department

The Ministry of Environmental and Natural Protection, Forest Department – the counterpart agency in the Study – has long been aware of the essential need to promote female participation in forest resource management, and it had established 'women's departments' (volets feminins) in a number of forestry projects and programs and conducted activities from the approach of 'women and forest development' (Femmes et Developpement forestier) even before the above action plan was introduced. Following introduction of the

action plan, it continued to actively promote gender policy and, in September 2001, established the 'Gender and Development' section (Cellule Genre et Developpement) with a view to reassessing previous projects and programs from the viewpoint of gender, staging workshops and conducting other activities to promote learning and expand application of the gender approach both within the Forest Department and beyond.

As a result of the said reassessment, it was found that although the above activities made some improvements regarding women's practical needs (for example, mitigation of labor burden, provision of literacy education, loan accommodation, etc.), they did not necessarily lead to the sustained management of forest resources. For example, mitigation of water drawing labor through the construction of wells and communal faucets, and improvement of access to fundraising through the introduction of micro credit can be raised as specific achievements. On the other hand, communal forests for women's groups, introduced with the aim of mitigating firewood collecting labor, have not been well received by women in terms of forest plantation and management due to their distance from the center of villages. The reason for this failure was that the opinions of women were not adequately reflected when deciding the location of communal forests. In this way, the sustainable management of forest resources is not always successful, and this is because adequate progress is not always made in improving the strategic benefits of women (access to and control of resources and benefits, and participation in the decision-making process). Accordingly, the Forest Department aims to continue work on improving the practical needs of women, while at the same time putting additional effort into improving strategic benefits.

(2) State of women in the area under study and the issues they face

1) Production activities (See A-2-5-9)

Women in the area under study engage in a wide range of production activities: in agriculture, cultivation of peanuts, vegetables, and food crop cultivation in groups; in fisheries, shellfish gathering and processing, and fish processing; and running small shops, and gathering and selling of firewood. Compared to men, they have limited proprietary rights over land necessary for agriculture: for instance, they mostly engage in peanuts cultivation in a part of their husband's peanuts field. In islands with little arable land, the main production activities of women are the gathering, processing and selling of shellfish, and many women try to catch oysters that sell at higher prices than other types of shellfish. The most important factor that limits shellfish gathering is means of transportation: it greatly affects the quantity of shellfish that can be gathered and amount of labor needed. The selling and processing of fresh fish, which is done by many women in both land and islands, are also major sources of income. Other sources of income for women include peanuts cultivation, vegetable cultivation, running small shops, and the gathering and selling

of firewood. Income by such means is not controlled by men but it is directed to household usage such as the purchase of food and everyday items. Women's groups have an easier time in obtaining proprietary rights over land. They engage in cultivation of vegetables and food crops. In some villages, they gather and process shellfish, sell the products jointly, and save revenues for future activities and mutual aid.

2) Other activities

Women carry out water fetching and millet grinding, which constitute the bulk of reproduction activities. These physically demanding duties are major burdens on women. Women also actively engage in unpaid community tasks such as maintenance of public water faucets and constitute the main labor force for tree planting activities.

Division of labor among female members of the family supports a wide range of women's activities. There is a division of labor between mother and daughter, and among wives if the household practices polygamy. There are many ways of exercising it as well. For instance, one of the two wives accompanies her husband who happens to be a fisherman, or moves with him on a seasonal basis for shellfish gathering, while the other wife stays in the village and takes care of the family. In another case, one female family member gathers shellfish while others engage in farming.

3) Constraints on women's organizations

Women have access to funds as several organizations provide microcredit through GIE and GPF as stated in 2.1.2 (5). Some organizations provide credit only to women as they have better repayment rates than men. Thus women tend to have better access to credit than men. However, many loans to women are of small amounts and have short grace periods of 6 months to a year. Most women's groups distribute funds gained through a loan to their members, have them earn revenues by such means as running small businesses, and then pay back the principal and interest to the groups. GIE is functioning actually as a recipient of credit rather than a cooperative of producers. On the other hand, GPF is taking on characteristics of a cooperative as it saves earnings from joint work and sales in its own safe. To improve women's working conditions and income, it is necessary to strengthen the existing organizations, turn individual work gradually into group work, and enhance the functions of product processing and selling.

4) Women and mangrove resources

In the project area, most women gather shellfish within the mangrove area, a production activity related to mangrove resources, to varying degrees. Women are aware of the

correlation between shellfish stock and mangrove resources through their own experience, and seem to have high potential for contributing to environmental conservation activities. However, women also consume mangrove resources through shellfish processing and daily cooking and happen to play a role in the destruction of mangrove resources as well. In recent years, many women start or ask to start making smoked ethmalose, resulting in an increase in the number of collectors of mangrove resources as fuel for women. Women are thus direct and indirect beneficiaries of mangrove, and sustainable mangrove resource management is impossible without their help. To promote women's active involvement in mangrove resource management, it seems critical to carry out educational activities for women and support to women's production activities in mangrove areas.

5) Issues in women's production activities in mangrove areas

As stated above, women's production activities that are closely linked to mangrove are the gathering, processing and selling of shellfish. Even women without property or funds can have access to fish.

Such activities have some elements of group work, but they are as a whole individual or family work. As a result, they are inefficient and end up increasing the consumption of firewood in processing. In selling, dependence on outside merchants tends to be high as it is hard for individuals to sell shellfish products in the urban areas.

The making of smoked ethmalose is also becoming a major production activity of women who live in mangrove areas. Although smokehouses are being built with outside support and increasing in many villages, many women's groups cannot begin production due to a lack of funds. Only women (or groups) with a certain level of capital can enter this business as there is a competition with the Guineans on prices of fresh fish to be smoked.

6) Division of labor among women and the generation gap

Shellfish gathering is a field that even women without resources can enter. However, it entails large workload and high physical risks, and women who have money tend to avoid it. Women who gained capital through such means as microcredit tend to buy processed fish and shellfish from other women and become full-time brokers. Thus division of labor among women is also developing. A typical example of division of labor is as follows: in the making of smoked fish, a woman with capital leads the group, with a supplier of fresh fish (fisherman), a firewood supplier (a woman), suppliers of other work needed for processing (women), and buyers of smoked fish (foreigners such as Guineans). In short, women who can obtain support such as microcredit and those with business acumen are moving away from production and becoming brokers and small business owners, and the

gap between women who have access to credit and those who do not is increasingly permanent.

There is also a generation gap between women over 50 who are “illiterate and conservative” and those in their 30s and 40s who are “literate and reasonable”. The latter have better access to outside support and a more entrepreneurial mindset. The two generations occasionally have a hard time working together due to differences in opinions. There is also a risk of a rivalry or conflict emerging between the two if they have different sources of outside support. It is thus necessary to pay close attention to such differences between generations and make sure that support to women benefits women as a whole, especially women who engage in production work.

2.5.5 Activities of other development assistance organizations

The following are areas of mangrove planting and conservation activities by two NGOs (UICN and WAAME), and GTZ of Germany (See A-2-5-10, 11).

(1) UICN

It engages in a wide range of activities that include not only mangrove planting and conservation but also production activities and BHN-related support including water. To preserve and restore fishery and mangrove resources, it has, in cooperation with residents, set no-fishing zones and seasons, selected planting areas, and established participatory resource preservation plans in 8 villages. In 2001, UICN supported the establishment of the Shore Commission (CP) in line with the national Fisheries Law and Forestry Law, and established the Conference Committee (Cadre de Concertation: CC) at the village level, which is the organization that is above the Shore Commission. The establishment of the two organizations completed the institutional framework for implementing conservation plans but issues in its functions remain unresolved. UICN established CP and CC but does not provide support to their legal procedures and institutional strengthening. UICN’s activities cover a wide area and receive high marks from residents of the villages that receive its support. However, two major issues remain: the number of on-site staff members is insufficient for the number of villages UICN supports, and the NGO finds it difficult to follow up on its assistance.

(2) WAAME

It is an organization founded by people from Foundiougne, and based in the branch areas of Saloum and Bagal rivers (CR Djilor). The EU-backed Mangrove Project (Projet Mangrove) since 2002 has significantly expanded the scale and activities of WAAME. Currently, WAAME provides support to Rhizophora planting and formation of community forests in 65 villages in

4CRs of Djilor, Toubakouta, Bassoul, and Djirnda; in 25 out of the 65 villages, it also provides support to beekeeping and fisheries. The target villages in this project have steering committees for each of the activities. However, since the project has no overall coordinating organization and each activity is done by a different resident group, the link between each activity and mangrove preservation is weak. It was planned at the beginning to provide support to each village through CRs, but the project has failed to involve CRs to a sufficient extent. Currently there is no organization at the CR level. The project is to conclude in August 2005.

(3) The GTZ project

This is a technical-cooperation based project of GTZ that began in 1993 as PAGERNA (Projet Autopromotion et Gestion des Ressources Naturelles au Sine Saloum), aiming at comprehensive resource management of land, water and forests and the strengthening of organizational and institutional aspects needed for such purpose. The project area includes nearly 30 CRs in Fatick and Kaolack regions. The project duration is 12 years. The project has implemented mangrove planting in a few villages in Fatick.

To ensure sustainability after the project period, PAGERNA regards CRs, in line with the Senegalese government's decentralization policy, as the most important partner, and makes it a priority to build their capacities. PAGERNA supports the process of putting together the Development and Management Plan (PAGT), a master plan of resource management activities based on the ideas of the village-level Management Organization System (CAC). PAGERNA also set up small banks with saving and lending functions at the CAC level to devote interest income to resource management activities. GTZ is currently consolidating multiple projects into a single one and in a transition to program-type assistance, launching a new 12-year comprehensive program. As part of this process, in Fatick region, GTZ plans to support natural resource management that succeeds a portion of the PAGERNA activities.

As described above, mangrove planting and preservation activities by UICN and WAAME have already begun in most of the villages in the area under study (see A-2-5-10, 11). These organizations have not coordinated their activities or exchanged information to a sufficient extent although they are engaged in assistance in the same field in the same region and villages. Thus there are risks of increased burdens on residents due to duplication in activities and organizations, and confusion in residents through introduction of different approaches in the same area. Coordination at the prefecture or county level is needed.

(4) Related projects and organizations

In related projects and organizations, PROMER of IFAD (International Fund for Agricultural Development, or FIDA: Fonds International pour le Développement de l'Agriculture) has begun

activities in the prefectures of Foundiougne and Fatick; and the new technology dissemination organization ANCAR (Agence Nationale de Conseil Agricole et Rural) has begun its activities in CR Djilor and CR Toubakouta, respectively. PROMER implements technical training for individuals and organizations, with an emphasis on women and youth, and lends needed funds for small businesses that stand a good chance of turning a profit. The loan conditions are as follows: loan for operating funds is up to 1.5 million CFA and the maximum grace period is 9 months; and loan for investment is up to 3.8 million CFA and the maximum grace period is 3 years. Businesses that are eligible for loans include fish processing, beekeeping and tourism. ANCAR is a government-owned comprehensive agricultural development corporation that provides technical support based on the needs of producers, receives in return a portion of products as compensation and uses it for operating costs. As part of the World Bank's agricultural program, it employs the method above to extend agriculture. ANCAR plans to cover not just agriculture but institutional strengthening, marketing and the fisheries industry.

Moreover, the Global Environment Facility (FEM: Fonds pour l'Environnement Mondial) of UNDP is providing funds to micro projects on environmental preservation in the entire Saloum delta area. WAAME and the resident unions described in 2-5-3(3) are also utilizing this support for mangrove planting and protection. FEM has made "building network of FEM-funded environmental organizations" a new strategy and will promote coordination and cooperation among different organizations from now on.

2.6 Empowerment activities and environmental education

2.6.1 Environmental education in schools

(1) Undertaking by government

1) Environmental Education Program (PFIE)

With the support from the EU, the Senegalese government implemented from 1990 to 2000 the Environmental Education Program (PFIE: Programme de Formation Information pour l'Environnement) that is common to all the countries in the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) with the aim of "understanding the surrounding environment in relation to the individual and social groups, raising awareness on environmental issues, and promoting active involvement in environmental protection".

In implementing PFIE, the following departments were selected as pilot departments: 4 prefecture Education Departments (IDEN: Inspection Départemental de l'Education Nationale) in the first phase (1990 – 1995) and 17 IDEN in the second phase (1997 – 2000). In addition, several PFIE-priority schools were selected in each pilot IDEN.

At PFIE-priority schools, a two-year Environmental Action Plan (PAE: *Projet d'action environnementale*) was set, spelling out solutions and specific actions for regional environmental issues. PAE was implemented in the form of combination of classroom sessions, activities outside schools and practical training. In the formulation, implementation and evaluation of PAE, the participation of residents is promoted and the use of local resources is emphasized. A precondition is that funds and technologies needed for implementing PAE are to be provided locally; and support from PFIE is regarded as strictly supplementary. In addition, each of the PFIE-priority schools has devised a communication strategy, and implemented empowerment activities for residents through theater performance, film screening, and "Ethnic Culture Day".

PFIE is considered a "pilot" undertaking. Ideally, the results of PFIE should be extended in the next phase. However, the extension phase has not been put into practice as support from the donors has ended and the Senegalese government has no funds to implement the phase on its own.

2) PFIE in the area under study

In the area under study, Foundiougne prefecture was selected as a pilot IDEN, and it has been reported that at 17 PFIE-priority schools out of the 127 schools in total, 129 teachers and 5850 students took PFIE. Out of the 17 PFIE-priority schools, 11 are primary schools located in mangrove-area villages. However, no school has implemented a mangrove-themed class or extracurricular or activity on its own ²⁾. In teacher training implemented in PFIE, there is no material on mangrove and no mangrove-related resources have been distributed, either. This is because PFIE is a program common to all CILSS countries: PFIE touches upon such environmental issues as desertification, but it does not deal with the different natural environments of the member countries. Other reasons are as follows: teachers themselves have no capacity or time to formulate a mangrove education plan on the basis of the basic knowledge of environmental education that they acquired through PFIE and the specific regional circumstances; they have no sources of information nearby (resource persons or publications) even if they want to improve themselves; and most teachers are from areas without mangrove and do not have sufficient knowledge of or interest in the subject.

The IDEN in Foundiougne prefecture has begun such activities as dispatch of teachers of PFIE-experienced schools to other schools to extend their PFIE experience and promote formation of school forests. However, now that the program is over, such activities are

2) An elementary school in Gague Cherif took part in 2001, as an extracurricular activity, in mangrove planting that was implemented by a village ASC, but this was not the school's own activity.

shrinking even at PFIE-priority schools, and they are down to the level of planting in schoolyards as an extracurricular activity. The reasons for such state of affairs include: (1) Teachers have no time for setting PAE and integration of environmental education in existing subjects as they are complicated and time-consuming tasks; and (2) During the PFIE implementation there was some money left for PAE implementation, but after the PFIE implementation there is no incentive for PAE. From now on in trying out mangrove-related environmental education, it seems appropriate to take the following approach: find motivated schools and teachers, and, based on them as well as through the existing inter-school network (such as a study group among teachers of different schools) build a system for extending environmental education that suits the local contexts.

(2) Undertaking by NGOs and other organizations

In the area under the plan, two NGOs, namely WAAME and SAPAD, have carried out environmental education activities. WAAME has carried out a drawing competition for elementary school students on the theme of mangrove areas to grasp how children perceive mangrove and look more deeply into the submitted drawings as a theme of environmental education. SAPAD is implementing, as part of participatory management of the “sacred forest” next to the training center ground, an observation tour of the forest on various themes for elementary school teachers and students in vicinity. The NGO also has the logical assistance strategy of inviting teachers to an eco-guide education course and training them on environmental education at the same time.

In environmental education on mangrove conservation, JOCV has also implemented a picture-story show for students in the classroom and field trips to mangrove planting. Exchange field trips between students from areas with rich mangrove and those from areas that have lost mangrove have a major impact as educational activity for students and teachers and they should continue. Given the density of JOCV volunteers in Foundiougne prefecture, such field trips have high potential for enhancing ties among the current JOCV volunteers as well as developing ties with the next generation of volunteers.

Moreover, ASPROVRECE, an organization of residents in Mbam village, is making, as part of environmental education, a nursery field in the village’s elementary school as a basis for extending such practice to elementary schools in other villages.

2.6.2 Empowerment activities for residents

(1) Sports and cultural activities in farm villages

As empowerment activities for residents of farm villages, it would make sense to take advantage of the following sports and cultural activities that take place annually either within a single village or among several villages and attract a large number of residents in vicinity.

1) Traditional wrestling competition

Along with football, wrestling is a highly popular sport in Senegal. The annual wrestling competition is held in villages in the dry season (January to June) for a period of three days to a week. During the competition, many villagers come home and many others also come from neighboring villages, providing an excellent opportunity for empowerment activities.

2) Football tournaments

Football tournaments are held every year during the rainy season of August and September, organized by such entities as ASC, local ASC unions and CR, at various levels including prefecture, CR and village. These occasions can be used as a forum to send a message to youth and, since they are held in the rainy season, an opportunity to get village ASCs involved in planting activities.

3) Theater

Theatrical and ethnic evenings are usually organized around young women of villages. There are many folk theater companies in the area under study, and well-known local theater companies are occasionally summoned from Dakar. Many of the performance themes are educational: they include environmental issues (e.g. planting and garbage), AIDS, family planning, and female circumcision. Theater seems an effective means of empowerment as it is a medium that sends a direct message to residents, and also works as a form of entertainment.

(2) Vacances citoyennes

At the initiative of President Wade, the new administration that came to power in 2000 has introduced a youth activity called Vacances citoyennes (VC) that advocates “planting” and “cultivation of the spirit to work the soil” as countermeasures for desertification and move of youth to the urban areas, which are important issues that farm villages face. VC is held every year in the rainy season at sites of the national and municipal levels. In municipalities within Foundiougne prefecture, mangrove planting as part of VC was carried out in 2000 and 2001 in cooperation with WAAME: 5,600 trees were planted in 2000 in Mbam, Djilor, Toubakouta, and

Sokone; 17,600 trees in 2001 in Fayako and Gague Cherif. In Foundiougne district in 2002, and Toubakouta district in 2004, mangrove planting through VC continues. VC is worth noting as an empowerment activity for youth who take the areas into the future as well as an environmental protection activity through a partnership of government, municipalities and the private sector (including NGOs).

(3) Empowerment activities that have been implemented so far

Regional radio broadcast :

On the Fatick FM station, UICN and GTZ air such contents as PR of project activities, environmental issues as a whole, and discussions with residents of the project activity area, in the Serer language. The radio is a widely disseminated medium that can be used for the illiterate as well. Through the FM radio, the head of the Fatick regional Forest Bureau promotes participation in planting activities and measures to prevent and put out forest fires.

Forums :

UICN and Yungar hold forums on specific environmental issues. Such forums serve as an active means of disseminating knowledge as they carry out in-depth discussions on the themes and enable participants to exchange views. However, the number of participants is limited and it will be up to the participants to disseminate information.

Football matches :

WAAME holds football matches with prizes in Log district. In halftime a message is put forward, introducing WAAME's activities and advocating environmental protection.

Traditional wrestling matches :

WAAME holds wrestling matches with prizes in various villages. Matches also take the time to introduce WAAME's activities and promote environmental protection.

Ethnic theater :

In cooperation with the theater company in Mbam mentioned above, WAAME puts up theatrical performance on mangrove and trees in Mbam, Bassoul, and Foundiougne on Environment Day.

Youth gatherings:

The Fatick regional Forest Bureau holds festivals to express gratitude to the work of youth who take part in planting activities in the rainy season. There are many events that are reported on TV.

2.7 Oceanographic Condition and Coastal Erosion Survey

2.7.1 Oceanographic Condition Survey

A survey on the sea conditions regarding the flow regime, water quality (salinity and dissolved oxygen), bed materials and tide level was conducted at the Saloum Delta to clarify the current conditions of the salinity of river water affecting the survival rate and speed of growth of planted mangrove and of the sea water movement, water temperature, salinity and dissolved oxygen, etc. affecting the reproduction and growth of oysters.

(1) Flow Regime

A floating buoy was used at the time of both high tide and low tide during the flood tide periods in the dry season (February and June) and the rainy season (August and November) in 2002 to determine the flow direction and flow velocity of river water. The measurement results show similar tendencies in both the dry season and the rainy season. The observed flow velocity of the river water of each river was 0.1 – 1.2 m/sec for the section from the lowerstream to the midstream and 0 – 0.5 m/sec for the section from the midstream to the upstream, showing a slower velocity in the upstream. The flow direction depends on the change of the tide.

(2) Water Quality

• Salinity

The salinity of the surface layer (0.5 m below the water surface) and bottom layer (0.5 m above the river (sea) bed) at the time of both high tide and low tide during the flood tide periods in the dry season (February and June) and the rainy season (August and November) in 2002 was 40 ppt at the some 20 km point from the mouth of Saloum River, 103 ppt at Kaolack located some 110 km from the river mouth and 131 ppt at Fatick located some 80 km from the mouth of a north tributary. To be more precise, the level of salinity in the rainy season is lower than that in the dry season. The actual figures recorded were 40 ppt at a point some 40 km from the mouth of Saloum River, 70 ppt at Kaolack and 65 ppt at Fatick. Longitudinal changes of the salinity show that the increasing tendency of salinity towards the upstream in the dry season is more prominent with tributaries rather than the main stream, reaching a peak in June at the end of the dry season. In the rainy season, there is

little difference between the main stream and tributaries in regard to the increasing tendency of salinity towards the upstream. This tendency is least observed in November at the end of the rainy season. Both the highest level of salinity of 130 ppt in the dry season (June, 2002) and the lowest level of salinity of 67 ppt in the rainy season (November, 2002) observed under the present Study are slightly higher than the corresponding figures of 110 ppt and 60 ppt observed in 1982 (E.S. Diop, 1990). When the distribution of mangrove forests produced by analysis of the Landsat satellite image (taken on 18th April, 2002) is overlaid on the distribution map of salinity in the dry season (average of the figures for January and June, 2002), the growth of mangrove cannot be verified in areas where the average salinity in the dry season exceeds 70 ppt, indicating that a salinity level of approximately 60 ppt (6‰) constitutes the survival limit for mangrove.

(3) Dissolved Oxygen

The timing of a survey or the location of a survey appears to have hardly any effect on the level of dissolved oxygen. The oxygen saturation ratio is 9.7 – 127% (average of 69%) in February and 30 – 96% (average of 70%) in June in the dry season and 32 – 98% (average of 65%) in August and 31 – 146% (average of 73%) in November in the rainy season. The state of anoxia at the bottom layer is not found at any site.

(4) Base Materials

The principal base material is mud or mud mixed with sand at places where mangrove grow or sand at nearby places where mangrove do not grow. The base materials near places of mangrove growth show an anaerobic environment below several centimetres from the bed surface and a sulphurous odour can be observed.

(5) Tide Level

The tide level observation results using a staff gauge at three points in February in the dry season and November in the rainy season show that the tide level changes at roughly a half day cycle in both February and November. The difference between the tide levels during the flood tide period is 1.65 m (0.25 – 1.90 m) in February and 1.57 m (0.45 – 2.02 m) in November at Djifer near the sea, 1.87 m (0.10 – 1.97 m) in February and 1.99 m (0.09 – 2.08 m) in November at Toubakouta and 0.75 m (0.25 – 1.00 m) in February and 0.80 m (0.30 – 1.10 m) in November at Foundiougne located some 45 km from the river mouth. Compared to changes of the tide level at Dakar, those at the local observation points are delayed by approximately one hour at Djifer and Toubakouta and by approximately three hours at Foundiougne.

2.7.2 Coastal Erosion Survey

In regard to the situation of coastal erosion at Petit Côte stretching from Mbour to the mouth of Saloum River in the Study Area, the changing situation of the coastal topography over a long period of time was interpreted using LANDSAT satellite images taken in 1972 and 2002 as well as aerial photographs taken in 1989. Based on the interpretation results, a survey was conducted on the situation and causes of coastal erosion, state of growth of mangrove forests in the hinterland, present situation of the coast and conditions of the waves, etc. at the coast where the trend of erosion appears to have been intensifying in recent years.

The survey results show that coastal erosion often has a human cause (collection of sea sand) in the section from Somone to Point Sarene. Other types of damage at this section include the collapse of houses and the loss of farmland. Meanwhile, the shoreline from Palmarin to Niodior has generally receded by more than 100 m in the last 30 years.

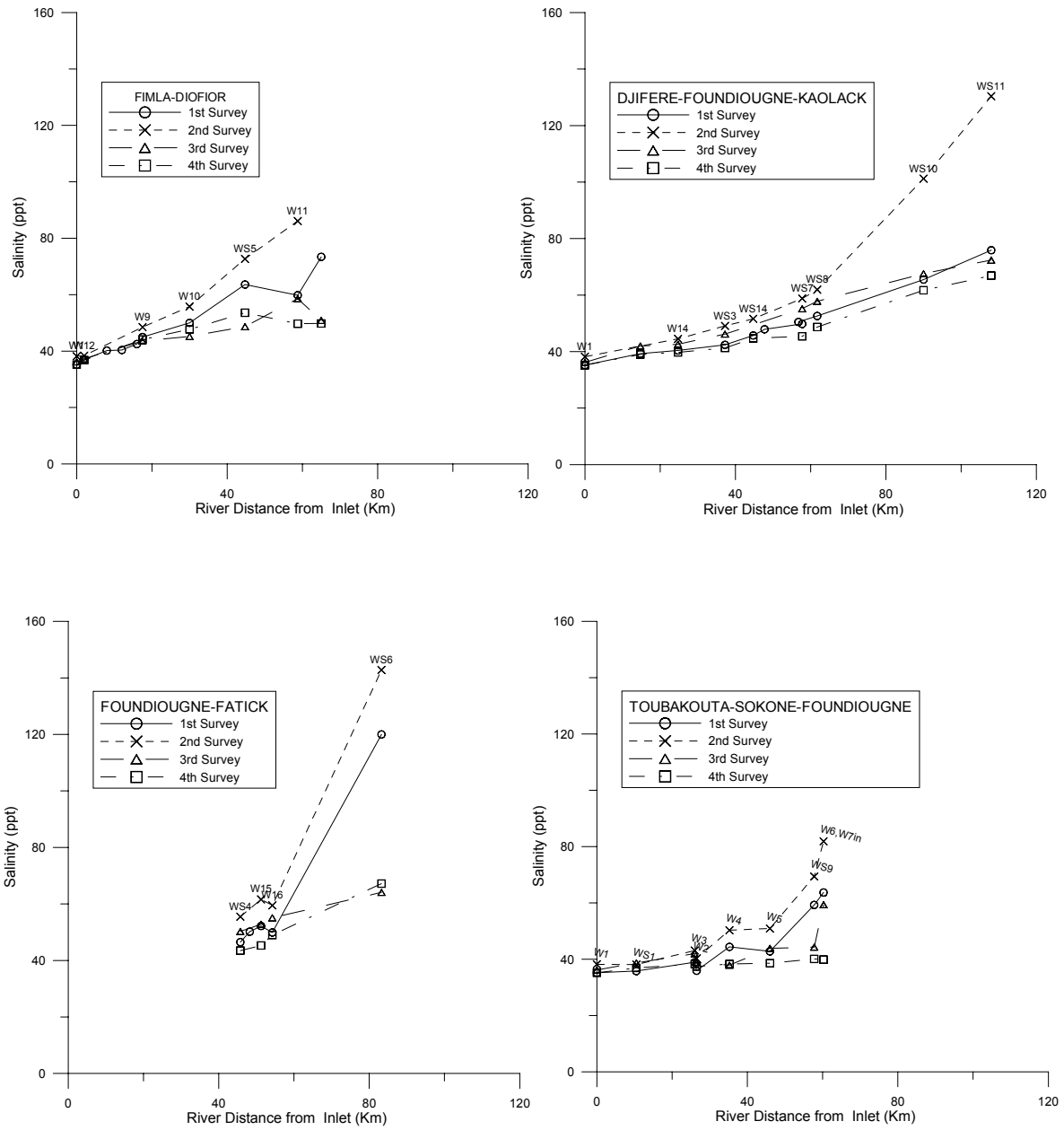


Fig. 2.7-1 Changes of Salinity According to Distance from River Mouth

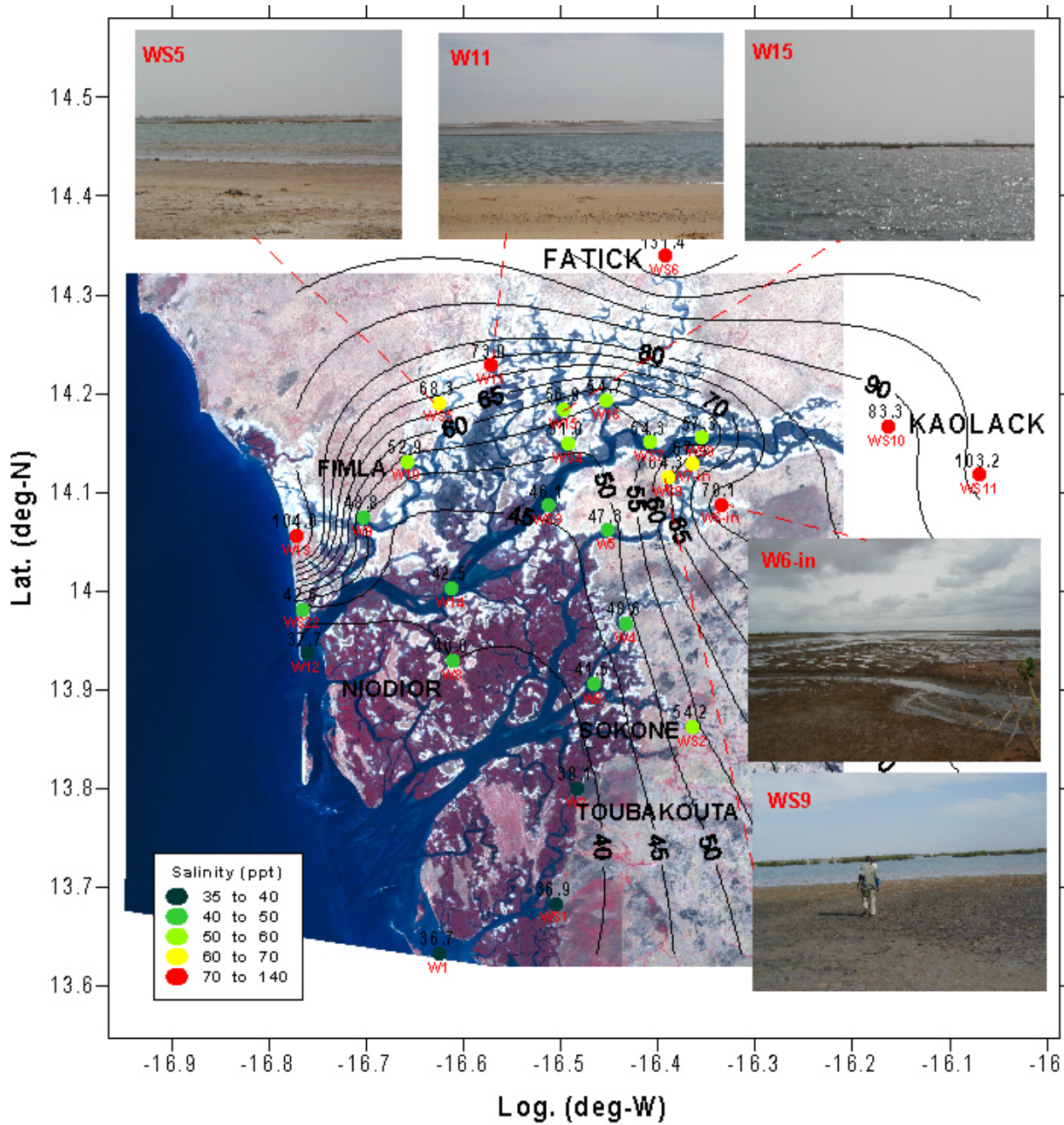


Fig. 2.7-2 Distribution of Mangrove Forests and Salinity in the Dry Season in the Saloum Delta

- * Landsat TM Image (taken on 18th April, 2002)
- * Reddish brown area: dense mangrove area

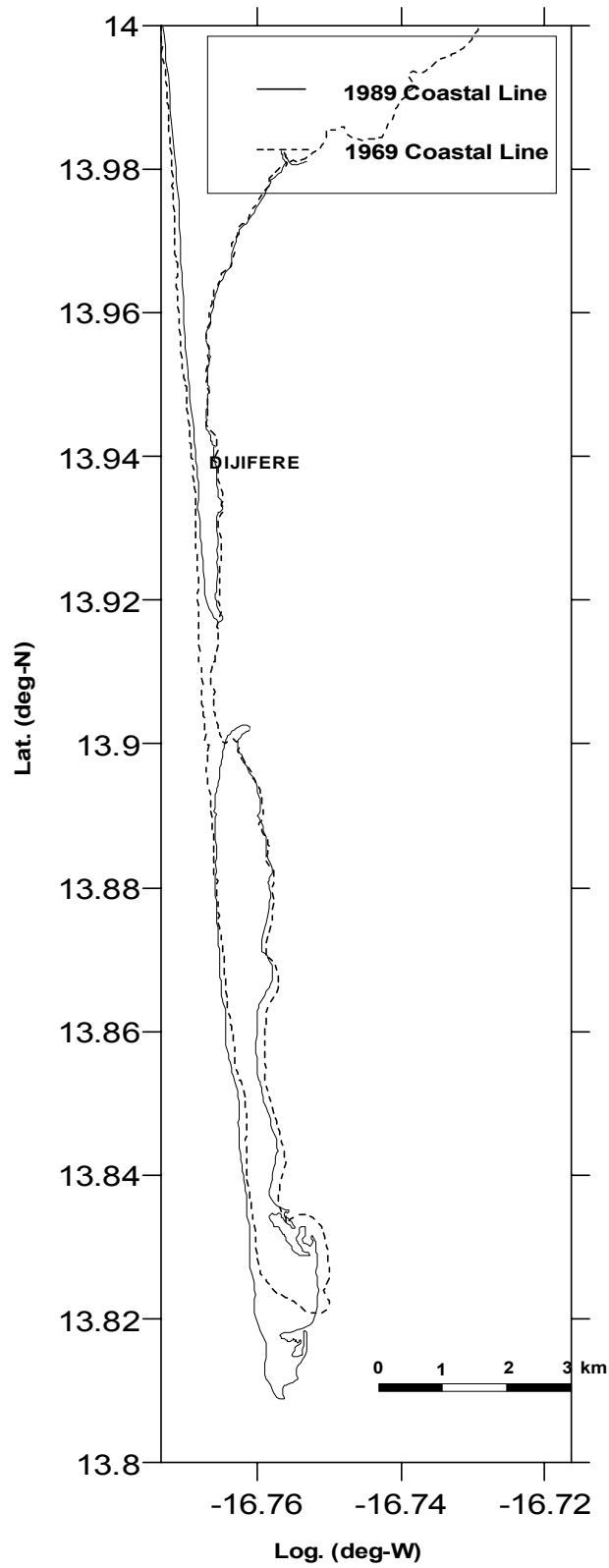


Fig. 2.7-3 Changes of the Shoreline in 20 Years Based on Aerial Photographs (1969 – 1989)

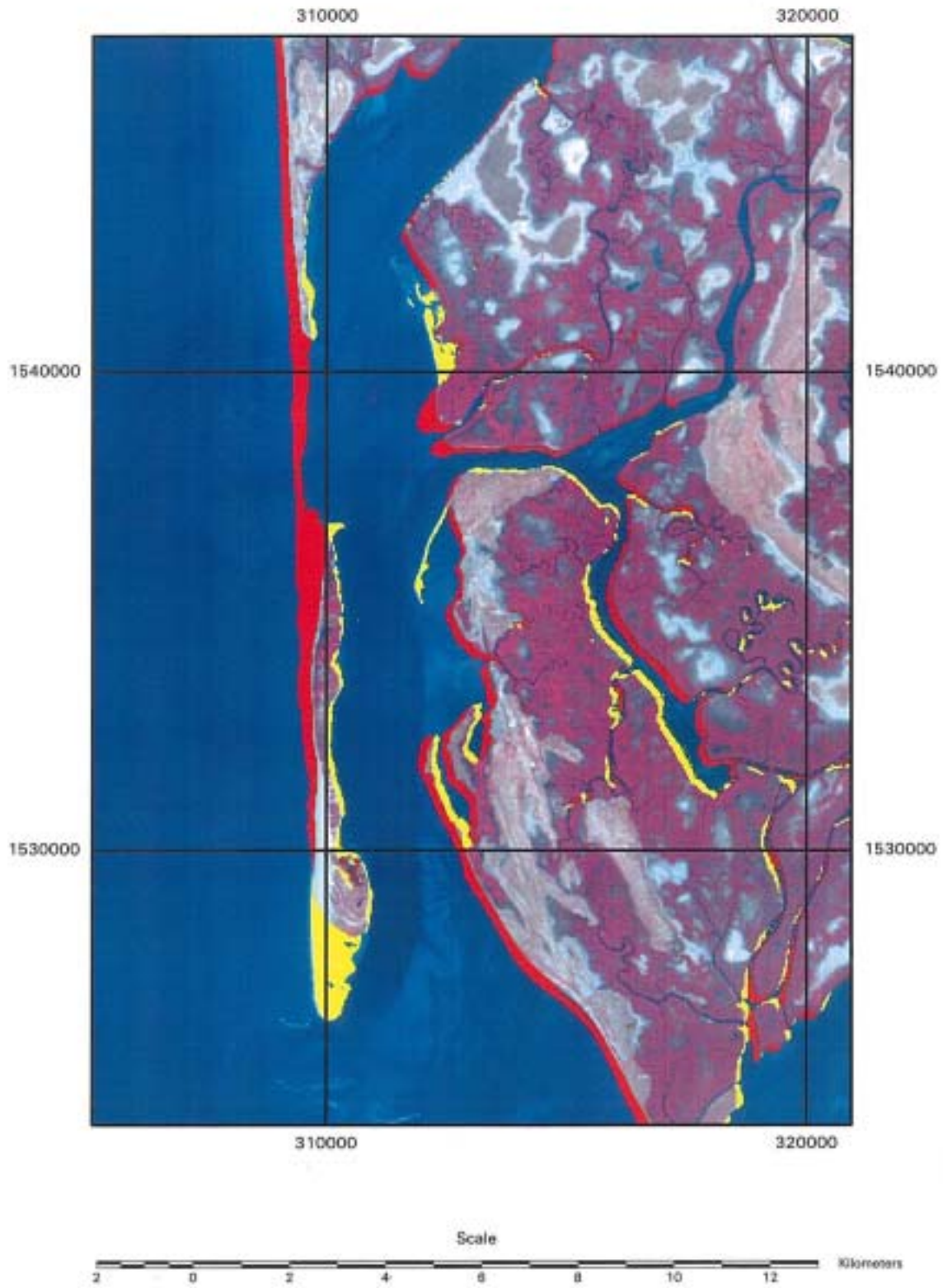


Fig. 2.7-4 Changes of the Shoreline in 30 Years Based on Landsat Images

2.8 Socio-Economic Evaluation of Mangrove Forests

2.8.1 Diversified use of mangrove

The mangrove is utilized as building material and firewood. A variety of Non-Timber Forest Products (NTFPs) are also derived from the mangrove, including honey, tannic acid for animal skin tanning, medicine, dye, and wine.

Generally, the forest, the mangrove being one of them, is recognized to contribute the welfare and benefit of human beings in many different ways, as follows:

- Preserving rural landscape and recreational amenities
- Nurturing fisheries resources
- Soil erosion and landslide prevention
- Water purification
- Air Purification – CO₂ sequestration and oxygen supply
- Conservation of biodiversity

2.8.2 Framework for analysis

In this report, an attempt will be made to measure the socio-economic value of the entire mangrove forest in the Saloum Delta of Senegal as an aggregate environmental good. Since the impact of environmental goods is extensive and long lasting, a framework for the evaluation of the mangrove needs to be made clear prior to analysis.

(1) How far we go?

In measuring the value of the mangrove as an environmental good, analysis will be carried out under the conditions that omnipresent surroundings such as water, air and sun are given and outside of the framework

(2) Impact on the local economy

Value of the mangrove that has been computed in another country cannot be immediately applied to Senegal. Rather its socio-economic impact on the economy of Senegal will be looked at. Value that have been identified or is highly likely to realize will be computed.

The latest World Bank Development Indicators (Year 2004) shows that GNI of the country is about US\$ 470, which is a little above the average of the Sub-Sahara countries, but still among

the low-income group, globally. Analysis within the framework of Senegal will certainly reflect this income level in evaluation.

(3) **Mutual exclusivity**

One ought to bear in mind that one way of evaluation may not be independent of others. Willingness to Pay (WTP) for the mangrove has been assessed by way of questionnaires with selected residents of the Delta. When answering the questions, they must have taken into account all the benefits derived from the mangrove. It would be therefore to double count if the WTP value were added to another value.

(4) **Conservative estimate**

In evaluating environmental goods, one often has to make an estimate and/or guess of costs and benefits. When a band of value is detected, one has to be conservative, namely adopting the lower end for benefits of the band and higher end for costs.

2.8.3 Methodology

A number of literatures has presented by scholars and experts regarding the evaluation of environmental goods. Dr. Dennis M. King and Dr. Marisa Mazzotta describe methods that are employed to estimate economic values associated with ecosystems. (“Ecosystem Valuation! ”, Dennis M. King and Marisa Mazzotta) The following 8 appraisal methods are identified:

(1) **Market Price Method**

- Evaluate goods as bought and sold in commercial markets.

(2) **Productivity Method**

- Evaluate environmental goods in accordance with contribution to the production of marketable goods.

(3) **Hedonic Pricing Method**

- Evaluate goods as they affect market prices of some other goods, such as housing prices.

(4) **Travel Cost Method**

- Evaluate environmental goods as a travel cost people are willing to pay to visit the site used for recreation.

(5) Damage Cost Avoided, Replacement Cost, and Substitute Cost Methods

- Based on costs of providing substitute services.

(6) Contingent Valuation Method

- Based on willingness to pay (WTP) for specific environmental services.

(7) Contingent Choice Method

- Based on tradeoffs among sets of environmental services.

(8) Benefit Transfer Method

- By transferring existing benefit estimates from another studies.

In this study, the different methods are adopted to make the diversified use of mangrove clear and quantify it accurately as possible. Concretely saying, the market price method will be applied to Timber and Non-timber forestry products of the mangrove, the productivity method to fisheries and tourism, and the substitute cost methods to some others. WTP shall be calculated based on questionnaire collected from residents (Contingent valuation method). Attention needs to be paid the issue of mutual exclusivity.

2.8.4 Diversified use of mangrove

(1) Timber and non-timber forest products

There exist markets for timbers (logs and firewood) and non-timber forestry products such as tannin, honey, medicine, and alcohol products. It would be straightforward to evaluate these products through the market system.

Only timber products and honey are included in evaluation, as other NTFPs are not produced currently nor planed to produce.

(2) Nurturing fisheries resources

There is no doubt that the mangrove contributes significantly to fisheries resources in the Delta, providing spawning and nursery grounds, nourishing the water by shedding leaves and twigs, enriching the water with droppings of birds that come to rest on the it. This knowledge does not cause one to easily evaluate and quantify the impact of the mangrove upon the fisheries production. Nonetheless, one can say:

- The disappearance of all the mangroves in the Delta would do a devastating damage upon oysters that live on mangrove roots.
- If the mangrove forests ever vanish completely in the Saloum Delta, fishery resources would be almost extinct.
- Concerning marine fishery production in the coastal waters adjacent to the Delta , a damage function will be tested to indicate relationship between depleted mangroves and reduced fishery resources.

(3) Tourism resources

The existence of vast mangrove resources is the prime reason to make the Saloum Delta as an established tourist destination in Senegal. To measure the extent of mangrove's contribution to tourism in the country, thus its economic value in tourism industry, the question to be asked is, "What would happen to tourism if all the mangrove forests disappeared". The value as tourism resources could be tested based on the responses of it .

Fatick region was estimated to generate about FCFA 3.7 billion from tourism in year 2002. In addition, tourists visit the region on daily excursion from Thies and Dakar. If the mangrove were to vanish completely in the Delta, there might be no tourism revenue in the region. However, considering a possible effect of substitution within the national economy of Senegal, the entire revenue may not be lost. Ziguinchor with resources similar to those in Saloum Delta or Saint Louis with little mangrove but sits along the coast, might serve as alternative tourist sites, thereby retaining part of the tourism revenue that Fatick could have lost completely. Tourist on excursions might be diverted to different destinations. Substitution effect is unlikely to happen to the circular tours of Senegal.

(4) Prevention of coastal erosion

Coastal erosion is caused by a number of different factors; climatic conditions such as wind direction, wind force and precipitation, volume and timing of sedimentation. The whole process of coastal erosion has not been thoroughly known. One can say convincingly that the mangrove prevents coastal erosion, but the level of its contribution to the prevention is not clear. Even if coastal erosion has taken place after the felling of mangrove forests along the coast, planting of the mangrove does not warrant the prevention of coastal erosion.

In addition to these technical issues, economic aspect needs to be looked at. As referred to above, in quantifying direct and/or indirect economic benefits, the occurrence of these benefits within Senegalese economy should be expected with reasonable likelihood.

The presumption in attributing economic value to the mangrove for erosion prevention is that as the mangrove goes away, erosion proceeds and erosion control measures must be initiated. The existence of the mangrove would save the costs of the measures that would have incurred without the mangrove. Hence these costs can be attributed to the mangrove as the value of its erosion prevention function.

Whether it can be also applied in Senegal is probably judged by the decision of national economic policy makers when erosion is imminent. In other words, it depends on an expected return of the required investment.

This study team supposes that given limited economic resources available, the decision makers are highly unlikely to divert the scarce resources for the prevention of erosion in the Delta. It is more realistic to assume that they would accept the erosion as force majeure and would allot the resources for something else.

In the Fatick region, more serious damage has been caused by salt. According to the agriculture officials, about one-third of the land in the region has been affected, about 200,000 to 300,000ha of farmlands have been put out of service, and, because of on-going salt attack, rice, the second biggest import, cannot be cultivated on islands in the Delta.

However, there has been no record to show that the mangrove reduces the salinity content of the water; rather, higher level of salinity has reportedly destroyed mangrove forests in the Delta. As such, no benefits of the mangrove against salt attack would be enumerated.

(5) Water purification

The mangrove impounds unsuitable substances in the water, and prevents it from contamination, thereby purifying the water. The reduction or loss of mangrove forests would conceivably bring down the operational efficiency of its water purification mechanism, and the water quality in the sea and rivers would soon become deteriorated in the Saloum Delta.

A normal evaluation practice is to similarly assume that the mangrove saves the construction and operating costs of waterworks, which would be required without the mangrove. Following the same reasoning for the coastal erosion, no attempt will be undertaken to quantify this function on the ground of scarcity of economic resources in the country.

(6) Carbon dioxide (CO₂) sequestration

It is now globally recognized that carbon sequestration by the forest is effective in checking global warming. The monetary evaluation of carbon sequestration has been tested through some

studies commissioned by international organizations like the Intergovernmental Panel on Climate Change (IPCC), and some prices have been quoted for sequestered carbon under nascent trading systems. Calculating standard is biomass created by mangrove forests and evaluation cost per ton.

However such pricing through trading is applicable only to newly planted forests at the moment. There is no sign of trading activity for the existing mangrove forests under the study.

The vast mangrove forests in the Delta do undoubtedly contribute to carbon sequestration. It may be possible to provisionally compute the value of the mangrove forests in reference to that of new forests. Nonetheless, actual benefit inflow into the country is unlikely to take place in the near future. As such, only tentative evaluation will be attempted below.

(7) Conservation of biodiversity

Biodiversity will be reflected in estimating the “Willingness To Pay” through questionnaires to some of residents in the Delta.

WTP to be estimated will incorporate all the value, including that of biodiversity, to be accorded by the residents, and should not therefore add up with any other.

2.8.5 Estimate of socio-economic value of the mangrove

(1) Timber and non-timber forest products

Latest production volume and sales are shown in the table below with the total production of 22,938mt and sales of FCFA482 million.

	Production (ton)	Sales (FCFA'000)
Timbers	375.7	26,299
Firewood	22,561	451,220
Honey	1.5	4,500
Total	22,938	482,019

• Data of timbers is adjusted by 10% upward in consideration of self-consumption. Data of firewood needs no adjustment because it is included the amount of firewood consumption in whole Delta

(2) Nurturing fisheries resources

1) Oyster

A total of 22,700-dozen raw oysters were recently shipped from the Delta at unit price of FCFA 1,250 or total of FCFA 28.375 million, excluding oysters cultured in Joal. Assuming an average weight of 50 grams per piece, their total weight comes to 13,620 kg. Of overall oyster production (22,250 kg) in Fatick, the remaining balance of 8,630 kg is processed. Considering a 20% weight loss during processing and unit price of FCFA 1,500/kg, the processed oysters must fetch FCFA 10.356 million. The extinction of the mangrove would sweep the revenues of FCFA 38.73million (FCFA 28.375million + FCFA 10.36million) away entirely.

2) Inland fishery in the Saloum Delta

As referred to above, the concerned fishery officials believe that the loss of the mangrove would virtually result in the extinction of fishery resources in the Delta. The Fatick region produced 18,023 mt of aquatic products valued at FCFA 4,641 million in year 2002, of which inland fishery is estimated, after deducting 3,165 mt (or FCFA 2,558 million) landed at the Djifer port, to account for 14,859 mt with the value of FCFA 2,083 million. Considering that there would be some fish as long as the water exists even after the extinction of the mangrove and that some marine fish have been landed in ports other than Djifer, the estimated loss is adjusted by 25% downward to FCFA 1,562 million (75% x FCFA 2,083 million).

3) Marine fishery

To project the damage to marine fishery, the parameter of the damage function will be set at 0.1 and 0.25 for the fish landing (3,165 mt, FCFA 2,558 million) in the previous section, assuming a 10% fall in landing at the Djifer fishery port and a 25% drop respectively. This brings about an estimated damage between CAF 256 million and 639 million.

Combining the numbers above, the value of fishery products to be lost as a result of mangrove disappearance is estimated as follows:

Oyster	→	FCFA 39 million
Inland fishery	→	FCFA 1,562 million
Marine fishery	→	FCFA 256 to 639 million
<hr/>		
Total	→	FCFA 1,857 to 2,241 million

(3) Tourism resources

1) Tourism revenue in Fatick

In year 2002, the Fatick region received 23,565 non-residents, earning estimated FCFA 3,722 million.

2) Receipts from excursion

According to informed local sources, daily arrival of tourists on day trip is about 20 in Ndangane and one hundred in Djifer during the tourism season, which probably includes those from the Fatick region. With a 50% reduction, monthly arrival of excursion tourists in season is conservatively estimated at 1,800 (30days x 50% of 120pax). With further 50% reduction for off-peak season, an estimated annual arrival is 16,200 (6 months x 1,800pax + 6 months x 900pax). This estimate is equivalent to 2.1% of the total arrival in Dakar and Thies, and to 1.0% of the national total, and therefore appears reasonable.

Per capita spending of tourists in Fatick is estimated to be FCFA 69,000, about the same level as the national average, with 24% of it spent on excursions and souvenirs. An estimated loss of revenues from day trips is hence about FCFA 2,680 million (16,200pax x FCFA 69,000 x 24%). Revenue from day trips within the region is included in the overall revenue of the region above.

3) Alternative destinations

Tourism revenue that the loss of the mangrove could have forgone in the Delta might have been partially retained in the country if a tourist flow could be diverted to Saint Louis and Ziguinchor. It is up to the tourists to decide about it. In playing out a possible scenario, one has to take into account that tourism markets are never uniform, ranging from upscale markets to which comfortable hotels are catered, to the lower-end markets of pack-packers.

① Tourist arrival to other regions

Considering the hotels in Saint Louis locating along the coast show room occupancy of 26% as annual average and below 30% even in busy months, it might be possible to divert some tourists there from Fatick. But, average duration of stay in Saint Louis is only 2.3 days against the national average of 3.6 days. It is relatively a small place with different types of tourism resources. In Ziguinchor with resources similar to the Delta, hotels are almost fully occupied and enjoy long duration stay (7.4 days) during peak season, but average duration goes down to 2.1 days during off-season. Under the circumstances, not much switch could be probably expected.

Likewise, little substitution could be anticipated from circular tour in Senegal and boat cruise in the Delta. Some of circular tours that cover the Delta might be entirely cancelled because of the missing leg, which would negatively affect tourism revenue in other regions.

The lost mangrove could create additional revenue to other regions as a result of diversion of tourists and net loss to them because of negative impacts. Assuming that positive effects and negative impacts cancel out, the net secondary impact on the national economy would be nil and the entire tourism revenue from the Fatick region would be forfeited.

② Excursion

Day trip to the Saloum Delta is popular among tourists in Thies and others. Daily excursion is of optional nature, and they participate if interested. Ziguinchor, probably only alternate destination, is too far from the Delta.

4) Evaluation

Since little net impact to other regions is expected as explained above, it is assumed reasonably that the extinction of the mangrove would wipe off the tourism revenue (FCFA 3,722 million) and excursion revenue (FCFA 268 million) in Fatick, or total of FCFA 3,991 million. This gross value will be attributed to the mangrove.

(4) Prevention of coastal erosion

The whole mechanism of coastal erosion has not been elucidated, but if the loss of the mangrove results in coastal and riverbank erosion, agricultural production will decline and affected residents will secure replacement land and to relocate, thereby incurring costs to the economy. One can hardly make a realistic interpretation of the damage, but farmlands of 1,300ha, or 0.5% of total cultivated lands (0.26 million ha) in Fatick are assumed to vanish for the purpose of computation.

Major crops in the region are millet and maize. Millet is dominant in coastal and river front areas of the Delta. A regional average yield of millet is 580 kg/ha, and imported prices of grain are about FCFA 62/kg. The value of the loss then arrives at FCFA 49 million. Assumption of the 0.5% loss is probably on a high side, but the estimated value of about FCFA 50 million is not significant compared with the total value shown below. Relocation cost, of which estimate is only FCFA 2 to 3 million, is non-recurrent, and can be thus neglected. Evaluation has been tried only to tentatively assess the financial damage, and it will not be added to the total value.

(5) Carbon dioxide (CO₂) sequestration

As shown in the attached table A-3-4-1), the mangrove forests of 64,286ha in the Saloum Delta are estimated to sequester 278,759 mt of carbon dioxide annually. Based on indicative prices of US\$ 1.5/mt in the United States (Chicago Climate Exchange) and about US\$ 10 in Europe for carbon credits, estimated value is 2.788 million.

(6) Willingness To Pay (WTP)

Based on the questionnaire survey carried out by the study team, Willingness To Pay (WTP) for the mangrove is estimated to be FCFA 78 million/month or FCFA 931 million per annum for all the population in the Delta area, totaling 118,230. WTP is supposed to incorporate comprehensively all the benefits of the mangrove perceived by the residents. It cannot be combined with other numbers. Note also needs to be taken that the estimate is relative to the population size.

(7) Total value

Putting all the relevant numbers together, the total gross socio-economic value of the mangrove in the Saloum Delta comes to

GDP of Senegal is FCFA 3.4 trillion in year 2003, and this gross value is equivalent to 0.2% of GDP. Further, it is about 7 times larger than the WTP value calculated in the section above.

FCFA 6.33 billion ~ FCFA 6.71 billion

**CHAPTER 3 SUSTAINABLE
MANAGEMENT PLAN
FOR MANGROVE FORESTS
(MASTER PLAN)**

CHAPTER3 SUSTAINABLE MANAGEMENT PLAN FOR MANGROVE FORESTS (MASTER PLAN)

3.1 Basic Concepts of the Master Plan

3.1.1 Background

The Study Area, including the Saloum Delta and Petit Côte, is located in the southern part of Senegal. Mangrove trees grow throughout the Saloum Delta which covers some 270,000 ha. These mangrove forests in Senegal roughly mark the northern limit for the distribution of mangrove forests in West Africa and form a precious ecosystem to maintain biological diversity.

In the Study Area, there are six national forests in Petit Côte, four national forests in the Saloum Delta, five national forests (part of the Baria National Forest) in the east and one national forest in the north. In 1976, the Saloum Delta National Park was established, including the open ocean part of the Saloum Delta and the land part of the former Fatala National Park located in the southeastern part of the Saloum Delta.

This Saloum Delta area was designated as the Saloum Delta Biosphere Reserve (RBSD) by the Department of National Parks (DPN), followed by the formulation of the Biosphere Reserve Management Plan in 1999. Three zones, i.e. the core zone incorporating the National Park, the buffer zone and the transition zone, are set up in the RBSD. The purposes of this zoning are the conservation of primarily the biological diversity in the core zone in view of the low level of devastation, sustainable development in the buffer zone where the scale and types of development activities are restricted and sustainable development in the transition zone in view of the highest potential of this zone for development. The analysis results of the SPOT satellite images taken in 1993 and 1997 of the present Study Area indicate that the Saloum Delta has 42,000 ha of low mangrove forests and 6,300 ha of high mangrove forests, totalling 58,300 ha of mangrove forests out of the 64,300 ha of the Study Area. The mangrove forest area accounted for 25% of the total area of 232,500 ha of the RBSD. Meanwhile, the Petit Côte area had 6,000 ha of low mangrove forests.

Local mangrove forests have long been used by local residents as sources of mangrove wood which is used as building timber and firewood, etc. The mangrove forest area also provides fishing grounds while its inland areas are used for farming. Its rich ecosystem and beautiful scenery have been attracting many tourists in recent years. Meanwhile, the progressive depletion of mangrove forests since the 1970's is causing concern in regard to adverse impacts on forest, fishery and tourism resources in the mangrove forest area as well as worsening of the natural environment.

The depletion of mangrove forests has been caused by such natural factors as a rise of the salinity due to drought as well as man-made factors, including the sedimentation of soil discharged from the land as a result of the expansion of farmland, cutting to obtain construction timber, collection of firewood for cooking and collection of firewood for the processing of marine products in the island area. Even though the cutting of natural forests, including mangrove forests, is in principle prohibited in both national and non-national forests, illegal cutting is taking place because of the lack of sufficient monitoring.

The Project Areas located in the Study Area are territories of villages or communes which have a mangrove forest(s) and/or access to a mangrove forest(s). In these Project Areas, there are three communes, 11 rural communities (RCs) and 95 villages with a total population of some 100,000. While both Betinti Island and Saloum Island, which are the main islands in the Saloum Delta and which are part of the Project Areas, entirely consist of national forests, the former has three villages with some 4,400 residents while the latter has 17 villages with some 23,000 residents (see A-3-1-1 – List of Target Villages of the Project). Fisheries are the main local industry and consume a huge quantity of mangrove wood as firewood for the processing of marine products.

The depletion as well as degradation of mangrove forests in the Project Areas suggests an urgent necessary for the formulation of a management and improvement plan. As the joint implementation of this plan by local residents who have a close relationship with mangrove forests and local administrative bodies is desirable, the formulation of a plan which facilitates such joint efforts is intended here.

3.1.2 Basic Planning Policies

Mangrove forests play a critical role for the local natural environment and biological diversity and are also essential for the livelihood of local residents. Here, the Sustainable Management Plan for Mangrove Forests (hereinafter referred to as the Master Plan) is formulated from the medium to long-term viewpoint based on a multi-faceted approach, including (i) the promotion of forestry, fisheries and tourism and (ii) the improvement and stabilisation of the livelihood of local residents. Fig. 3.1-1 shows the relationship between the Master Plan and local residents as well as the multiple functions of mangrove forests.

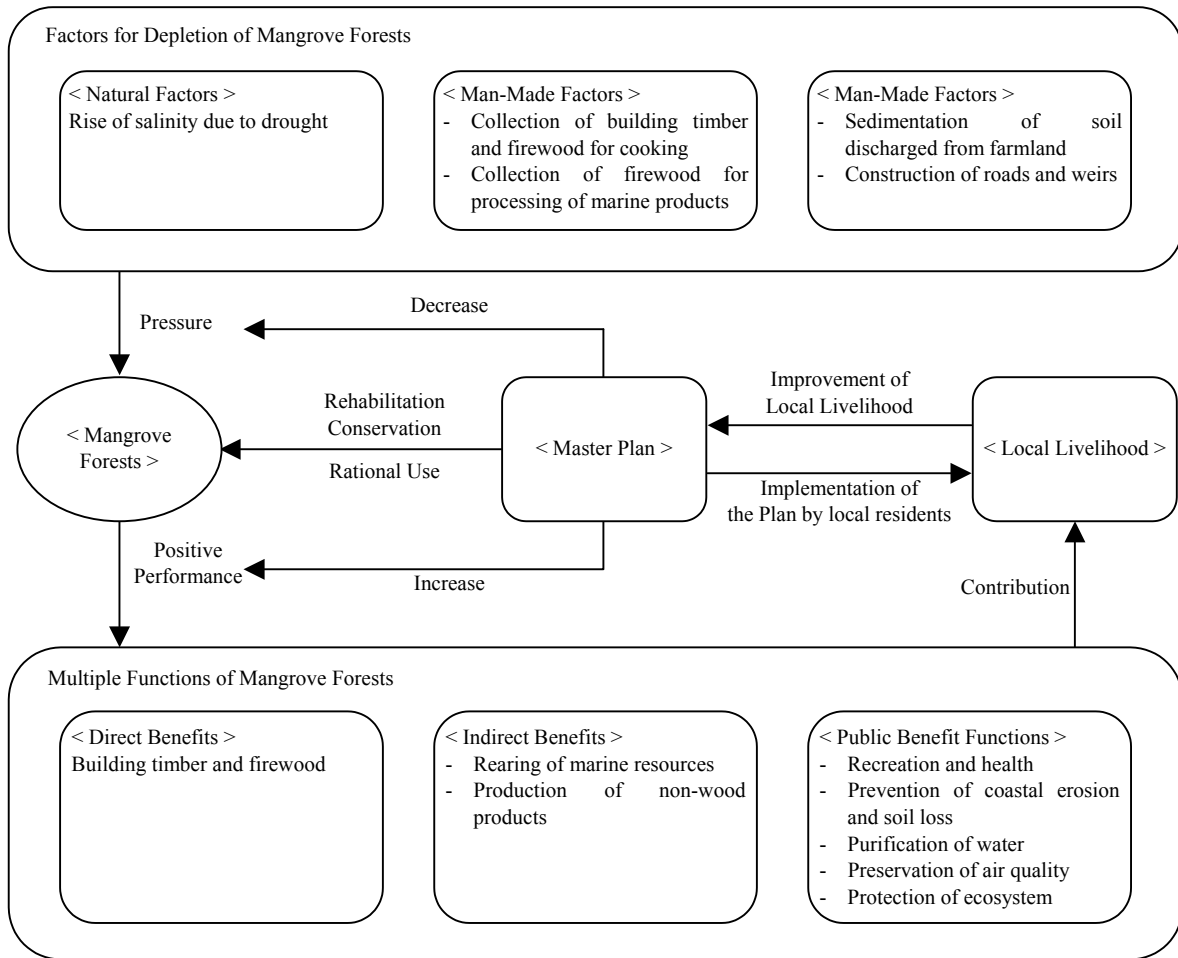


Fig. 3.1-1 Status of the Master Plan
(Relationship Between the Master Plan and Local Residents/Mangrove Forests)

The primary objectives of the Master Plan should be (i) the conservation of mangrove forests which show a trend of depletion and degradation due to natural and man-made factors and (ii) the rehabilitation of mangrove forests which have already disappeared. Given the fact that the lives of local residents are closely related to mangrove forests in terms of forestry, fisheries and tourism, etc., the Master Plan envisages the participatory management of mangrove forests.

The Master Plan for the conservation and sustainable use of mangrove forests will be formulated along the following three main axes.

- ① Rearing and use of forest resources
- ② Management and use of marine resources
- ③ Conservation and use of tourism resources

In addition to planning along these three axes, general education on mangrove forests and an environmental education programme will also be formulated.

The planning flow of the Master Plan is shown in Fig. 3.1-2.

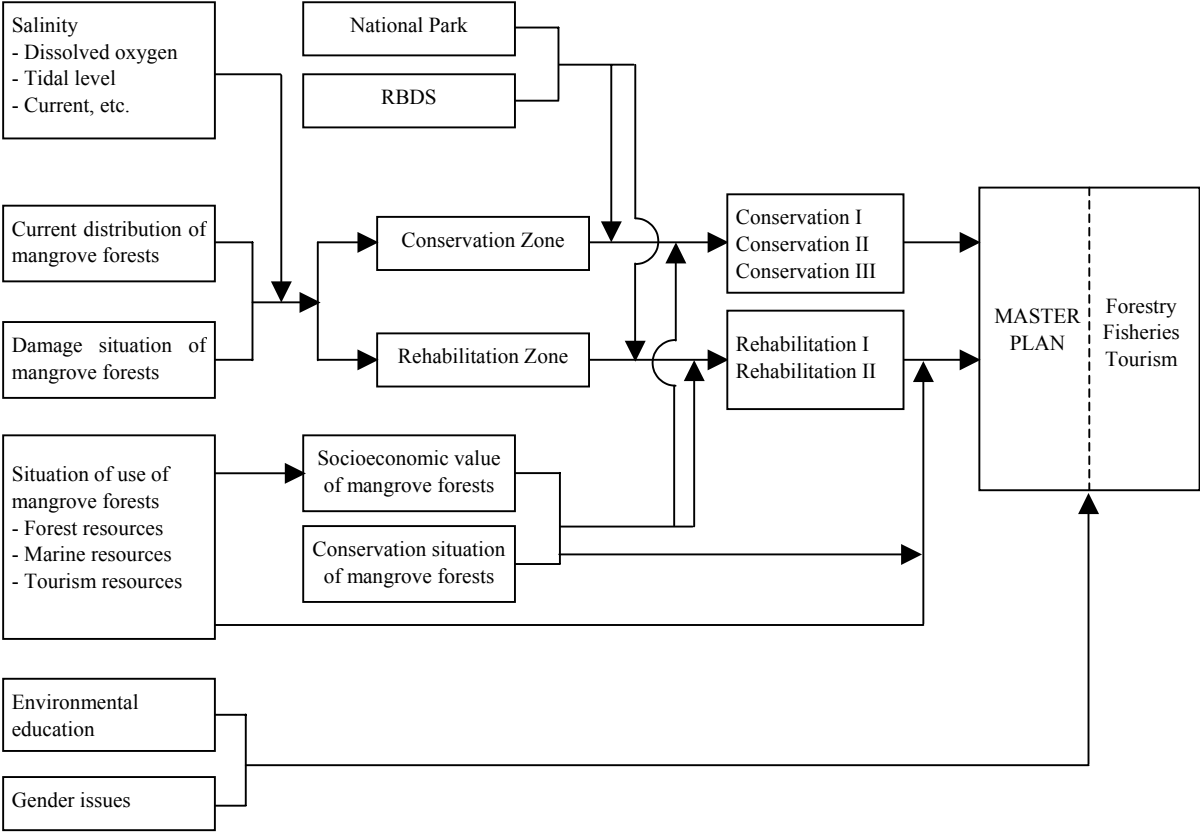


Fig. 3.1-2 Planning Flow of the Master Plan

3.1.3 Zoning

Given the priority objectives of the Master Plan for the Project Areas, i.e. the conservation and rehabilitation of mangrove forests which have been depleted or degraded or which have disappeared due to natural and man-made factors, areas for mangrove forest conservation (Conservation Zone) and areas for mangrove forest rehabilitation/restoration (Rehabilitation Zone) have been set up to fulfil these objectives. The purpose of zoning is to make the management of mangrove forests easier by means of grouping areas with similar conditions and setting forth the management method for each zone. The actual zoning is based on the distribution situation of *Rhizophora* and *Avicennia*, the situation of forest damage, including the state of depletion, and such natural conditions as the sea conditions (salinity, etc.) and others.

The Conservation Zone aims at sustaining and even expanding mangrove forests in areas where many mangrove trees have survived without much adverse impacts of the natural conditions. The Conservation Zone is established on Saloum Island, Betanti Island and the southern inland area with Bolon Irragago forming the boundary.

The Rehabilitation Zone aims at the rehabilitation (restoration) of mangrove forests in the coming years in those areas where mangrove forests have been depleted or have disappeared due to natural and/or man-made factors. The Rehabilitation Zone is mainly located in the inland area to the north of the Conservation Zone and consists of an area to the north of Saloum River and the eastern area around Foundiougne with the boundary being set by Bolon Irragago. Moreover, taking the national park area and areas marked by the biosphere reserve protection programme into consideration, the Conservation Zone and the Master Plan are further divided into three conservation sub-zones and two rehabilitation sub-zones respectively.

The relationship between the sub-zones and the national park as well as the biosphere reserve is shown in Table 3.1-1.

Table 3.1-1 Zoning of the Project Areas

	Biosphere Reserve							Outside Biosphere Reserve
	Core			Buffer		Transition		
	National Park	National Forest	Outside National Forest			Little Human Impacts	Much Human Impacts	
Conservation Zone	C-I	C-I	C-I	C-II	C-III	C-III	C-III	-
Rehabilitation zone	-	-	-	-	-	R-II	R-I	R-I

Note: C = conservation; R = rehabilitation

The present situation of and desirable future for mangrove forests in the sub-zones are described in Table 3.1-2.

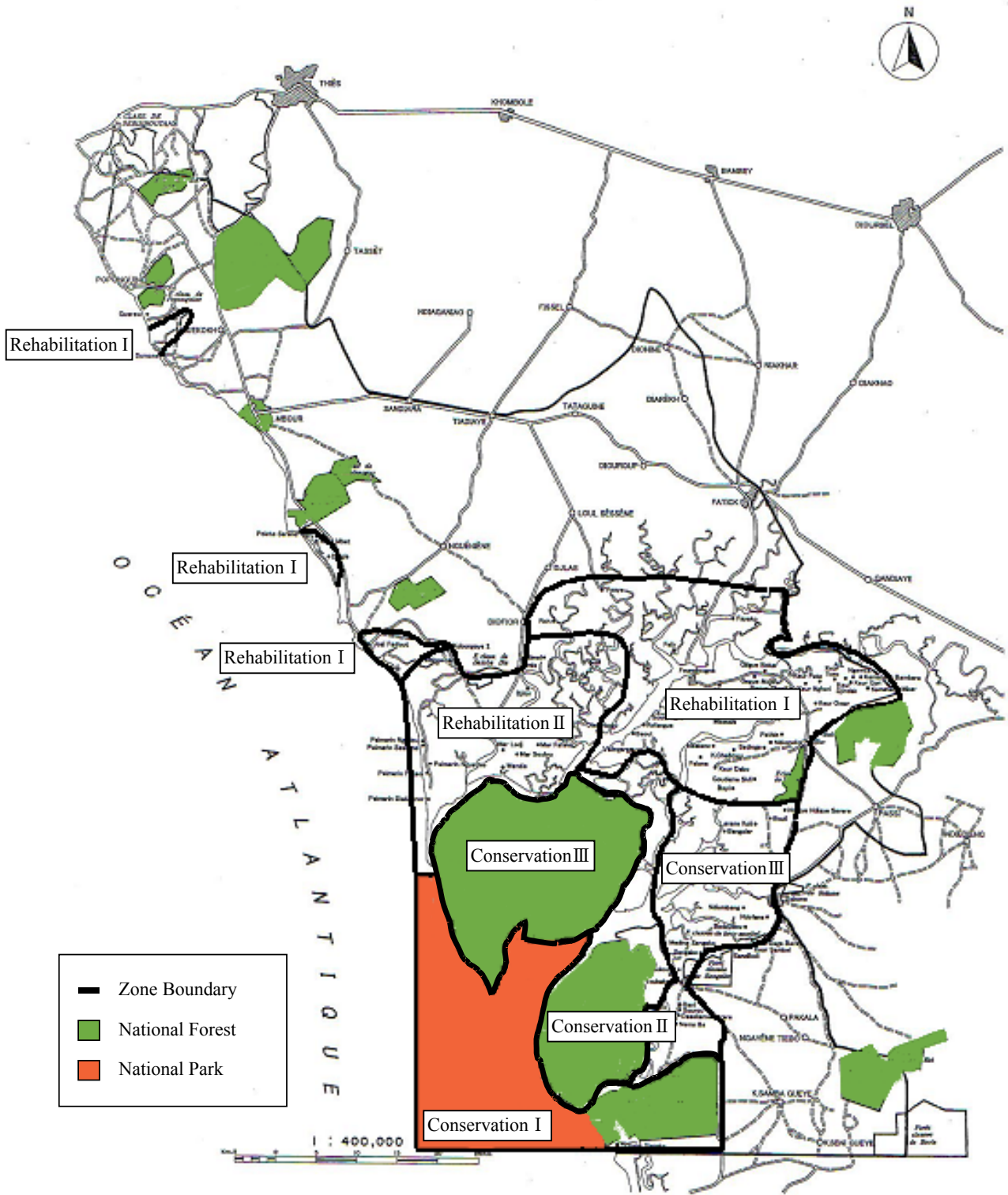


Fig. 3.1-3 Location of Sub-Zones

Table 3.1-2 Present Situation of and Desirable Future for Mangrove Forests by Zone

		Present Situation of Mangrove Forests	Desirable Future
Conservation Zone	Conservation Sub-Zone I	<ul style="list-style-type: none"> • Mangrove forests mainly consist of <i>Rhizophora</i> and some large forests have an upper story tree height of more than 10 m. At sites with poor conditions, the tree height is around 2 m. 	<ul style="list-style-type: none"> • Biological diversity will be maintained by mangrove forests which grow without human interference.
	Conservation Sub-Zone II	<ul style="list-style-type: none"> • Mangrove forests mainly consist of <i>Rhizophora</i>. The upper story tree height exceeds 10 m at some sites but is generally 5 – 6 m. 	<ul style="list-style-type: none"> • Mangrove forests will basically be observed in the same manner as the Conservation I Sub-Zone. • At places with local residents, the collection of such forest products as dead trees, fruits, leaves, roots and bark, etc. for food or medicinal purposes will be permitted. • At places where there is a shortage of mangrove wood, an alternative village forest will be created while mangrove forests will be protected. • <i>Rhizophora</i> will be planted in places where mangrove forests have degraded.
	Conservation Sub-Zone III	<ul style="list-style-type: none"> • On Saloum Island to the west, mangrove forests mainly consist of <i>Rhizophora</i> and the tree height is generally 5 – 6 m. • Mangrove forests located inland to the east mainly consist of <i>Rhizophora</i> and the tree height can exceed 10 m along a river. The tree height is generally lower inland and <i>Avicennia</i> is also found. The height of <i>Avicennia</i> along a river is 1 – 2 m. Some <i>Avicennia</i> trees inland exceed 5 m in height. 	<ul style="list-style-type: none"> • The area is subject to strong human interference and mangrove forests will be used in the same manner as Conservation Sub-Zone II. • At places where there is a shortage of mangrove wood, an alternative village forest will be created while mangrove forests will be protected. • <i>Rhizophora</i> will be planted in places where mangrove forests have depleted.
Rehabilitation Zone	Rehabilitation Sub-Zone I	<ul style="list-style-type: none"> • While <i>Rhizophora</i> of some 5 m in height can be observed at the side of Bolon Bagal near Sadioga, the tree height is generally low. • The dominance of <i>Rhizophora</i> declines from Foundiougne towards Kaolack as it is increasingly replaced by <i>Avicennia</i> with a height of some 1 – 2 m. 	<ul style="list-style-type: none"> • Planting will mainly be conducted in places where mangrove forests have previously existed. • The main planting species will be <i>Avicennia</i> in places with a high salinity and <i>Rhizophora</i> in other places to rehabilitate/restore mangrove forests.
	Rehabilitation Sub-Zone II	<ul style="list-style-type: none"> • While <i>Rhizophora</i> can be found along Saloum River and bolons flowing into Saloum River, the tree height of 1 – 3 m is low. <i>Avicennia</i> becomes prominent towards the upstream. 	<ul style="list-style-type: none"> • While mainly <i>Rhizophora</i> will be planted, <i>Avicennia</i> will also be planted in places with a high salinity to rehabilitate/restore mangrove forests.

3.1.4 Improvement Policies by Zone

The established zones and sub-zones are designed to either conserve or rehabilitate mangrove forests and the relevant improvement policies by zone (sub-zone) are described in Table 3.1-3.

Table 3.1-3 Improvement Policies by Zone (Sub-Zone)

Zone	Sub-Zone	Improvement Policies
Conservation Zone	I	<ul style="list-style-type: none"> • Protection of mangrove forests • Natural regeneration without human interference
	II	<ul style="list-style-type: none"> • Conservation of mangrove forests • No human interference but those sites degraded due to human interference will be subject to planting for the urgent recovery of mangrove forests
	III	<ul style="list-style-type: none"> • Conservation and utilisation of mangrove forests • Preservation or planting, if necessary, for those stands to be conserved
Rehabilitation Zone	I	<ul style="list-style-type: none"> • Planting of mainly <i>Avicennia</i> to rehabilitate/restore mangrove forests • Planting of <i>Rhizophora</i> in suitable places
	II	<ul style="list-style-type: none"> • Planting of mainly <i>Rhizophora</i> to rehabilitate/restore mangrove forests

The Master Plan to preserve or develop forest, fisheries and tourism resources will be formulated based on the improvement policies listed in Table 3.1-3.

3.1.5 Planning Items for Sustainable Management

From the viewpoint of rearing mangrove forests in the Project Areas for their sustainable use, the appropriate management of natural and man-made mangrove forests is essential. Despite such a need, however, the degradation, depletion and disappearance of mangrove forests are progressing in the Project Areas because of such man-made factors as illegal cutting by local residents to obtain building timber and firewood for home consumption or the processing of marine products and also because of such natural factors as a rise of the salinity of the seawater due to drought and an inflow of sediment from the mainland.

Marine resources and tourism resources are closely related to mangrove forests as these resources cannot exist without mangrove forests. The appropriate management of mangrove forests is, therefore, necessary to conserve these resources as well as forest resources. From the viewpoints described above, the Master Plan should adopt the rehabilitation and conservation of natural mangrove forests as its primary targets. The improvement targets listed in Table 3.1-4 are, therefore, set to achieve these targets.

Table 3.1-4 Improvement Targets by Sub-Zone

Sub-Zone	Land Use	Inside National Forest	Outside National Forest
C-I	Forest		<ul style="list-style-type: none"> • Designation as part of the National Park • Preservation of the present state • Natural regeneration
	Mangrove Forest		<ul style="list-style-type: none"> • Designation as part of the National Park • Preservation of the present state
	Village Area		<ul style="list-style-type: none"> • Clarification of the village area for those villages which existed prior to the designation of a national forest or the National Park
C-II	Forest	<ul style="list-style-type: none"> • Preservation of the present state because (i) it exists in the inland area of an island and (ii) its utilisation is not planned 	
	Mangrove Forest	<ul style="list-style-type: none"> • Preservation of the present state or planting in natural forests located in areas to be conserved. 	<ul style="list-style-type: none"> • Preservation of the present state as it exists inside the conservation area • Planting around villages
	Village Area	<ul style="list-style-type: none"> • Setting up of the village area where a village forest is created to produce logs and firewood, etc. by villagers 	
C-III	Forest	<ul style="list-style-type: none"> • Preservation of existing forests in the inland of an island as their use is not planned • Recovery of forests on the mainland side by planting local species • Formulation of an improvement programme to create production forests by planting to produce logs and firewood, etc. 	
	Mangrove Forest	<ul style="list-style-type: none"> • Preservation of existing mangrove forests and planting, if necessary 	<ul style="list-style-type: none"> • Creation of mangrove forests by planting in places where planting is possible • Apiculture using mangrove forests
	Village Area	<ul style="list-style-type: none"> • Setting up of the village area where a village forest is created to produce logs and firewood, etc. by villagers 	<ul style="list-style-type: none"> • As left
R-I	Forest	<ul style="list-style-type: none"> • Preservation of existing forests • Restoration of forests by the planting of local species • Formulation of an improvement programme to create production forests by planting to produce logs and firewood, etc. 	<ul style="list-style-type: none"> • Formulation of an improvement programme by the RC (to be implemented by each village) to create production forests by planting to produce logs and firewood, etc.
	Mangrove Forest		<ul style="list-style-type: none"> • Preservation of existing mangrove forests • Rehabilitation/restoration of <i>Avicennia</i> forests by planting in areas with high salinity • Creation of <i>Rhizophora</i> forests by planting in areas which are suitable for <i>Rhizophora</i>
	Village Area	<ul style="list-style-type: none"> • Setting up of the village area but no future expansion 	
R-II	Forest	<ul style="list-style-type: none"> • Preservation of existing forests • Restoration of forests by the planting of local species • Formulation of an improvement programme to create production forests by planting to produce logs and firewood, etc. 	<ul style="list-style-type: none"> • Formulation of an improvement programme by the RC (to be implemented by each village) to create production forests by planting to produce logs and firewood, etc.
	Mangrove Forest		<ul style="list-style-type: none"> • Preservation of existing mangrove forests • Creation of <i>Rhizophora</i> forests by planting in areas which are suitable for <i>Rhizophora</i> • Creation of <i>Avicennia</i> forests in some areas with a high salinity
	Village Area	<ul style="list-style-type: none"> • Setting up of the village area but no future expansion 	

Note: C = conservation; R = rehabilitation

The planning items for sustainable management in each of the forestry, fisheries and tourism sectors are described next to achieve the improvement targets listed in Table 3.1-4. The flow chart to determine the planning items is shown in Fig. 3.1-4.

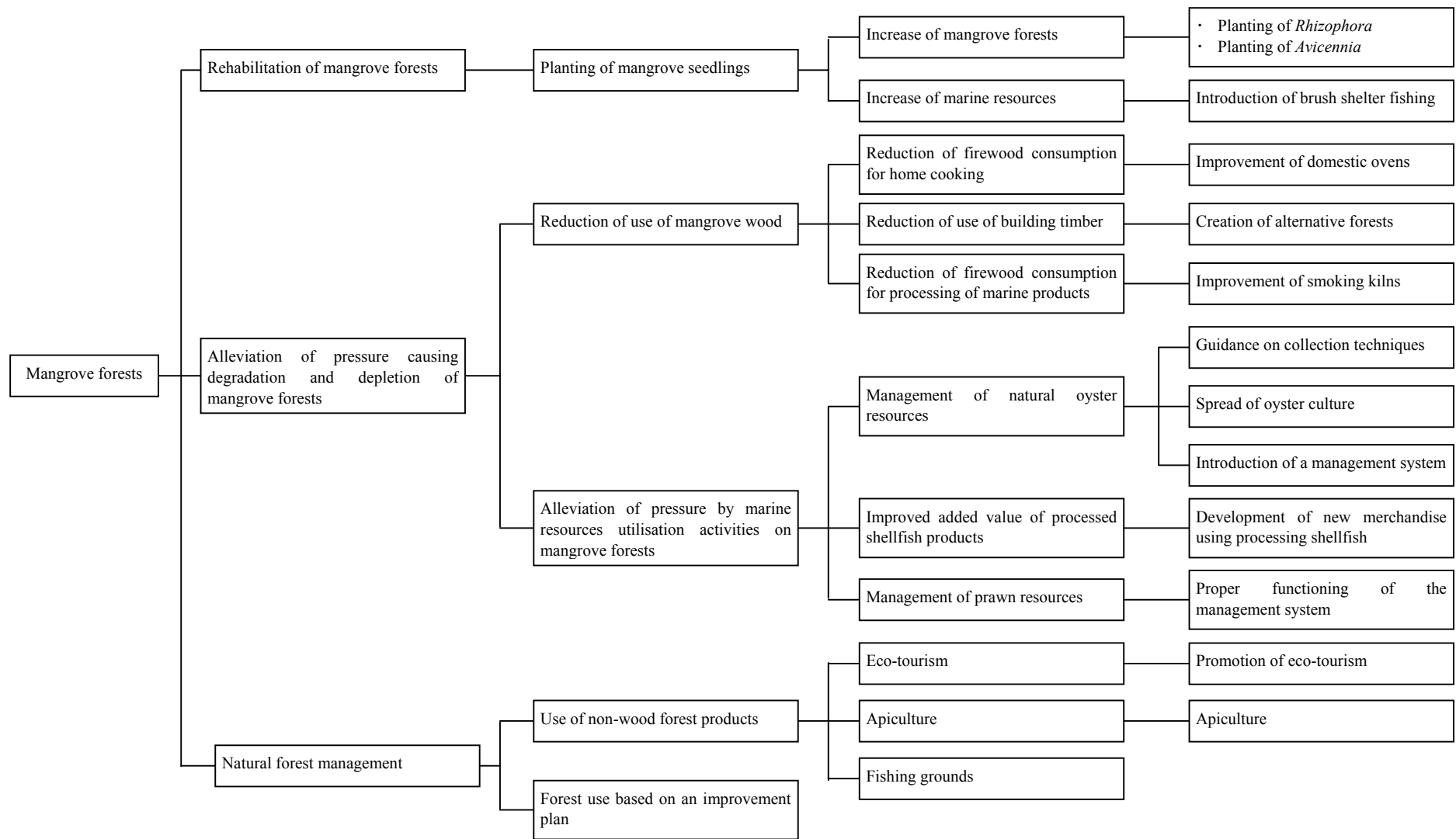


Fig. 3.1-4 Planning Items for the Master Plan

(1) Forests and Forestry

The cutting of mangrove trees for consumption is prohibited in all parts of Senegal, including the Project Areas. However, the reality is that local residents continue to cut natural mangrove trees to produce logs and firewood, etc. The continued use of natural mangrove forests as the supply sources of logs and firewood which are required to support the lives of local residents will certainly aggravate the depletion or degradation of natural mangrove forests around villages. To prevent the further depletion or degradation of natural mangrove forests, the conservation or rehabilitation of natural mangrove forests and the creation of village forests as alternative sources of wood supply in inland areas are planned as forest and forestry-related activities. Apiculture which uses mangrove trees as sources of honey is also planned to facilitate the conservation of mangrove forests. The ultimate goal of the Master Plan is the conservation of natural mangrove forests through the facilitation of the supply of alternative wood to mangrove wood by means of creating man-made mangrove forests and the planned as well as sustainable production of wood by village forests. The planning items relating to forests and forestry are listed below.

- ① Planting of *Rhizophora* : rehabilitation of mangrove forests
- ② Planting of *Avicennia* : rehabilitation of mangrove forests
- ③ Management of natural mangrove forests
- ④ Creation of village forests : supply of alternative wood to mangrove wood
- ⑤ Apiculture : rehabilitation/conservation of mangrove forests as supply sources of honey

(2) Fisheries

For such marine resources as fish and shellfish, mangrove forests provide essential breeding as well as rearing grounds for various species. The Saloum Delta as a Project Area is experiencing the depletion and degradation of mangrove forests because of a rise of the salinity, in turn caused by a decline of the rainfall and the inflow of sediment from farmland. Villagers with access to mangrove forests in the island area require mangrove wood for their daily lives as well as various activities in the fisheries sector. Despite the prohibition of the cutting of mangrove trees in principle, the cutting of these trees by villagers to obtain firewood for the smoking of fish and processing of shellfish and also the cutting of the prop aerial roots to collect mangrove oysters are the causes of the depletion and degradation of mangrove forests. As marine resources are inseparably linked to mangrove forests, the utilisation and management of marine resources are included in the Master Plan from the viewpoint of facilitating the conservation and rehabilitation of mangrove forests. The planning items relating to fisheries are listed below.

- ① Introduction of improved smoking kilns: reduction of the firewood consumption, resulting in a reduction of the cutting of mangrove trees to obtain firewood

- ② Introduction of management techniques for natural mangrove oysters: management of oyster resources and conservation of mangrove forests
- ③ Spread of ocean culture of natural mangrove oysters: management of oyster resources and conservation of mangrove forests
- ④ Improved added value of processed shellfish products: establishment of a fund to finance the creation of village forests to produce alternative firewood for shellfish processing
- ⑤ Self-supply of protective gear for shellfish collection (making of heavy cloth shoes and gloves): rehabilitation/conservation of mangrove forests
- ⑥ Support for beach committees: management of marine resources and rehabilitation/conservation of mangrove forests
- ⑦ Strengthening of the management of prawn resources: improvement of fishing grounds and rehabilitation/conservation of mangrove forests
- ⑧ Making of life jackets: rehabilitation of mangrove forests and establishment of a fund to finance the creation of village forests
- ⑨ Judgement on an increase of marine resources as a result of mangrove forest rehabilitation: improvement of fishing grounds and rehabilitation/conservation of mangrove forests

(3) Tourism

In 1972, Senegal commenced the promotion of large-scale tourism based on the typical model of people of advanced countries seeking the 3Ss (sea, sand and sky) in developing countries and local tourism is still dependent on tourism assets provided by the country's own natural environment. While a major part of tourism in Senegal is controlled by foreign capitals, it is a fact that Senegalese tourism as that of a developing country has achieved certain development, supporting the country's economic growth. As in the case of tourism in many developing countries, the entire holiday schedules for foreign tourists are currently arranged by hotels or travel agents and local residents simply receive tourists in a passive way. As such, the opportunities for local residents to benefit from tourism are quite limited. In the face of such an industrial structure, tourism by the Senegalese has been called for. To promote tourism by the Senegalese even in a minor way, a proposal is made in the Master Plan to introduce active tourism promotion measures in a niche field by which it is hoped to establish a complementary relationship with the existing mainstream tourism.

Accordingly, eco-tourism which features mangrove forests as local natural resources and which will be promoted by the initiative of local residents is planned in the Saloum Delta area.

- ① Eco-tourism using eco-routes

In addition to the three sectors described above, the following activities are planned to provide general education on mangrove forests and environmental education throughout the Project Areas.

- ① Introduction of environmental education mainly featuring mangrove forests in primary schools
- ② Mangrove seminars and workshops for RC councillors
- ③ Study visits to model villages of the sustainable management of mangrove forests (spread of the use of improved ovens for home cooking, spread of the making of heavy cloth shoes and gloves and spread of the making of protective face masks for apiculture)
- ④ Educational activities linked to local sporting and cultural activities
- ⑤ Extension of techniques/skills with villagers acting as instructors

3.1.6 Classification for Management

The management and improvement units described below are set up to ensure the efficient management of the planned activities which are determined based on the improvement policies explained above.

(1) Management Unit

For local public bodies to manage/improve national forests or non-national forests, they must obtain the approval of the DEFCCS for a forest improvement plan in the case where the target area exceeds 20 ha, a simple management plan in the case where the target area is between 5 ha and 20 ha or cutting in the case where the target area is less than 5 ha. As the DEFCCS designates forest management bureaus as the management units for national forests and non-national forests at the regional level, the management unit is the area under the jurisdiction of each forest management bureau, i.e. each region.

(2) Improvement Unit

Following decentralisation, the smallest unit which can implement forest improvement activities is a city (MC) or a rural community (RC) provided that the approval of the DEFCCS is obtained. Accordingly, the forest improvement unit under the Master Plan is a MC or RC. In regard to the actual forest improvement work, forest management stations and their staff will assist the forest improvement and management activities conducted by the MCs and RC within the geographical area of their jurisdiction. The residents of the relevant MCs and those of villages belonging to the relevant RCs will follow the improvement plan or simple management plan if such a plan exists. If such a plan does not exist, it is desirable for villages to formulate their own plans so that

villagers can participate in forest improvement and management activities in a planned manner. The relationship between the improvement unit (MC or RC) and the sub-zones is shown in Table 3.1-5.

Table 3.1-5 Zoning by RC or MC

Region	Department	RC or MC		Sub-Zone				
				C-I	C-II	C-III	R-I	R-II
Fatick	Foundiougne	RC	Toubacouta	O	O	O		
			Bassoul			O		
			Dinouar	O	O			
			Djirnda			O	O	
			Djilor			O	O	
			Diossong			O	O	
	MC	Foundiougne				O		
		Sokone			O			
	Fatick	RC	Djilass				O	
			Fimela					O
Parlarin Fakao							O	
Thies	Mbour	RC	Nguekoh				O	
		MC	Joal				O	

Note: C = conservation; R = rehabilitation

3.1.7 Application Areas for Planning Items

A precondition for the sustainable management of mangrove forests is the conservation of such forests. The planning items in the forest/forestry, fisheries and tourism sectors for the conservation and/or rehabilitation of mangrove forests which are necessary to meet this precondition are described in 3.1.5. All of the planned items are mutually linked and will not be implemented individually.

The main objectives of the planned items (activities) in the forest/forestry sector are rehabilitation through the planting of mangrove seedlings and the conservation of mangrove forests through the creation of village forests. In the case of the fisheries sector, the main objective is reduction of the use of mangrove forests to obtain firewood for the smoking of fish and processing of shellfish. The planting of mangrove seedlings aims at the rehabilitation of forest resources and environmental resources and is not envisaged as an economic activity to produce income. Because of this, planting should be combined with other economic activities so that the money required to meet the cost of planting is disbursed from economic activities to an environment fund. Meanwhile, the creation of village forests is an economic activity to produce income through the production of logs, etc. However, at least six years will be required for this income to materialise. During this period, this activity must be combined with other economic activities as in the case of the planting of mangrove seedlings. Such economic activities as the smoking of fish and processing of shellfish in the fisheries

sector which require firewood will necessarily be combined with the planting of mangrove seedlings and the creation of village forests.

As a complementary relationship must be established between non-economic activities and economic activities as in the case of economic activities funding planting or the supply of firewood by a village forest for the smoking of fish and the processing of shellfish, the development of a management system to ensure the smooth implementation and management of various activities is important.

In both the forest/forestry sector and the fisheries sector, the intended effects of the sustainable management of mangrove forests will only be achieved when the planning items, i.e. planned activities, in these sectors are combined as shown in Table 3.1-6.

Table 3.1-6 Combination of Planning Items Between Forest/Forestry Sector and Fisheries Sector

Forest/Forestry \ Fisheries	Introduction of Improved Smoking Kilns	Processing of Shellfish	Management and Culture of Oyster Resources	Making of Life Jackets	Making of Heavy Cloth Shoes and Gloves
Planting of <i>Rhizophora</i>	O	O	O	O	O
Planting of <i>Avicennia</i>	O/Δ	Δ	Δ	O	Δ
Village Forests	O	O		O	

Note: O = strongly linked; Δ = occasionally linked

The target areas and villages in these areas for each planning item in the forest/forestry, fisheries and tourism sectors are listed in Table 3.1-7. These areas are established based on the applicability of the same planning item in each of the forest/forestry sector and the fisheries sector while taking the sub-zones and boundaries of each RC, which is the improvement unit, into consideration.

Table 3.1-7 Target Areas of Application of Planning Items and Villages in Target Areas

RC or Commune	Sub-Zone	Area (Village or MC)	Forest/Forestry	Fisheries
Toubacouta	Conservation I	Bakadadji		
		Djinakh Bara		
		Djinack Biattake		
	Conservation II	Betanti	Planting of <i>Rhizophora</i> village forest	Establishment of oyster resources management techniques; establishment and extension of oyster culture techniques/seminar
		Bossikang		
		Sipo		
	Conservation III	Bani	Village forest/ planting of <i>Rhizophora</i>	
		Sourou		
		Dassilame Sérère		
		Nema Ba	planting of <i>Avicennia</i>	
		Missira		
		Toubakouta	Planting of <i>Rhizophora</i> /village forest	
		Sangako		
		Badoudou		
		Daga Bera		
		Keur Sambel		
Ndiambang				
Ngofane				
Médina Sangako		Village forest/ planting of <i>Rhizophora</i> apiculture	Establishment of oyster resources management techniques; establishment and extension of oyster culture techniques/seminar	
Sandikoli				
Soukouta				
Diossong	Conservation III	Bambougar El Hadji	Village forest/ Planting of <i>Rhizophora</i>	
		Lerane Koli		
		Bangaler		
		Bambougar Massamba		
		Bouli		
		Ndiaye Ndiaye Sérère		
Sokone		Sokone		
Bassoul	Conservation III	Bassar	Village forest/ planting of <i>Rhizophora</i> apiculture	Improved smoking kiln for ethomarse/control by total weight
		Bassoul		
		Diogane		
		Siwo		
		Tialiane		
Djirnda	Conservation III	Moundé		
		Djirnda		
		Fambine		
		Maya		
		Ngadior		
	Rehabilitation I	Baout		
		Rofangué		
		Velingara		
	Rehabilitation II	Diamniadio		
	Dionouar	Conservation III		
Falia				
Niodior				
Malikounda	Rehabilitation I	Pointe Sarene		
		Diagle		
		Keur Mbat		
Nguekokh	Rehabilitation I	Guéréw	Planting of <i>Avicennia</i> /village forest	
		Somone		

RC or Commune	Sub-Zone	Area (Village or MC)	Forest/Forestry	Fisheries
Djibr	Rehabilitation I	Fayako	Planting of <i>Rhizophora</i> /village forest	Management of prawn resources
		Felir		
		Boli		
		Kamatane Bambara		
		Kamatané Mbar		
		Keur Djindak		
		Keur Gori		
		Keur N'ghari		
		Keur Omar		
		Keur Pate		
		Keur Yoro		
		Ngamsa		
		Gagué Bokar		
		Gagué Chérif		
		Gagué Modi		
		Bambou		
		Mbam	Planting of <i>Avicennia</i>	
		Sap		
		Mbassis	Planting of <i>Rhizophora</i> /village forest	
		Ndong Log		
		Thiaré		
		Soum 1, 2		
		Djibr		
		Niomdi		
		Pethie		
		Sadioga		
		Mbelane		
		Félane		
Keur Cheikhou				
Keur Dabo				
Goudeme Sidi				
Bayi				
Djilass	Rehabilitation I	Faoye		
		Roh		
Joal	Rehabilitation I	Joal		
Foundiougne	Rehabilitation I	Foundiougne		
Fimela	Rehabilitation II	Dibr	Planting of <i>Rhizophora</i> /village forest	Improved smoking kilns for ethomarse
		Fimela		
		Simal		
		Ndangane		
		Ndangane Campement		
		Kobongoye 2		
		Mbissel		
		Mar Fafako		
		Mar Lodj		
		Mar Soulou		
Wandie				
Palmarin Fakao	Rehabilitation II	Palmarin Diakhanor		
		Palmarin Facao		
		Palmarin Ngalbu		
		Palmarin Nguethie		
		Palmarin Sessène		

Note: Villages in bold are located in island areas.

3.2 Utilisation and Rearing of Forest Resources

3.2.1 Contents of Planning

(1) Planning Items

The planning of the utilisation and rearing of forest resources based on the improvement policies for each sub-zone involves four items (activities), i.e. “planting of mangrove”, “natural mangrove forest management”, “creation of village forests” and “production of secondary mangrove forest products: apiculture”.

① Planting of Mangrove

In the Rehabilitation Zone (both Sub-Zone I and Sub-Zone II), suitable mangrove species will be planted at suitable sites. In areas with a relatively low salinity, mangrove forests will be created by the planting of *Rhizophora*. In areas with a high salinity, mangrove forests will be rehabilitated by the planting of *Avicennia*. In Conservation Sub-Zones II and III, most mangrove forests are natural *Rhizophora* forests and planting will be conducted around villages to rehabilitate these forests.

② Natural Forest Management

The conservation of natural mangrove forests is planned.

③ Village Forest Creation Programme

At present, mangrove trees are illegally cut by local residents to obtain firewood and building timber (logs). In particular, mangrove wood is used as firewood for the processing of marine products in island areas. Village forests will be created on village land to supply alternative wood to mangrove wood. Planting on private land is included in this village forest creation programme.

④ Apiculture Programme

Apiculture is planned to provide a secondary source of income for local residents.

The target sub-zones for planning items ①, ②, ③ and ④ above are shown in Table 3.2-1.

Table 3.2-1 Planning Items and Target Sub-Zones

Planning Item (Planned Activity)		Target Sub-Zone(s)
1. Planting of mangrove	<i>Rhizophora</i>	Conservation II and III Rehabilitation I and II
	<i>Avicennia</i>	Conservation II Rehabilitation I and II
2. Creation of village forest		Conservation III Rehabilitation I and II
3. Production of secondary mangrove forest products: apiculture		Conservation III

(2) Programme Implementation Period

While it is necessary to consider the creation of sustainable man-made mangrove forests as a long-term prospect, a programme implementation period of 10 years is currently adopted to allow realistic forecasting for the planting programme for the sole purpose of forest rehabilitation and conservation. The Master Plan plans the creation of village forests using fast growing species in addition to the creation of man-made mangrove forests and the planting for village forests will generally be completed in six years, allowing the first harvesting in the sixth year. For the purpose of the planning of the Master Plan, a programme period for village forest creation of 10 years is set as in the case of the mangrove planting programme and planting and cutting in this period are planned.

(3) Classification of Planting Areas (Man-Made Forests)

Land for the planting of mangrove (*Rhizophora* or *Avicennia*) and the creation of village forests will be that land allocated by RCs and classified as forest land. Each village conducting planting must record the planting species, number of seedlings planted, planting area, i.e. size of the land, and year of planting in a register for the purposes of planning, execution and management. In addition, the locations and size (plot size and shape) of the planting sites must be clearly indicated on a map.

3.2.2 Mangrove Planting Programme

(1) Purpose of Planting

While mangrove seedlings will primarily be planted in the Rehabilitation Zone, they will also be planted at suitable sites in the Conservation Zone to expand mangrove forests. The mangrove forests to be created by the planting of *Rhizophora* or *Avicennia* will be designated as conservation forests designed to enhance the various functions associated with mangrove forests.

(2) Suitable Sites for Planting

The survival and growth of both *Rhizophora* and *Avicennia* are closely related to the salinity as their growth is adversely affected by an increase of the salinity. *Avicennia* has slightly better resistance to a high level of salinity than *Rhizophora*. The salinity considerably fluctuates between the rainy season and the dry season and Table 3.4-2 shows the suitability of planting in response to the salinity at the end of the dry season when the salinity reaches its peak. The suitability of mangrove planting by village based on the salinity is shown in A-3-2-1.

Table 3.2-2 Suitability of Planting in Response to Salinity

Area	Salinity in Dry Season	<i>Rhizophora</i>	<i>Avicennia</i>
I	< 4.5%	Suitable	Suitable
II	4.5% - < 6%	Moderately Suitable	Moderately Suitable
III	6% - < 8%	Unsuitable	Growth is possible
IV	8% \leq	-	Unsuitable

(3) Silviculture

1) Regeneration

Both *Rhizophora* and *Avicennia* seedlings will be manually planted.

2) Growth Forecast for Planted Seedlings (*Rhizophora*)

The field survey results suggest a tree height of 10 m at high quality sites, 6 m at medium quality sites and 4 m at low quality sites in 30 years after planting. The tree height curve and basal diameter curve based on these figures are shown in Fig. 3.2-1. High quality sites are found near the National Park to the south of Toubacouta, medium quality sites in island areas and low quality sites in inland areas. To be more precise, high quality sites correspond to Conservation Sub-Zone II, medium quality sites to Conservation Sub-Zone III and low quality sites to Rehabilitation Sub-Zones I and II.

Table 3.2-3 Tree Height Growth by Site Quality (m)

Stand Age	High Quality Sites	Medium Quality Sites	Low Quality Sites
5	1.7	1.2	0.8
10	4.2	2.4	1.7
15	6.2	3.6	2.5
20	7.8	4.5	3.1
25	9	5.3	3.6
30	10	6	4

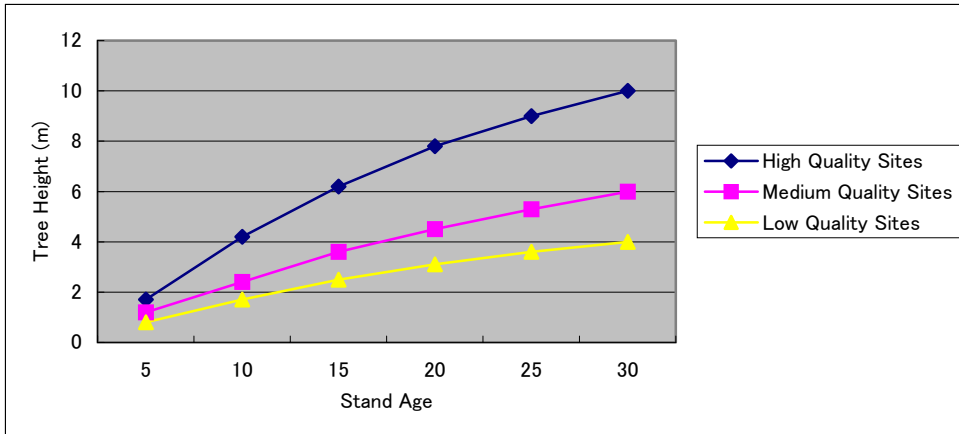


Fig. 3.2-1 Tree Height Growth Forecast by Site Quality

Table 3.2-4 Basal Diameter Growth by Site Quality (cm)

Stand Age	High Quality Sites	Medium Quality Sites	Low Quality Sites
5	2.9	2.5	2.4
10	4.5	3.7	3.4
15	6.1	4.6	4.1
20		5.5	4.6
25			5

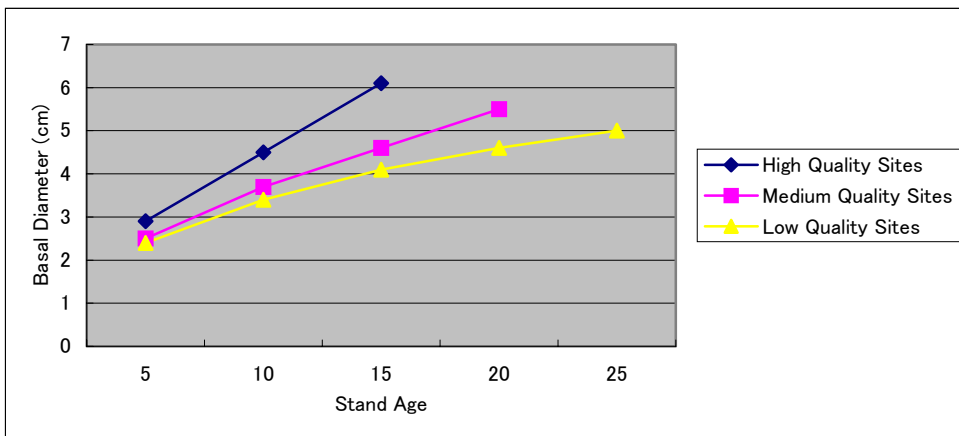


Fig. 3.2-2 Basal Diameter Growth Forecast by Site Quality

(4) Planting Area and Planting Period, etc.

1) Possible Planting Area

The possible area for planting by village is listed in A-3-2-5. This area is calculated by interpreting the river bank lines where no mangrove forests currently exists although a village is situated nearby using aerial photographs and the topographical map (scale: 1 to 50,000) while taking the inclination and size of each site, etc. as determined by the field survey into consideration.

2) Planting Period

10 years

3) Planned Planting Area

Based on the results of the Pilot Project (which was conducted at 10 villages for the purpose of the capacity building of villagers and local organizations in relation to the planned activities for the sustainable management of mangrove forests with the results being fed back to the planning process for the Master Plan; see the separate report on the Pilot Project for further details), the standard planting density, volume and area for *Rhizophora* per village per year are set at 50 cm x 50 cm, 10,000 seedlings and 0.25 ha respectively provided that planting is conducted on a self-reliant basis. The corresponding figures for *Avicennia* are 50 cm x 50 cm, 4,000 seedlings and 0.10 ha. The number of target villages in the target sub-zones is 51 villages for *Rhizophora* and 15 villages for *Avicennia*. In total, the planting of 142.5 ha (127.5 ha for *Rhizophora* and 15.0 ha for *Avicennia*) in 10 years or an annual planting area of 14.3 ha (12.8 ha for *Rhizophora* and 1.5 ha for *Avicennia*) per year is planned. The planned planting area by sub-zone and by RC is shown in Table 3.2-5.

Table 3.2-5 Planting Area by Sub-Zone and by RC

Zone	RC or Village	Planting Area (ha)	Area by Species		Number of Villages		
			<i>Rhizophora</i>	<i>Avicennia</i>	<i>Rhizophora</i>	<i>Avicennia</i>	
Conservation	II	RC Toubacouta	7.5	7.5		3	
		Sub-Total	7.5	7.5		3	
	III	RC Diossong	7.5	7.5		3	
		RC Toubacouta	31.0	30.0	1.0	12	1
		RC. Bassoul	12.5	12.5		5	
		RC. Dionouar	7.5	7.5		3	
		RC.Djirnda	12.5	12.5		5	
		Sub-Total	71.0	70.0	1.0	28	1
Rehabilitation	I	Malikounda	2.5	2.5		1	
		Ngueniene					
		RC.Nguekokh	1.0		1.0		1
		RC Djilor	22.0	10.0	12.0	4	12
		RC. Djilass	1.0		1.0		1
		RC.Djirnda	7.5	7.5		3	
		Sub-Total	34.0	20.0	14.0	8	14
	II	RC Fimela	17.5	17.5		7	
		RC. Palmarin Fakao	10.0	10.0		4	
		RC.Djirnda	2.5	2.5		1	
Sub-Total		30.0	30.0		12		
Total		142.5	127.5	15.0	51	15	

4) Planting Area by Year

The planned planting area by year and by sub-zone is shown in Table 3.2-6.

Table 3.2-6 Planting Area by Zone and by Year

Sub-zone	Species	Year										Total
		1	2	3	4	5	6	7	8	9	10	
C-II	<i>Rhizophora</i>	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	7.50
C-III	<i>Rhizophora</i>	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	70.00
	<i>Avicennia</i>	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.00
R-I	<i>Rhizophora</i>	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	20.00
	<i>Avicennia</i>	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	14.00
R-II	<i>Rhizophora</i>	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	30.00
Total	<i>Rhizophora</i>	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	127.50
	<i>Avicennia</i>	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	15.00

(5) Planting Method

1) *Rhizophora*

① Seed Collection Timing and Timing of Planting

The suitable timing for seed collection is from July to October when a large quantity of seeds mature. In the case of *Rhizophora*, the collected seeds will be immediately sown. The timing of planting (sowing) is the most important aspect of planting as it determines the success or failure of planting. The best time is August during the rainy season when the salinity is low. However, the actual timing for each village will be decided taking the busy time of villagers to pursue their livelihood into consideration.

② Seed Collection

The collection of high quality seeds is important. Larger seeds should preferably be collected by shaking the mother trees to make the seeds drop to the ground rather than the collection of seeds floating in a river.

③ Selection of Planting Sites

Planting should commence in a place where the bed is soft and is flooded to a depth of some 50 cm at the time of high tide and then spread to the surrounding area.

④ Planting Distance and Number of Seeds

The planting distance is set at 50 cm x 50 cm. Each village which conducts planting should collect 10,000 viviparous seeds and plant them over an area of 0.25 ha.

⑤ Protection

To prevent the planted seeds from being eaten by domestic animals, the villagers should be reminded not to allow their animals to go near the planting site(s). This warning should be followed by monitoring activities.

2) *Avicennia*

① Seed Collection Timing

In principle, the suitable timing for *Avicennia* seed collection is the same as that for *Rhizophora*. However, because of the higher susceptibility of *Avicennia* than *Rhizophora*, it is preferable to collect *Avicennia* seeds as early as possible so that they can be planted during the period of the dry season when the salinity is low. If the seeds

are collected in July, the planting of seedlings can be conducted in early September after nursing in pots for 1.5 months to better adapt to the new environment.

② Seed Collection

As large seeds as possible should be collected from large *Avicennia* trees for the purpose of collecting high quality seeds. Each village where the planting of *Avicennia* is planned should collect 4,400 seeds, i.e. 10% more than the planned number of seedlings to be planted in view of the expected yield rate in pots.

③ Selection of Planting Sites

Sites where natural *Avicennia* trees grow should be selected on the inland side of the *Rhizophora* planting side and *Avicennia* seedlings should be planted around these sites.

④ Planting Distance and Quantity

The planting distance is set at 50 cm x 50 cm. After nursing in pots, 4,000 seedlings a year should be planted over an area of 0.1 ha by each village concerned.

⑤ Protection

As the young buds of *Avicennia* are often eaten by fish, the planned planting sites should be encircled by fine netting to prevent the incursion by fish.

⑥ Nursing

i. Setting Up of Nursery

Sites which are flooded by the neap tide during the period of high tide, i.e. flooded twice a day, in the dry season should be selected for the setting up of a nursery and the nursing beds should be shaded.

ii. Nursing Method

Pots should be used.

iii. Pot Size

The pots to be used should have a diameter of 7 cm.

iv. Sowing of Seeds

When the seeds are immersed in seawater for 4 – 5 days, the skin will peel off to start the process of root growth. The seeds should then be sown in pots with the roots inserted into the soil.

v. Arrangement of Pots

Wooden frames with a width of 1 m should be set up in the nursery and the seeded pots should be placed in these frames.

vi. Transplanting from Pots (Planting)

Seedlings which have grown in pots for 1.5 months should be transplanted.

(6) Number of Seeds to be Collected

As already described, 10,000 viviparous *Rhizophora* seeds each year should be collected by each village. In the case of *Avicennia*, as the production of 4,000 seedlings is planned by each participating village, 4,400 viviparous seeds should be collected by each village based on an expected yield rate of 90%.

(7) Timing of Planting Work

The timing of the work involved is shown in Table 3.2-7.

Table 3.2-7 Timing of the Work

Species	Work Item	1	2	3	4	5	6	7	8	9	10	11	12
<i>Rhizophora</i>	Seeds Collection								—	—			
	Marking of Planting Sites							—	—	—			
	Planting							—	—	—			
	Management	—	—	—	—	—	—	—	—	—	—	—	—
<i>Avicennia</i>	Setting-up of Nursery					—	—						
	Seeds Collection							—	—				
	Filling of Soil into Pots						—	—					
	Seeding in Pots							—	—				
	Nursing							—	—	—			
	Enclosure of Planting Sites						—	—					
	Marking of Planting sites								—	—			
	Planting								—	—			
	Management	—	—	—	—	—	—	—	—	—	—	—	—

(8) Costs

1) Work Processes

The number of person-days required to conduct each type of work involved in the planting for each village is shown in Table 3.2-8 based on the planting of 0.25 ha for *Rhizophora* and 0.1 ha for *Avicennia*. Although the personnel cost is not included in the cost tables because of the participatory nature of planting-related work, i.e. free of cost, the personnel cost is calculated for reference purposes.

Table 3.2-8 Planting Processes and Required Person-Days

(Unit: person-days)

Species	Type of Work	Person-Days per Village	
<i>Rhizophora</i>	Marking of planting site	5	Marked by rope
	Seed collection	10	Use of a pirogue; 1,000 seeds/person-day
	Planting	40	250 seedlings/person-day
	Total	55	
<i>Avicennia</i>	Seed collection	10	440 seeds/person-day
	Filling of soil into pots	10	400 pots/person-day
	Creation of nursery (shading)	20	
	Creation of nursery (wooden frames)	10	
	Sowing in pots	10	400 seeds/person-day
	Arrangement of pots in frames	5	800 pots/person-day
	Nursing	20	Monitoring as required
	Netting to prevent damage by fish	20	
	Marking of planting site	5	Marked by rope (or string)
	Planting	40	100 seedlings/person-day
	Total	150	

2) Planting Costs (per Village)

① First Year

Table 3.2-9 *Rhizophora* Planting Costs in First Year

(Unit: FCFA)

Item	Unit Cost	Quantity	Direct Cost
Rope	100	100 m	10,000
Stake	300	10	3,000
Boat rental	20,000	1	20,000
Fuel	350	60 litres	21,000
Total			54,000

Table 3.2-10 *Avicennia* Planting Costs in First Year

(Unit: FCFA)

Item	Unit Cost	Quantity	Direct Cost
Rope	50	100 m	5,000
Spade (large)	1,600	5	8,000
Planting trowel	1,000	5	5,000
Stake	300	10	3,000
Vinyl Pot	10	4,000	4,000
Shading	50,000	1 set	50,000
Net to prevent eating damage	1,000	150 m	150,000
Vehicle or boat rental	20,000	1	20,000
Fuel	250	60 litres	21,000
Total			266,000

② Second Year Onwards

Table 3.2-11 *Rhizophora* Planting Costs from Second Year Onwards

(Unit: FCFA)

Item	Unit Cost	Quantity	Direct Cost
Stake	300	10	3,000
Boat rental	20,000	1	20,000
Fuel	350	60 litres	21,000
Total			44,000

Table 3.2-12 *Avicennia* Planting Costs from Second Year Onwards

(Unit: FCFA)

Item	Unit Cost	Quantity	Direct Cost
Stake	300	10	3,000
Vinyl pot	10	4,000	40,000
Vehicle or boat rental	20,000	1	20,000
Fuel	350	60 litres	21,000
Total			84,000

3) Project Cost by RC and Year

Table 3.2-13 shows the project cost by RC and year based on the necessary planting cost per ha.

Table 3.2-13 Project Cost by Sub-Zone and Year

(Unit: '000 FCFA)

Zone	Activity		Year									
			1	2	3	4	5	6	7	8	9	10
C-II	Planting	R	162	132	132	132	132	132	132	132	132	132
C-III	Planting	R	1,512	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232
		A	266	84	84	84	84	84	84	84	84	84
	Sub-Total		1,778	1,316	1,316	1,316	1,316	1,316	1,316	1,316	1,316	1,316
R-I	Planting	R	432	352	352	352	352	352	352	352	352	352
		A	3,724	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176
	Sub-Total		4,156	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528
R-II	Planting	R	648	528	528	528	528	528	528	528	528	528
Total	Planting	R	2,754	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244
		A	3,990	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260
	Sub-Total		6,744	3,504	3,504	3,504	3,504	3,504	3,504	3,504	3,504	3,504

Note: R = *Rhizophora*; A = *Avicennia*

4) Personnel Cost (for reference only)

① Personnel Cost for Planting per Village

Assuming a daily wage of 3,000 FCFA, the personnel cost for planting can be calculated in the following manner.

i. Planting of *Rhizophora*

$$3,000 \text{ FCFA/person-day} \times 55 \text{ person-days} = 165,000 \text{ FCFA}$$

ii. Planting of *Avicennia*

$$3,000 \text{ FCFA/person-day} \times 150 \text{ person-days} = 450,000 \text{ FCFA}$$

② Annual Personnel Cost for Entire Planting Work

The annual personnel cost for the entire work under the planting programme is shown in Table 3.2-14.

Table 3.2-14 Annual Personnel Cost for Mangrove Planting Work (for reference only)

(Unit: FCFA)

Item		No. of Villages	Personnel Cost per Village	Annual Personnel Cost for All Villages
Planting	<i>Rhizophora</i>	51	165,000	8,415,000
	<i>Avicennia</i>	15	450,000	6,750,000
Total				15,165,000

3.2.3 Natural Mangrove Forest Management Programme

In principle, no cutting is currently allowed in natural mangrove forests. Accordingly, the activities planned under the programme only aim at the conservation of these forests.

The primary aim is the conservation of existing *Rhizophora* and *Avicennia* forests in both the Conservation Zones and Rehabilitation Zones. In Conservation Sub-Zone I, no human interference will be made, leaving any changes to nature. The mangrove forests in Conservation Sub-Zone II and Sub-Zone III will be categorised as conservation forests of which the regeneration will, in principle, be natural regeneration. However, enrichment planting will be conducted in places where urgent rehabilitation is required because of the state of devastation, etc. This enrichment planting will be conducted by each village based on local knowledge.

3.2.4 Village Forest Creation Programme

(1) Objectives of Village Forest Creation

Village forests will be created as production forests to supply alternative wood to mangrove logs and firewood. In addition to the creation of village forests for common use, the planting of wood producing species and fruit trees on privately owned land (vacant land and farmland, etc.) will be encouraged in parallel with the creation of village forests for the purpose of promoting the diversification of income sources through fruit production and alleviation of the supply shortage of firewood.

Although village forests will be created as alternative forests to mangrove forests to supply wood, the total area would be impossibly huge if the current consumption of mangrove wood is to be entirely substituted. While entire replacement is ultimate direction in the future, the present programme aims at determining a realistic area of production forests in each target village for the production of firewood.

(2) Silviculture

1) Regeneration

Regeneration will be conducted by sprouting.

2) Cutting

Clear cutting will be adopted.

3) Species, Target Product and Rotation Age

The species, target product and rotation age for village forests are shown in Table 3.2-15.

Table 3.2-15 Species, Target Product and Rotation Age

Species	Target Product	Rotation Age	Usage
Eucalyptus	Firewood	6	While the production of firewood is the primary objective, cut trees may also be used as logs.

Melaleuca is another candidate species for village forests. *Tectona grandis*, *Gmelina arborea* and *Cassia siamea* may be candidates for planting in village forests in areas with high rainfall.

4) Tending

After cutting which takes place after the second regeneration, two or three excellent sprouts will be left for each tree while the others will be pruned.

5) Volume at Time of Cutting

Based on the field survey results, the average volume per ha at the time of cutting is estimated as follows.

Table 3.2-16 Volume of Eucalyptus at Time of Cutting

Height	DBH	Single Tree Volume	Number of Trees per ha	Volume per ha
8.0 m	10.0 cm	0.037699 m ³	888	33 m ³

Notes

- 1) The single tree volume is based on a DBH factor of 0.6.
- 2) In regard to the number of trees, the full growth of 80% of the originally planted 1,110 seedlings (planting distance of 3 m x 3 m) is assumed.

(3) Area of Village Forests

Village forests will be created in Conservation Sub-Zones II and III and Rehabilitation Sub-Zones I and II. The target villages are those with a population of 500 or more and planting over an area of 0.5 ha/year is planned for six years. The rotation age of Eucalyptus is assumed to be six years.

Table 3.2-17 Area of Village Forests by Sub-Zone and RC

Zone		RC or Village	Number Villages	Area (ha)
Conservation	II	RC Toubacouta	2	6
	III	RC Diossong	1	3
		RC Toubacouta	6	18
		RC. Bassoul	4	12
		RC. Dionouar	3	9
		RC.Djirnda	3	9
	Sub-Total	19	57	
Rehabilitation	I	RC.Nguekokh	2	6
		RC Djilor	10	30
		RC. Djilass	1	3
		RC.Djirnda	1	3
	Sub-Total	14	42	
	II	RC Fimela	5	15
		RC. Palmarin Fakao	3	9
		RC.Djirnda	1	3
Sub-Total		9	27	
Total			42	126

(4) Planting Period

Six years

(5) Forest Demarcation

The planned site for the village forest should be demarcated in each village. In this context, the area for the creation of a production forest, i.e. village forest, in six years should be demarcated and marked on a map. The year of planting, planting area and number of planted seedlings should be recorded in a register.

(6) Planting

1) Planting Distance and Number of Seedlings

The planting distance should be 3 m x 3 m and the total number of planted seedlings should be 1,110/ha.

2) Obtaining of Seedlings

The seedlings should be obtained from the DEFCCS. Assuming a supplementary planting rate of 10%, some 1,200 seedlings per ha should be obtained each year to plant 1,110 seedlings per ha.

(7) Cutting

1) Yield (per ha)

Based on the available volume at the time of cutting, the yield per ha shown in Table 3.2-18 can be expected. Here, the successful growth to mature trees (888) trees of 80% of the originally planted 1,110 seedlings is assumed.

Table 3.2-18 Yield per ha

Firewood
33 m ³

2) Annual Yield

The expected annual yield after the sixth year is shown in Table 3.2-19.

Table 3.2-19 Yield from Village Forests by Sub-Zone and RC

Zone		RC or Village	Planted Area (ha)	Annual Cutting Area (ha)	Annual Cutting Volume (m ³)
Conservation	II	RC Toubacouta	6	1	33
	III	RC Diossong	3	0.5	17
		RC Toubacouta	18	3	99
		RC Bassoul	12	2	66
		RC Dionouar	9	1.5	50
		RC Djirnda	9	1.5	50
		Sub-Total	57	9.5	314
Rehabilitation	I	RC Nguekokh	6	1	33
		RC Djilor	30	5	165
		RC Djilass	3	0.5	17
		RC Djirnda	3	0.5	17
		Sub-Total	42	7	231
	II	RC Fimela	15	2.5	83
		RC Palmarin Fakao	9	1.5	50
		RC Djirnda	3	0.5	17
		Sub-Total	27	4.5	149
Total			126	21	693

(8) Summary of Planting and Cutting Volumes by Year

The planting and cutting volumes for the entire Project Areas are shown in Table 3.2-20.

Table 3.2-20 Planting and Cutting Volumes for Entire Project Areas

Year	1	2	3	4	5	6	7	8	9	10
Planting Volume (ha)	21	21	21	21	21	21				
Cutting Area							21	21	21	21
Cutting Volume (m ³)							693	693	693	693

(9) Costs

The number of person-days required for planting and cutting is described below. Although the personnel cost is not accounted for because of the participatory nature of the work, the personnel cost is calculated purely for reference purposes.

1) Person-Days for Planting

Table 3.2-21 Planting Processes and Person-Days

(Unit: person-days)

Species	Work Item	Person-Days per Village (0.5 ha)	
Eucalyptus	Marking of planting spots	5	Marked by small stake
	Digging of planting holes	10	62 holes/person-day
	Planting	10	62 seedlings/person-day
	Total	25	

2) Person-Days for Cutting

The required person-days for cutting is assumed based on 0.20 m³/person-day, i.e. 20 trees/person-day, meaning that five person-days are required to obtain 1 m³ of firewood.

3) Costs

① Direct Costs

The costs to be paid by each village for the period from the first year to the sixth year are shown in Table 3.2-22.

Table 3.2-22 Planting Cost per Village

(Unit: FCFA)

Item	Unit Cost	Quantity	Direct Cost
Rope	100	100 m	10,000
Stake	300	10	3,000
Hatchet	1,600	5	8,000
Wire for fencing of village forest	100	1,200 m	120,000
Total			141,000

From the seventh year onwards, there will be no direct cost because of regeneration by sprouting.

② Personnel Cost (for reference only)

The personnel cost for planting per year and per village will be 75,000 FCFA (3,000 FCFA/person-day x 25 person-days) or 3,150,000 FCFA per year for the entire Project Areas (42 villages).

The annual personnel cost for cutting will be 6,000 FCFA per 1 m³ (3,000 FCFA/person-day x 2 person-days) in the seventh year onwards. The cost for each village will be 99,000 FCFA (6,000 FCFA/m³ x 16.5 m³). For the entire Project Areas, the annual cost will be 4,158,000 FCFA (6,000 FCFA/m³ x 693 m³) per year from the seventh year to the 10th year.

4) Income

The use of the produced wood will vary depending on the particular type of demand in each village although the main use will be as alternative firewood to mangrove firewood. The difference between the required volume of firewood for home consumption and the cutting volume will be available for sale. Assuming that 50% of the yield is used as firewood for home consumption with the remaining 50% being sold (30% as firewood for smoking, etc. and 20% as logs), the average income per village in the seventh year onwards is as shown in Table 3.2-23.

Table 3.2-23 Average Annual Income per Village in Seventh Year Onwards

Usage	Cutting Volume (m ³)	Seles Capital Volum	Unit Sales Price (FCFA)	Income (FCFA)
Firewood (Home Consumption)	8.25	-	-	-
Firewood	4.95	19.8/lot	4,200/lot	83,160
Logs	3.30	8.91/log	2,000/log	178,200
Total	-	-	-	261,360

Note: 1m³ = 4 lots; 1 lot = 200 – 250 kg (based on local practice)

5) Income and Expenditure Balance

The income and expenditure balance regarding the creation of village forests for the entire Project Areas is shown in Table 3.2-24.

Table 3.2-24 Annual Balance for Entire Project Areas

(Unit: FCFA)

Year	No. of Villages	Average per Village		Entire Project Areas	
		Expenditure	Income	Expenditure	Income
1	42	141,000		5,922,000	
2	42	141,000		5,922,000	
3	42	141,000		5,922,000	
4	42	141,000		5,922,000	
5	42	141,000		5,922,000	
6	42	141,000		5,922,000	
7			261,000		10,962,000
8			261,000		10,962,000
9			261,000		10,962,000
10			261,000		10,962,000

Notes

- 1) The personnel cost is not accounted for because of the participatory nature of the work.
- 2) As the seedlings will be supplied by the DEFCCS, neither the nursery construction cost nor seedling production cost are accounted for.

3.2.5 Apiculture Programme

(1) Objectives of Apiculture

In the Project Areas, 1.5 tons of honey is currently produced in three villages near Toubacouta using some 200 wooden beehives. This translates to the production of some 7.5 kg of honey per wooden beehive. However, it is said that the production volume can be increased by some fivefold even now if the recovery of honey from wooden beehives placed in the island area is possible. At present, wooden beehives are placed in *Rhizophora* forest areas. Areas where apiculture is feasible in the Project Areas are those with a large number of mangroves which flower profusely. By sub-zone, Conservation Sub-Zones II and III are relevant. The apiculture union in Toubacouta currently utilises only a small area, indicating a high potential for apiculture. Once mangrove forests have been rehabilitated in the future, apiculture may well be feasible in both Rehabilitation Sub-Zone I and Rehabilitation Sub-Zone II. Given such situation, apiculture is planned to create a secondary source of income for local residents using mangrove forests which are sources of honey.

(2) Planning

The UICN plans to commence the production of honey in areas where apiculture is feasible. In view of this, three villages in Conservation Sub-Zone III which are not included in the UICN's plan are selected for the introduction of apiculture.

1) Formation of Apiculture Group

Five villagers will be selected in each village to conduct apiculture activities.

2) Distribution of Necessary Tools, etc.

The following tools, etc. will be distributed to each of the five villagers acting as apiculturalists in each of the three selected villages.

- Wooden beehives : 5 sets
- Smoke sprayer : 1
- Gloves : 1 pair
- Boots : 1 pair
- Honey removal tool : 1

In regard to protective outfits, the Moundé model of such outfits which combine a face mask, heavy cloth shoes and gloves will be made by the villagers in question.

3) Training and Making of Protective Outfit

Training on apiculture techniques and practical training will be conducted by means of the villagers concerned participating in the training organized by the UICN. The same villagers will visit Moundé to receive the relevant training on the making of protective outfits.

(3) Costs

1) Expenditure

① Required Tools for Apiculture

The cost and specifications of the tools, etc. required for apiculture are shown in Table 3.2-25.

Table 3.2-25 Cost of Apiculture Tools, etc.

Item	Cost (FCFA)	Remarks
1. Wooden beehives (with a bottom + without a bottom)	22,500/set	Production volume of honey per one collection and per wooden beehive: 30 kg
2. Protective outfits · Protective outfit (jacket + trousers) · Boots · Gloves	2,000	Even though old clothing is used, 2,000 FCFA is accounted as the necessary cost for sandals, etc. Villagers will make the outfits which will combine a face mask, heavy cloth shoes and gloves.
3. Collection tools · Smoke sprayer · Bee brush · Frame lifting tool	15,000 2,000 3,000	
4. Waxed paper	800/kg	

② Training Cost

Training will only be conducted in the first year. The five apiculturalists will undergo three types of training (knowledge of apiculture, practical skills and making of protective outfit) twice. The cost of each training session (lasting for two days) is set at 5,000 FCFA, including the transport cost and the overnight accommodation cost.

③ Required Expenditure per Village

The tool cost and training cost required for each village as the initial investment cost is shown in Table 3.2-26. The tool cost is depreciated over a period of 10 years.

Table 3.2-26 Tool and Other Costs per Village

		(Unit: FCFA)		
	Item	Quantity	Unit Cost	Total Cost
Apicultural Tools, etc.	Wooden beehive	25	22,500	562,500
	Smoke sprayer	5	15,000	75,000
	Bee brush	5	2,000	10,000
	Frame removal tool	5	3,000	15,000
	Waxed paper	5	800	4,000
	Sub-Total			
Training	Training (6 sessions x 5 villagers)	30	5,000	150,000
	Protective gear (twice x 5 villagers)	10	2,000	20,000
	Sub-Total			170,000
Total				826,500

2) Income

The first year will be spent for the distribution of tools, etc. and the second year will be spent for training. In the third year, 7.5 kg of honey per wooden beehive will be produced. Subsequently, the production volume will increase by 2.5 kg each year over a three year period to reach an annual production volume of 15 kg per wooden beehive in the sixth year onwards.

Assuming a sales price of 1,000 FCFA per kg after the deduction of expenses for the buyer, etc., the annual income per village from 25 wooden beehives will be 375,000 FCFA (1,000 FCFA/kg x 15 kg/beehive x 25 beehives).

3) Income and Expenditure Balance

The income and expenditure balance of apiculture for the entire Project Areas (three target villages) is shown in Table 3.2-27.

Table 3.2-27 Annual Income and Expenditure Balance for Entire Project Areas

(Unit: FCFA)

Year	No. of Villages	Per Village		Entire Project Areas	
		Expenditure	Income	Expenditure	Income
1	3	836,500	0	2,592,000	
2	3		0	0	0
3	3		187,500		562,500
4	3		250,000		750,000
5	3		312,500		937,500
6	3		375,000		1,125,000
7	3		375,000		1,125,000
8	3		375,000		1,125,000
9	3		375,000		1,125,000
10	3		375,000		1,125,000

Notes

- 1) The personnel cost is not accounted for because of the participatory nature of the work.
- 2) For training on knowledge of apiculture and practical skills, the villagers will participate in the training organized by the UICN.

3.3 Fisheries Resources Utilization and Management

3.3.1 Planning Details

We present 9 items on fisheries resources in the plan. Mangrove forests and fisheries resources are closely connected. Accordingly, we concentrate on the fisheries resources that are important to

economic activities at Saloum Delta in accordance with the rehabilitation and conservation zones in this plan.

The conservation zone covers islets of Saloum Delta where mangrove forests grow well with abundance of shellfish resources. They are very important production objects for women in the delta. Guineans come to Saloum Delta to smoke the ethmalose migrating up to the rivers with the help of local people. The smoking business has developed in the delta because people there have access both to migrating ethmalose and mangrove firewood. We plan 6 items in this zone to control mangrove firewood consumption and conserve mangrove for sustainable shellfish and ethmalose utilization.

The rehabilitation zone covers inlands of the delta where many people catch shrimps. It is fair to say that shrimp catching is only the economic activity for these people during the dry season. Therefore we plan 3 items at mangrove rehabilitation zone and conservation for sustainable shrimp utilization and management. The planning details are in the Table 3.3-1.

Table 3.3-1 Planning Items for Fisheries resources Utilization and Management

Zone	Resource	No.	Planning Items	Priority Subject
Conservation	Shellfish/ Ethmalose	1	Conversion to the improved smoking furnace	Controlling mangrove cutting and firewood consumption
		2	Introduction of a new system for mangrove oyster resource management	Mangrove oyster resource management, mangrove conservation
		3	Mangrove oyster culture extention	Mangrove oyster resource management, mangrove conservation
		4	Value added with shellfish processing	Establishment of a fund to plant village forest as substitution for mangrove firewood
		5	Self-production of shellfish harvest protectors (glove and boots)	Mangrove conservation and rehabilitation
		6	Support to the beach committees	Fisheries resources management, mangrove conservation and rehabilitation
Rehabilitation	Shrimp	7	Reinforcement of shrimp resource management	Fishing ground equipment, mangrove rehabilitation and conservation
		8	Establishment of life jacket workshop	Mangrove rehabilitation, establishment of fund for village forest
		9	Fisheries resources enhancement judgement due to mangrove rehabilitation	Fishing ground equipment, mangrove rehabilitation and conservation

3.3.2 Conversion to the Improved Smoking Furnace

(1) Objectives

There is a tendency to increase units of smoking furnace for ethmalose in Saloum Delta. As they use mangrove firewood for smoking, it will bring about mangrove forest deterioration through illegal cutting.

In this plan, we will reduce mangrove firewood consumption with the improved smoking furnace. This smoking furnace has better heat and work efficiency than the former type. Therefore we shall convert the old type to the improved smoking furnace in a wide area of Saloum Delta. Meanwhile, Community Rural (CR) should control the total units of smoking furnace in the delta to reduce total mangrove firewood consumption. It is also scheduled to save the environment funds from profits of the smoking business for the rehabilitation and conservation of mangrove forests.

(2) Advantages of Improved Smoking Furnace

Conversion to the improved smoking furnace aims to reduce mangrove firewood consumption. It has other advantages as follows:

1) Mangrove Firewood Consumption

It has twice the heat efficiency of the former type with two-story smoking space, and improves heat efficiency even more when all the entrances are closed.

2) Working Efficiency

The adoption of small wire baskets has shortened working hours because all the attendants can work together with the baskets.

3) Production Quality

The improved smoking furnace has improved production quality because smoke stays in the smoking furnace longer, holding the air temperature inside stable for a long time.

4) Smoking Pollution

The old type of the smoking furnace caused pollution due to much smoke reaching the villages nearby. The improved smoking furnace keeps most smoke inside, and decreases the smoking pollution.

(3) Methods

1) Design

The improved smoking furnace has 3 compartments with 2 layers as shown on Fig.3-3-1, at 603 cm long, 130 cm wide and 135 cm high. Each compartment loads 6 baskets on the first layer and 8 baskets on the second layer, totaling 42 baskets with 3 compartments. One basket can load 20 to 25 kg of raw fish, accordingly it is possible to smoke 950 kg of raw fish in one round of processing. The improved smoking furnace shown in the figure 3-3-1 is a basic type with the standard specifications.

- ① Size : 603 cm long x 130 cm wide x 135 cm high
- ② Total number of baskets : 42
- ③ Required raw fish : 950 kg
- ④ Final product : 247 kg
- ⑤ Required firewood : 133 kg

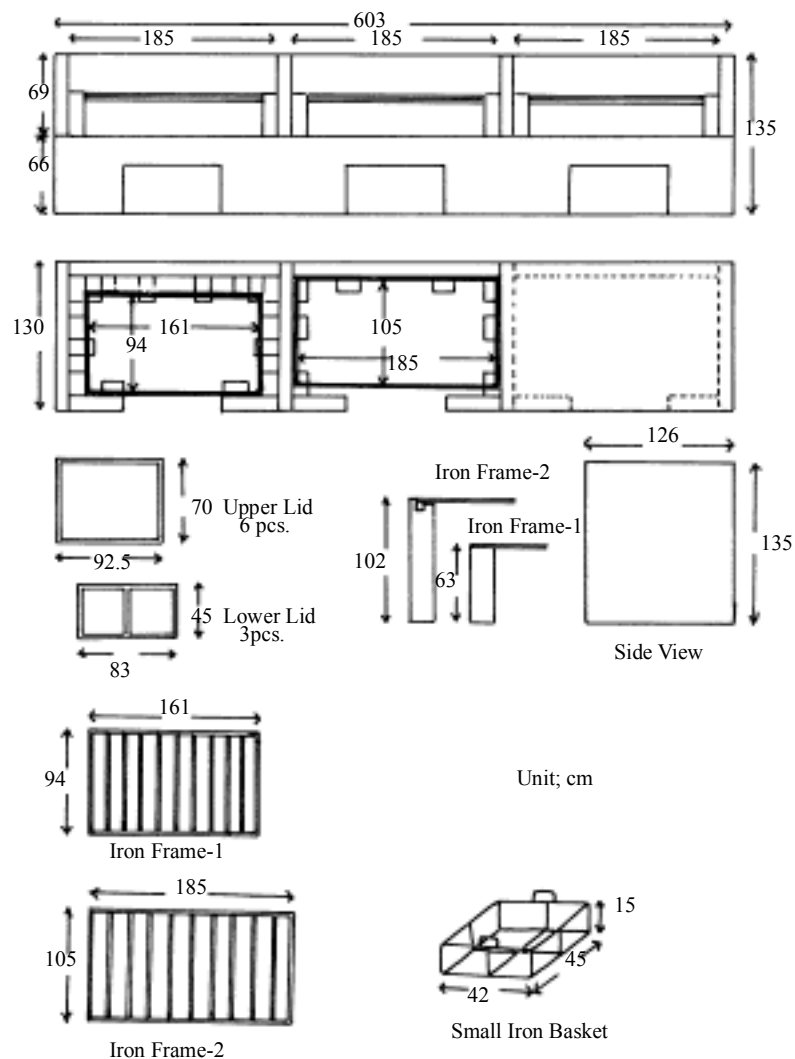


Fig. 3.3-1 Specifications of the Improved Smoking Furnace

2) Materials

Materials required for constructing a set of improved smoking furnace are shown in the Table 3.3-2.

Table 3.3-2 Required Material to Construct a Unit of the Improved Smoking Furnace

Improved Smoking Furnace (603cm x 135cm x 126cm)	Specifications	Quantity
Cement block	40cm x 20cm x 12cm	240 pcs.
Cement block	20cm x 20cm x 12cm	48 pcs.
Tube Galva	33mm x 42mm x 5.8m	1 pc.
Iron Frame-1	Fer a Beton 25mm, 145cm x 87cm	3 pcs.
Iron Frame-2	Fer a Beton 25mm, 175cm x 94cm	3 pcs.
Wire basket	42cm x 45cm x 15cm, Using Gantois MC on the bottom.	42 pcs.
Corrugated sheet for roof	250cm x 80cm, 0.23mm	4 pcs.
Corrugated sheet for lids	200cm x 80cm, 0.23mm	4 pcs.
Lumber for lids	4cm x 1.5cm x 4m	7 pcs.
Cement	50kg/bag	6 bags.
Shells	assorted	
Sand	assorted	
Spatulas		5 pcs.
Shovels		3 pcs.

3) Smoke Processing

① Raw Material Purchase

Raw fish (950 kg) and firewood (133 kg) are necessary for one operation to smoke the fish.

② Smoking

The processing method is the same as the former type in principle except closure of all the entrances after the fire is stable. It avoids firewood burning with wind and makes the fire stable.

③ Packing

The final products are packed the same way as in the former type.

④ Sales

The selling method is unchanged.

4) Organization

Organizations including the CR administration are required to utilize the business profit for environmental activities.

5) Total Units Management

It is necessary to adopt a smoking furnace registration system in which all the CR in the delta control the total units of the smoking furnace.

A permit for the construction of a smoking kiln can only be issued by the local public body concerned after the approval of the technical department concerned.

(4) Conversion Units and Firewood Consumption

1) Conversion Units

There are 132 units of smoking furnace at 14 villages in the delta as of April 2002. We aim to convert 50% of the total number, i.e. 66 units, to improved ones within 10 years. In 2002, the highest quantity of ethmalose was landed in Fatick region in the last 11 years when we counted the number of smoking furnace in the delta. Although 11,275 tons of ethmalose were landed in Fatick region in 2002, the comparable figure for 2001 was 4,411 tons. Landing of the ethmalose on average was 2,888 tons between 1992 and 2002. This means the big catch in 2002 was an aberration. We believe that, if we convert 66 units to the improved smoking furnace within 10 years, we will be able to cover all the ordinary demands for smoking in the delta.

2) Firewood Consumption

We calculate that there will be 7 operations a month for 3 months a year. If we convert 66 units, the necessary raw fish is 1,316,700kg (950 kg x 7 times x 3 months x 66 units).

The necessary firewood in the improved smoking furnace is 133 kg per 950 kg of raw fish, therefore it will be 184,338 kg (133 kg x 7 times x 3 months x 66 units) for a year. The former smoking furnace needs 304 kg of firewood per 950 kg of raw fish, so it consumes 421,344kg (1,316,700kg ÷ 950kg x 304kg) of firewood per year. Therefore, it will save 237 tons (56%) of firewood per year if we convert 66 units to the improved smoking furnace.

(5) Economic Advantage

It has been found that the improved smoking furnace reduces firewood consumption by 56 % and increases the quantity of final products by 4 %. With the former smoking furnace, it takes 304 kg

of firewood to smoke 950 kg of raw fish and produce 209 kg of final outputs; with the improved smoking furnace, it takes 171 kg of firewood to smoke 950 kg of raw fish and produce 247 kg of final outputs. These numbers prove the economic advantage of the improved smoking furnace. We have also compared business profits of using the former type of smoking furnace with those of the improved one.

Table 3.3-3 Comparison of Business Cost with Two Types of Smoking Furnace

(FCFA)			
Items	Improved furnace	Former Furnace	Difference
Construction cost for a furnace	450,000	275,000	175,000
Processing cost for a operation	55,711	58,418	-2,707
Sales amount for a operation	74,100	62,700	11,400
Rough profit for a operation	18,389	4,282	14,107

The smoking business with improved smoking furnace gains a profit 14,107 Fcfa higher per operation per unit than the former type. If we operate 7 times a month for 3 months a year, the annual additional profit will be 296,247 Fcfa, which is more than enough to cover more the construction cost hike (175,000 Fcfa).

(6) Business Investment and Profit

We plan to convert 5 units a year in the first 5 years, 8 units a year from the 6th to 9th years and 9 units in the 10th year. The annual business costs and profits based on 7 operations per month for 3 months a year are as follows:

Table 3.3-4 Business Figures on the Improved Smoking Furnace

(FCFA)					
Year	Conversion Units	Construction cost	Operation cost	Sales amount	Annual profit
1	5	2,250,000	5,849,655	7,780,500	1,930,845
2	5	2,250,000	5,849,655	7,780,500	1,930,845
3	5	2,250,000	5,849,655	7,780,500	1,930,845
4	5	2,250,000	5,849,655	7,780,500	1,930,845
5	5	2,250,000	5,849,655	7,780,500	1,930,845
6	8	3,600,000	9,359,448	12,448,800	3,089,352
7	8	3,600,000	9,359,448	12,448,800	3,089,352
8	8	3,600,000	9,359,448	12,448,800	3,089,352
9	8	3,600,000	9,359,448	12,448,800	3,089,352
10	9	4,050,000	10,529,379	14,004,900	3,475,521
Total	66	29,700,000	77,215,446	102,702,600	25,487,154

3.3.3 Introduction of a New System for Mangrove Oyster Management

(1) Objectives

Year after year, people in Saloum Delta depend more on mangrove oyster resources for their economic activities. As oyster resources become scarce, it takes more effort to harvest them, with a greater distance to the fishing grounds and smaller size of the harvested oyster. We aim to conserve mangrove forests and assure sustainable fishing ground utilization through introduction of the fishing ground management system for the mangrove oyster.

(2) Management Policy

Mangrove oysters depend much on the mangrove roots to grow up. This activity will support the oyster resource rehabilitation and also enable conservation of mangrove forests through the establishment of an environment fund.

1) To assure an sufficient period for growth

The closed fishing season for oysters should be extended to 1.5 years from the present 0.5 year. It will enable resource rehabilitation through protection of oysters throughout their lifetime.

2) To manage fishing grounds in a region-wide fashion

It makes sense to manage fishing grounds in a region-wide fashion by formulating a consensus at an oyster resource conference with the participation of all the stakeholders.

(3) Methods

1) To organize oyster resource conference

All the stakeholders who use the common oyster fishing grounds should attend the oyster resource conference to build a consensus on how to manage the fishing grounds. All the relevant stakeholders should be identified at the first stage based on the study. It will be difficult to proceed with the above activities without initiatives from authorities or NGOs at the first stage. However, inhabitant groups should take initiative after the framework has been formulated.

2) To introduce a rotation system to close oyster fishing grounds

Several main villages select three target fishing grounds for oyster to enable the extension of the no-fishing period from 0.5 year to 1.5 years. One of the three fishing grounds is always closed for 1.5 years on a rotational basis.

(4) Extension

Based on the results of the ongoing activity in Sokone, we will extend the same management system to 2 other sites in the delta. This system will be adopted at three sites in the delta within 10 years from the beginning.

(5) Business Investment

Annual business cost at a site is as follows:

Table 3.3-5 Annual Business Cost per Site

Costs for oyster resource management conference			
Meeting hall rental fee		500,000	FCFA
Transportation	3,000FCFA x 50people	150,000	FCFA
Material cost	1,500FCFA x 50pcs.	75,000	FCFA
Resource management costs			
Signboards	200,000FCFA x 4pcs.	800,000	FCFA
Operation log	5,000FCFA x 5pcs.	25,000	FCFA
Technical report		1,140,000	FCFA
Total		2,690,000	FCFA

Based on the above, the business plan for 10 years is as follows:

Table 3.3-6 Business Cost for the introduction of the Mangrove Oyster Management System

Year	Target areas	Annual business cost (FCFA)
1	1	2,690,000
2	1	2,690,000
3	1	2,690,000
4	2	5,380,000
5	2	5,380,000
6	2	5,380,000
7	3	8,070,000
8	3	8,070,000
9	3	8,070,000
10	3	8,070,000
Total		56,490,000

3.3.4 Mangrove Oyster Culture Extension

(1) Objectives

It is possible to assure sustainable use of the oyster resource by reducing the pressure to harvest it with oyster culture together with the oyster resource management system and mangrove conservation. We aim to spread the simple technique for oyster culture that the local people can easily adopt with their own knowledge and budget.

(2) Planning Details

This activity aims to attain the sustainable oyster resource utilization and enable the establishment of the environment fund for mangrove conservation. The planning details are as follows:

1) Juvenile Collection

The Sokone Fresh Oyster Association is to identify the suitable period for the juvenile collection and implement it by placing the *guirlandes* in the water. The collected juveniles should be protected from harmful conditions such as heat and predators.

2) Oyster Culture

Oyster culture is required until juveniles reach 70 mm long for delivery to the fresh oyster markets. After several years, this practice is to spread to other villages in the delta.

(3) Methods

1) Juvenile collection

The *guirlandes* method is used to collect oyster juveniles.

2) Location of oyster culture

A roof is required to shade oyster from the sunlight. Locations for oyster culture should have a slight water current, no predators, and be on the suitable land height where the *guirlandes* sink in the water during ebb tide in a neap tide. The oyster park is shown in the following figure where the suitable numbers of the juvenile-attached oyster shells are hung down or scattered.

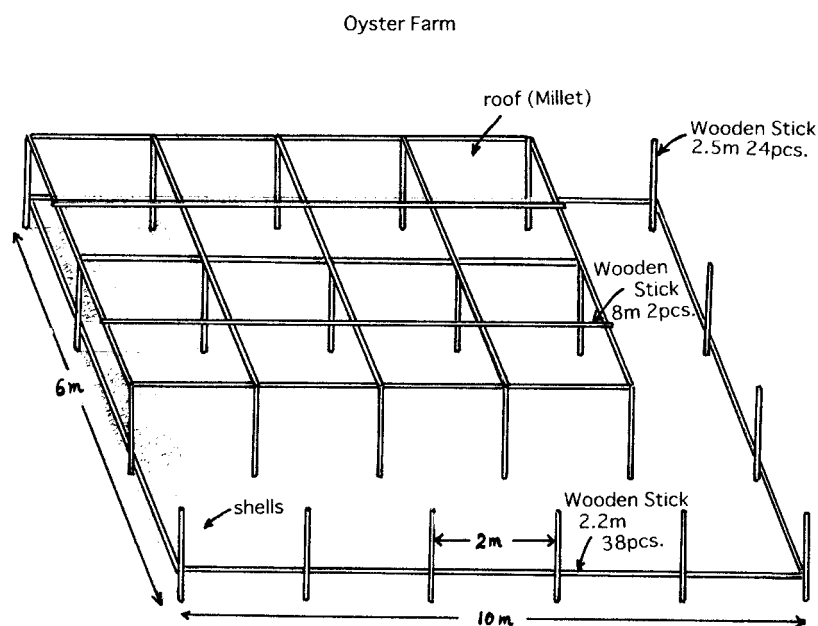


Fig.3-3-2 The oyster park

(4) Extension Plan

- Selling of cultured oysters will become regular work at the Sokone Fresh Oyster Association within 5 years. Cultured oysters cover more than 50 % of the total sales within 10 years.
- Oyster culture sites will be set up in two more villages in the delta in the 4th year and in yet two additional villages in the 8th year.

(5) Material Costs

The required costs to build a unit of oyster park and *guirlande* materials are as follows:

Table 3.3-7 Business Cost for Oyster Culture per Site

Material	Specifications	Quantity	Unit Price	Amount	(FCFA)
Stake	250cm	24 pcs.	3,000	72,000	FCFA
Stake	220cm	38 pcs.	3,000	114,000	FCFA
Roof material	2m x 8m	2 sheet	20,000	40,000	FCFA
Shells	6m x 1m	suitable amount		10,000	FCFA
PE cord for collectors	3mm dia.200m/circle	8 coils	5,000	40,000	FCFA
Eyeleteer		10 pcs.	2,000	20,000	FCFA
PE cord for tying	6mm dia. 200m/circle	3 coils	12,000	36,000	FCFA
Hammer	Large type	1 pc.		10,000	FCFA
Vernier micrometer		3 pcs.	10,000	30,000	FCFA
Measure	For 10m	1 pc.	5,000	5,000	FCFA
Notebook		4 pcs.	1,000	4,000	FCFA
Total				381,000	FCFA

(6) Business Investment

The necessary business investment within 10 years is as follows, in which two additional oyster parks each are added in the 4th and 8th years.

Table 3.3-8 Business Figures on Mangrove Oyster Culture

Year	Additional Parks	Culture Parks	Construction Cost(FCFA)	Maintenance Cost (FCFA)	Annual Cost	Sales Quantity (Dozen)	Sales Amount (FCFA)	Annual Profit (FCFA)
1	0	4	0	800,000	800,000	4,000	4,000,000	3,200,000
2	0	4	0	800,000	800,000	4,600	4,600,000	3,800,000
3	0	4	0	800,000	800,000	5,000	5,000,000	4,200,000
4	2	6	762,000	800,000	1,562,000	8,400	8,400,000	6,838,000
5	0	6	0	1,200,000	1,200,000	9,600	9,600,000	8,400,000
6	0	6	0	1,200,000	1,200,000	10,500	10,500,000	9,300,000
7	0	6	0	1,200,000	1,200,000	11,400	11,400,000	10,200,000
8	2	8	762,000	1,200,000	1,962,000	16,000	16,000,000	14,038,000
9	0	8	0	1,600,000	1,600,000	18,000	18,000,000	16,400,000
10	0	8	0	1,600,000	1,600,000	20,000	20,000,000	18,400,000
Total	4	8	1,524,000	11,200,000	12,724,000	107,500	107,500,000	94,776,000

3.3.5 Value Added with Shellfish Processing Improvement

(1) Objectives

Shellfish collection, processing and sales are important and precious economic activities for women in Saloum Delta. Since the infiltration of the commodity economy is not an exception in this area, women who need income seek an easily accessible resource such as shellfish. Shellfish resource reproduction is threatened due to increasing pressure to yield the same resource.

Sustainable use of shellfish resources in mangrove wetland is possible by maintaining the environment around people in the mangrove ecosystem. This activity plan aims to turn the production orientation from quantity to quality by improving shellfish processing and sales.

People use mangrove firewood to process shellfish. Accordingly, a part of the profit should be saved to found a village forest as a subsidiary of mangrove trees used for shellfish processing.

(2) Advantages of the Activity

Advantages of this activity are as follows:

1) Reduction of harvesting pressure

We can reduce harvesting pressure to stay on the same income level by increasing the unit price through value added processing.

2) Reduction of labor burden

We can reduce producers' labor burden to stay on the same income level by increasing the unit price through value added processing.

(3) Methods

1) Commodity development

① Purified processed ark

We eliminate mud in the ark meat by inserting the purification process and avoiding to attach sand in the wind on the ark meat by drying it on a higher rack.

② Smoked oyster

Smoked oyster is a new product. It smells, looks and tastes good.

2) Sales strategy

Sales promotions are required to attain value added business.

① Packing

Packing is an important element in adding the product value and improving sanitary conditions.

② Labeling

Labeling makes products stand out from the others. The label is to mention the product concepts such as resources conservation, processing improvement and better sanitation.

③ The second "fresh oyster"

The fresh oyster has been successfully sold with added value. The smoked oyster is aimed at becoming the second "fresh oyster", i.e. value added product. It will be vacuum-packed in the form with shells to keep the good smell and taste, and sold as materials for hors d'oeuvres.

(4) Extension

Value-added purified processed arks and smoked oysters are to be delivered and sold at markets within 3 years. At least 3 villages in Saloum Delta will have succeeded in the same business within 10 years.

(5) Business Investment and Profit

Required apparatuses for purification, drying and smoking including cost breakdown are as follows.

Table 3.3-9 Material Cost for Shellfish Processing Improvement

Item	Specification	Q'ty	Unit Price	Amount
1. Purified platform				
Stake	100cm	2 pcs.	1,000	2,000 FCFA
	150cm	7 pcs.	2,000	14,000 FCFA
	250cm	2 pcs.	3,000	6,000 FCFA
	300cm	2 pcs.	4,000	8,000 FCFA
Board	15cm width x 150cm long	10 pcs.	3,000	30,000 FCFA
PE rope	8mm, 200m/coil	1 coil	40,000	40,000 FCFA
PE netting bag		5 pcs.	5,000	25,000 FCFA
Subtotal				125,000 FCFA
2. Drying platform				
Stake	150cm	12 pcs.	2,000	24,000 FCFA
	200cm	4 pcs.	2,500	10,000 FCFA
Board	15cm width x 150cm long	10 pcs.	3,000	30,000 FCFA
Blue sheet	200cm x 200cm	1 pc.	2,000	2,000 FCFA
Ladder	180cm	1 pc.	10,000	10,000 FCFA
Subtotal				76,000 FCFA
3. Smoking box				
Stand	Round, 33cm dia.	1 pc.	10,000	10,000 FCFA
Smoking box		1 pc.	50,000	50,000 FCFA
Wire net	39.5cm x 39.5cm	3 pcs.	5,000	15,000 FCFA
Subtotal				75,000 FCFA
Total				276,000 FCFA

The following table shows the business cost within 10 years including additional investments for the 2nd village from the 4th year and the 3rd village from the 7th year. Each village produces 200 kg of purified processed ark and 300 dozens of smoked oysters annually.

Table 3.3-10 Business Cost for Shellfish Process Improvement

Year	Village	Equipment Cost	Production Cost	Sales Amount	Annual Profit
1	1	0	70,000	480,000	410,000
2	1	0	70,000	480,000	410,000
3	1	0	70,000	480,000	410,000
4	2	276,000	140,000	960,000	820,000
5	2	0	140,000	960,000	820,000
6	2	0	140,000	960,000	820,000
7	3	276,000	210,000	1,440,000	1,230,000
8	3	0	210,000	1,440,000	1,230,000
9	3	0	210,000	1,440,000	1,230,000
10	3	0	210,000	1,440,000	1,230,000
Total	3	552,000	1,470,000	10,080,000	8,610,000

3.3.6 Self-Production of Shellfish Harvest Protectors (Gloves and Boots)

(1) Objectives

Many women without any production means have limited employment opportunities and engage in shellfish collection with empty hands. They often hurt on their hands and feet at work. To avoid injury during the collection, they tend to cut mangrove roots. The use of protectors such as boots and gloves makes those women conserve mangrove roots.

Local lecturers with skills to fabricate boots and gloves spread their know-how to the people in the villages nearby.

(2) Advantages of Using Gloves and Boots

1) It enables practice in mangrove conservation.

With the protectors, people can practice the knowledge of mangrove conservation learned in environmental education.

2) It decreases women's health problems.

Injury during shellfish collection causes health problems in women and they need costs for medicine. It puts stress on their household budget. It is possible to avoid such problems by using self-made gloves and boots for their protectors.

(3) Methods

1) Boots fabrication

Local people can fabricate boots easily for shellfish collection by sewing used cloths or rice sack to beach sandals. Used tire or pieces of wood are adoptable as substitutes for beach sandals. A pair of boots combined with a used trouser is suitable for use in deep mud.

2) Glove fabrication

Local people can fabricate a mitten type of gloves by sewing any kinds of used cloths that they can easily obtain. Thicker cloths can be used to make durable gloves.

(4) Extension

Local lecturers who have mastered how to fabricate gloves and boots are to teach their know-how to others. Shellfish collectors in 30 villages in Saloum Delta will have received the lectures on how to fabricate gloves and boots within 10 years from the beginning.

(5) Activity Investment

The activity costs at 1,499,000 Fcfa a year provide three local lectures a year for 30 participants at a lecture. Details are shown in the Table 3.3-11.

Table 3.3-11 Annual Required Materials for Boots and Gloves Fabrications

Item	Specification	Q'ty	Remarks	Unit Price	Amount
Beach sandal		99 pcs.	33pcs./lecture	1,000	99,000 FCFA
Used trouser		99 pcs.	33pcs./lecture	2,000	198,000 FCFA
Needle	15cm long	99 pcs.	33pcs./lecture	500	49,500 FCFA
Twine		Assorted			20,000 FCFA
Braided twine		Assorted			135,000 FCFA
Rubber band	23mm x 40cm	50 m		150	7,500 FCFA
Scissors		99 pcs.	33pcs./lecture	10,000	990,000 FCFA
Total					1,499,000 FCFA

Costs for activity within 10 years are as follows:

Table 3.3-12 Activity Costs for Glove and Boots Productions

(FCFA)

Year	Villages	Recipients	Annual Cost
1	3	90	1,482,500
2	3	90	1,482,500
3	3	90	1,482,500
4	3	90	1,482,500
5	3	90	1,482,500
6	3	90	1,482,500
7	3	90	1,482,500
8	3	90	1,482,500
9	3	90	1,482,500
10	3	90	1,482,500
Total	30	900	14,825,000

3.3.7 Support to the Beach Committees

(1) Objective

Many villages in Saloum Delta have been establishing beach committees with the objective of conserving and managing environment resources in vicinity. Several villages along the coast are particularly active in committee activities. We will promote the beach committees in several villages along the coast.

(2) Planning Details

1) Enhancing Environmental Awareness for Mangrove Conservation

This activity promotes awareness on environment resource management and a consensus for sustainable utilization of resources.

2) Working out the Management Plan

This activity promotes cooperative management of environmental resources to avoid conflicts with external violators.

(3) Methods

- 1) To clarify target resources and protection zones.
- 2) To patrol environment resources.
- 3) To promote public relations.
- 4) To hold seminars.

(4) Dissemination

The activity is to be carries out in 4 coastal villages.

(5) Business cost

The activity cost within 10 years is shown in the following table:

Table 3.3-13 Activity cost to Promote Beach Committees

(FCFA)

Year	Villages	Cost per Village	Annual Cost
1	4	300,000	1,200,000
2	4	300,000	1,200,000
3	4	300,000	1,200,000
4	4	300,000	1,200,000
5	4	300,000	1,200,000
6	4	300,000	1,200,000
7	4	300,000	1,200,000
8	4	300,000	1,200,000
9	4	300,000	1,200,000
10	4	300,000	1,200,000
Total	4	3,000,000	12,000,000

3.3.8 Legal Enforcement of Shrimp Resource Management

(1) Objectives

Shrimp fishery is a very important economic activity for the people in the inland area of Saloum Delta. Fishermen know well the close relationship between mangrove forests and fisheries resources and they are aware that disappearance of the mangrove forests in the inlands since the 1970s has caused shrimp resource deterioration. It has motivated the people to plant mangrove voluntarily. Their interest in mangrove would decline if shrimp resource extinguished and shrimp fishery disappeared, but will remain steady if sustainable shrimp utilization succeeds. We should promote a shrimp resource management plan for mangrove conservation.

(2) Planning Details

The local government has set shrimp resource management policy including the shrimp fishermen's registration system, closed fishing season and mesh size regulation. However, illegal fishing has not stopped. It is necessary to strengthen governmental as well as community-based fisheries management for the shrimp resource. This activity promotes community-based shrimp fishery management through the empowerment of the local people.

(3) Methods

Beach committees are being established in the relevant villages in the delta. Selected members of the committees receive training on subjects including fishery laws, forestry laws and patrolling techniques to improve abilities for shrimp resource management.

(4) Business Investment

The training on shrimp resource management is carried out for the people of 4 villages. The activity cost within 10 years is shown in the following table.

Table 3.3-14 Activity Cost for Legal Enforcement of Shrimp Resource Management

(FCFA)			
Year	Villages	Cost per Village	Annual Cost
1	4	300,000	1,200,000
2	4	300,000	1,200,000
3	4	300,000	1,200,000
4	4	300,000	1,200,000
5	4	300,000	1,200,000
6	4	300,000	1,200,000
7	4	300,000	1,200,000
8	4	300,000	1,200,000
9	4	300,000	1,200,000
10	4	300,000	1,200,000
Total		3,000,000	12,000,000

3.3.9 Establishment of the Life Jacket Workshop

(1) Objectives

Many local people have realized that it is necessary to decrease shrimp fishing for the sustainable utilization of the resource. However, the reality is that there is no economic activity other than shrimp fishery during the dry season. Accordingly, the people cannot approach any resource but shrimp. This phenomenon is obvious in particular in the inland of the delta. To cut off this vicious cycle, the village economy must be varied and promoted. If they have several occupations during the dry season, shrimp fishing will decrease and sustainable resource utilization will be possible. After all, it takes the people's interest for mangrove conservation to succeed.

(2) Advantages of Producing Life Jackets in Villages

1) To strengthen the village economy

Village people exert efforts in producing life jackets to revitalize their economy. The production helps not only strengthen the village economy but also become a source of the environment fund for mangrove and village forest planting.

2) To avoid sea accidents

Sea accidents often occur during the shrimp fishing season because even inland people who cannot swim rash to participate in shrimp fishery. Therefore, life jackets are a necessity for village people. Sea accidents will decrease if village people obtain good life jackets at a reasonable price.

(3) Methods

1) Establishment of workshops

A life jacket production group is to consist of several sub-groups having the responsibility each for production, sales, accounting and administration.

2) Life jacket fabrication

Life jacket production groups at Kamatang Bambara and Mbam have mastered the technique to fabricate life jackets. They tried to improve the quality and have succeeded in producing a jacket as good as an imported one.

3) Life jacket sales

The sales strategy should be as follows:

① Consignment sales to shrimp middlemen

This will enable poor shrimp fishermen to purchase life jackets easily. The fishermen are to obtain life jackets in exchange for their catch.

② Consignment sales to retailer shops

Life jacket production groups consign their products to certain retailer shops in towns.

③ Direct sales at markets

Some members in charge of the sales take responsibility for selling their products at periodical markets in towns nearby.

④ Promotion to DOPM

Senegalese fishermen have to put on a life jacket whenever they go fishing, according to a regulation under DOPM. Accordingly, the life jacket production groups should promote their sales through DOPM.

4) Account management

The groups must prepare and submit a statement on accounts at the end of every year. The groups are also required to plan a training program on accounting and management so that they can prepare a fair statement.

(4) Extension

The ongoing two groups at Kamatang Bambara and Mbam keep on their business activities, and aim to be enrolled as GIE within 3 years.

(5) Business Investment and Profit

Investment costs for life jacket workshops are shown in the following table.

Table 3.3-15 Materials and Equipments to Establish a Life jacket Workshop

Item	Specification	Q'ty	Unit Price	Amount
1. Material and fabrication costs per 100pcs. Of life jacket				
Cloth material	150cm x 75cm	1 unit	1,000/m	75,000 FCFA
Lining material	150cm x 75cm	1 unit	500/m	37,500 FCFA
Float material	Soft type	105 m	1,250/m	131,250 FCFA
Bias	Orange color	400 m	100/m	40,000 FCFA
Belt	Black color	300 m	200/m	60,000 FCFA
Joint material	Black color	200 pcs.	100/pc.	20,000 FCFA
Rubber band	23mm, 40cm/set	40 m	64/m	2,560 FCFA
Braided rope	Black color	150 m	40/m	6,000 FCFA
Twine	Orange color	Assorted		20,000 FCFA
Material loss		10%		39,231 FCFA
Transportation				45,000 FCFA
Fabrication cost			1,000/pc.	100,000 FCFA
Subtotal				576,541 FCFA
2. Material cost for a workshop				
Cutter knife	For cutting float	2 pcs.	5,000	10,000 FCFA
Scissors	For cutting cloth	2 pcs.	10,000	20,000 FCFA
Measure	5m, for cloth	2 pcs.	5,000	10,000 FCFA
Sewing Machine	Manual use	2 pcs.	400,000	800,000 FCFA
Notebook	For recording account	2 pcs.	1,000	2,000 FCFA
Subtotal				842,000 FCFA
Total				1,418,541 FCFA

Based on the above table, business cost within 10 years is shown in the Table 3.3-16.

Table 3.3-16 Business Cost and Profit on Life jacket Workshop

Year	Workshops	Life Jackets	Operation Cost	Sales Amount	Annual Profit
1	2	200	1,153,000	1,400,000	247,000
2	2	210	1,210,650	1,470,000	259,350
3	2	220	1,268,300	1,540,000	271,700
4	2	230	1,325,950	1,610,000	284,050
5	2	240	1,383,600	1,680,000	296,400
6	2	250	1,441,250	1,750,000	308,750
7	2	260	1,498,900	1,820,000	321,100
8	2	270	1,556,550	1,890,000	333,450
9	2	280	1,614,200	1,960,000	345,800
10	2	290	1,671,850	2,030,000	358,150
Total	2	2,450	14,124,250	17,150,000	3,025,750

(FCFA)

(6) Environment Fund

A part of the business profit is saved for the environment fund for mangrove planting.

3.3.10 Fisheries Resources Enhancement Judgment due to Mangrove Rehabilitation

(1) Background

Mangrove forests nurse fisheries resources by providing shadows and supplying plant organic matters. They are a baby cradle for fisheries resources, so to speak. For the same reason, fish aggregating device (FAD) supplies a baby cradle for fish juveniles as well as a place to aggregate adult fishes. We implemented settling of FAD at the pilot project sites to ascertain the effects that mangrove forests nurse fisheries resources. Upon settlement of the FAD, many fishes arrive at the sites. However, fishermen in neighboring villages repeatedly violated the prohibition of fishing at the sites during the pilot project. We are afraid that local people cut too many branches of land trees as material for FAD and did too much damage to aggregating fish resources. The result of this pilot project shows that mangrove forests have good effects on nursing fisheries resources. Accordingly the FAD will be taken out from the sites upon the termination of data sampling.

(2) Relationship between Mangrove Forests and Fisheries Resources

1) Bringing up fish juveniles

Inland of Saloum Delta where avicenia forests barely remain has severe water conditions for bringing up fish and shrimp juveniles particularly during ebb tide while the water temperature rises in shallow waters. The FAD provides shadows to prevent rise in the water temperature, and provides suitable conditions for juveniles. Previously, mangrove forests worked well as the fish nursery in the area. If mangrove forests recover, fisheries resources will enjoy the same effects.

2) Gathering adult fishes

It is well known that the FAD has the function to gather not only juveniles but also many kinds of adult fishes. In the inland of the delta, mullet and tilapia among others often gather around the FAD.

(3) Methods

The activity of the FAD will terminate after data sampling at three sites, i.e. around the FAD, near the mangrove forest and a location without the FAD and mangrove, for comparison in fish

species, sizes and quantity. The fish caught during the sampling should be released after taking records.

3.4 Utilization and conservation of tourism assets

3.4.1 Concept of ecotourism

(1) Establishment of eco-route

There are some alternatives for the implementation of ecotourism. In this Study, feasible and self-sustainable ecotourism activities will be contemplated.

Mounde and Dasilame Serere have been selected as target villages and one more village may be chosen as one in the future. Each village have combined its own tourism assets to organize an eco-route and villagers have initiated eco-tourism.

The eco-route must include:

- 1) Combination of the existing tourism assets of each village with travel time of 2 to 3 hours;
- 2) Traditional means of transportation such as horse carriages, pirogues and, as supplement, locally-manufactured kayaks as much as possible without using motorized boats;
- 3) Locally recruited eco-guides who will stress the importance of nature and disclose the village history and daily life;
- 4) Sufficient measures taken to fully ensure the safety of tourists; and
- 5) Traditional handicraft as souvenir in the eco-tourism package., which will be provided with each tourist as a free gift, thereby creating substantial benefits in the village.

After the setting up of the eco-route, an essential second step is to promote the ecotour in the Delta by distributing an ecotourism brochure to hotels and travel agencies, which describes the points of interest on each eco-route. Official supports in one way or another would help.

With these efforts, additional income will be newly created as:

- Rental fees for transportation means like horse carriages, pirogues and kayaks
- Service fees for eco-guides
- Souvenirs included in the ecotour package

The decision rests with the village management committee and ecotourism committee as to how the proceeds will be distributed, but it is expected that some surplus will be put into an environment fund for nature protection such as reforestation.

(2) Concept of ecotourism

Ecotourism under the Study is defined as follows:

- 1) Eco-tourists will study and enjoy the natural environment and bio-diversity, particularly mangrove forests, without causing any damage.
- 2) Tourists will also learn about and enjoy the history and stories of an eco-village. These have been passed on from one generation to another for a long time within the village, but have never been made public.
- 3) A number of village people shall be directly and actively involved in eco-tourism activities.
- 4) As a result, eco-tourism will create reasonable income opportunities additionally for a fair number of villagers involved in the eco-tourism activities.
- 5) A certain portion of revenue from eco-tourism may be retained to ensure the continued conservation of mangrove forests in and near the village.
- 6) Once initial assistance in the form of physical investment and technical training is put in place, the project shall be self-sustained sufficiently by the concerned village people without further external assistance.
- 7) The eco-tour package to be organized may be priced higher than the exiting excursions offered by hotels and travel agents. It can be justified with the generally accepted idea of the “Fair Trade”.
- 8) Eco-tourism contemplated here does not intend to compete head-on with conventional tourism. Rather, it will try to create a new tourism market in the country.

People in the eco-villages have been traditionally engaged in agriculture and fisheries activities for many years. To successfully implement ecotourism projects and to satisfactorily resolve any problems arising in the future, they need to switch from the traditional mindset to the modern one as follows:

① “Customer First”

Eco-tourism is one form of tourism, and tourism is a part of service industry. In the industry, services are offered for prices. Its fundamental guideline is what the customer (tourist) wants, not what villagers want.

② Ultimate objective

It needs to be reminded that rich mangrove forests in eco-villages are a key to eco-tourism. The ultimate objective of this whole exercise is the conservation of mangrove forests in and around the eco-villages.

3.4.2 Ecotourism

(1) Establishment of eco-route

Moude and Dasilame Serere are targets under the pilot project and another one can be selected in the Saloum Delta. Moude expects tourists from Djifer and Ndangane, including those coming from Sali-Portugal and Joal whereas Dasilame Serere from Toubacouta, Foundgoune and Kaolak.

(2) Eco-route

An eco-route will be organized, combining tourism assets existing around an eco-village, such as mangrove forests, bolons, inlets, shoals, streams, shell mounds and sacred forests for tourists to spend 2 to 3 hours. Environment-friendly transportation means like a horse carriage and pirogue will be employed on the eco-route to the maximum extent possible.

(3) Training of eco-guides

Eco-guides are indispensable and the minimum two guides – principal and alternate – will be selected in each village.

They should be trained on fauna and flora on the eco-route, biodiversity including the mangrove, safety measures, related legislations, relevant statistics, pricing formula of the route, financial village history and anecdotes. Tourist safety, being an important subject, will be emphasized during the training course.

The training of eco-guides will be conducted with the cooperation of the related technical department of the Ministry of Tourism.

(4) Pricing of the ecotour

Each Ecotourism Committee ought to decide a price of its ecotour by tallying cost items. These should cover the souvenir product, horse carriage, pirogue and kayak and eco-guide. The Committee may decide how to distribute the proceeds, but both villages must have the same formula. Considering all the costs and existing markets, the ecotour price of Euro 5-10 can be justified. The tourist pays it upon arrival.

(5) Environment fund

An environment fund will be established in each eco-village to conserve the nature, particularly the mangrove, and will receive 5 to 10% or more of the proceeds. The final decision will be made by both villages. On the other hand, they need to build up a reserve fund for the future replacement of the equipment as soon as possible.

(6) Ecotourism brochure

To promote ecotourism, a A-4 1-page color brochure (folded in three and printed on both sides) that describes the eco-routes shall be produced and sufficient copies will be distributed to hotels and travel agents.

(7) Equipment

Major equipment required for ecotourism in each village includes:

- 1) Life vests.....About 20 sets of life vests, which have been designed and supervised a fishery expert under another pilot project, will be distributed to each eco-village to ensure the safety of tourists.
- 2) Horse carriageIndigenous horse and locally fabricated carriage with holding bars for safety will be supplied.
- 3) Pirogue and kayak..... Wooden kayaks and non-motorized pirogues will be produced by local carpenters under the designing and supervision of the same fishery expert from the viewpoint of environment friendliness and priority given to local products.
- 4) Mobile phoneOne set each will be provided, as it is indispensable to keep regular contacts with hotels and agents albeit not locally made with traditional materials.

(8) Souvenir

Inexpensive traditional handicraft will be included in the price of the ecotour package and presented to tourists as a free gift, so as to spread the benefits among villagers, particularly women. Both villages intend to provide dyed fabrics, but its quality should be monitored.

3.4.3 Details of the eco-route

(1) Mounde course

The primary asset for tourism is the panoramic distant view of the village when approaching the village from the west. The small bolon to the west where a landing pier is located also provides attractive scenery. On this route, the party leaves the village by horse carriage towards the shell mound. Although the shell mound is only a 10 – 15 minute walk, the use of a horse carriage is preferred because of the subsequent trip to an ancient tomb. Approximately 30 minutes is required to reach the tomb after crossing two fords while enjoying the mangrove colonies on both sides of the route. After seeing the tomb, tourists return to the village by horse carriage.

(2) Dassilame Serere course

Its routes start at the village square and goes on by horse carriage, enjoying the mangrove forests. There is the embarking point on the shoal. After going through a big and small bolon and watching monkey habitat, one reaches the disembarking site.

(3) Niodior Course

This course starts at the bolon located to the north of Niodior. As this bolon is relatively wide but short, it is suitable for a kayak ride. After landing at the side of an old bridge, the party crosses a series of short and shallow waterways, the bottom of which is covered by shells, on foot. It is then time to climb up a small shell mound to enjoy the view around it. Back to the shallow waterway and, after crossing it, and a short walk, the party can now see a nursery where the women of the village work together. The party returns to the village after passing a paddy field enclosed by reed screens (a some 30 minute walk). This course is full of variety and replacement of the final walking part by horse carriage makes it a good eco-route.

3.4.4 Details of the eco-route

Assuming the setup of an eco-route will be established for one village each during year 1, 2 and 3 under the master plan, cost estimate is as follow:

Table 3.4-1 Cost estimate for the setup of eco-routes

Year	No of new routes	Total number	Investment costs	O&M cost	Revenue	Annual income
1	1	1	4,358	936	1,300	364
2	1	2	4,358	1,872	2,600	728
3	1	3	4,358	2,808	3,900	1,092
4	0	3	0	2,808	3,900	1,092
5	0	3	0	2,808	3,900	1,092
6	0	3	0	2,808	3,900	1,092
7	0	3	0	2,808	3,900	1,092
8	0	3	0	2,808	3,900	1,092
9	0	3	0	2,808	3,900	1,092
10	0	3	0	2,808	3,900	1,092

3.5 Plans for extension, empowerment and environmental education

3.5.1 Plan items

Plans for extension and environmental education consist of the following five items:

- ① Introduction of mangrove-centered environmental education in elementary schools
- ② Seminars and workshops on mangrove for CR legislators
- ③ Visits to model villages of sustainable management of mangrove forests
- ④ Implementation of empowerment activities in partnerships with local sports and cultural activities
- ⑤ Implementation of technology extension by resident lecturers

The objective of the above-mentioned activities is to enable residents to practice mangrove resources management by themselves and the implementation of these activities supposes some external resources such as money provided by external organizations. For these activities, donors, NGOs or governmental agencies can be considered as financial resources and residents as key actors.

3.5.2 Introduction of mangrove-centered environmental education in schools

(1) Background and purpose

The Education Inspection Department (IDEN) in Foundiougne prefecture, which is part of the project area, is the pilot department of the Environmental Education Program (PFIE, see 2-6-1). Not only government agencies such as IDEN and the prefectural Forest Department but also teachers in the classroom have accumulated experience in environmental education. In addition,

study groups among teachers and the “Conference of Principals” are active. This plan is to take advantage of these existing organizations and the accomplishments of PFIE, introduce and extend mangrove-centered environmental education at elementary schools in the project area as well as mangrove and environmental protection activities through a partnership between elementary schools and local communities.

(2) Plan items

1) Introduction of mangrove-centered environmental education

The purpose is to raise children who understand natural and social environments through immediate surroundings with mangrove in the center, take an active interest in and know about issues on mangrove resources, and have correct understanding of environmental protection and ethics and an attitude to practice what they learn.

- ① Formation of a Mangrove-Centered Environmental Education Unit
- ② Setting themes for environmental education
- ③ Formulating a guide to mangrove-centered environmental education
- ④ Implementation of teacher training

2) Support to a children’s mangrove environment protection project

Schools are to be designated as a core of local natural resource management including mangrove. Participation of residents in school activities including environmental protection activities is to be promoted.

(3) Methodology

1) Introduction of mangrove-centered environmental education

First a Mangrove-Centered Environmental Education Unit (CEEM) will be organized by an external financial support organization such as NGO and CEEM is to introduce Mangrove-centered environmental education in schools in Foundiougne prefecture in the project area in partnership with IDEN.

① Formation of a Mangrove-Centered Environmental Education Unit

This plan will place the hub of environmental education in Foundiougne and formulate a Mangrove-Centered Environmental Education Unit (CEEM) consisting of local PFIE stakeholders, NGO staff members who deal with mangrove matters, and representatives of teachers (those from the areas where schools are located). In necessary, outside resource persons are to be summoned from places such as Dakar and work on training of CEEM members or provide support.

② Setting themes for environmental education

CEEM members take the lead in setting the framework for mangrove-centered environmental education in elementary schools. Such education is to be directed to middle to higher grades in elementary schools and its themes are to be decided in consideration of the existing educational programs. It is to have a theme per semester, be held two hours a week, and be carried out in a combination of classroom sessions and field activities. Themes may include “mangrove, animals and plants”, “mangrove and the environment (air and water)”, “mangrove and everyday life”, and “specific examples of mangrove conservation activities”. Field activities may include observation in mangrove areas, interviews with people who engage in production activities in mangrove areas, and participation in planting activities.

③ Formulating a guide to mangrove-centered environmental education

Based on the themes set and with the support of an outside resource person, CEEM is to take the lead in formulating a guide. The guide is to spell out academic and cumulative knowledge on mangrove that is to be taught in classroom sessions and specific examples of implementation and field activities. The “Manual for Planting” that was formulated in this study is to be used in formulating the guide.

④ Implementation of teacher training

Training on mangrove-centered environmental education is to be implemented for 250 elementary school teachers at 40 elementary schools in mangrove areas of Foundiougne prefecture. Utilizing study groups among teachers, CEEM is to be responsible for the contents of the guide in 3. and training on how to use it. In addition to classroom sessions, the training is to emphasize model classes by teachers who are CEEM members and should be a comprehensive one that includes a program for teachers to experience mangrove for themselves and an exchange of opinions on mangrove with the locals.

2) Support to a children’s mangrove environment protection project

In partnership with IDEN, CEEM leads schools in the project area to prepare a “children’s mangrove environment protection project” which will be carried out by the schools with PTA. Specific activities of such project may include the following: a survey of the mangrove environment; exchange of students and field trips between a “Mangrove Recovery Zone” and a “Mangrove Preservation Zone”; painting contest; theatrical performance on mangrove by students; planting of mangrove and school forests; and support to mangrove-related activities at a school or among several schools.

In addition, empowerment activities are to be carried out toward the School Area Federation (ACE) that implements the ten-year “School Project” so that this project can forge a partnership with the “School Project”. The “School Project” is also a likely source of funds for environmental protection activities at schools. With needed support to the formulation, implementation and evaluation of the project, a more effective partnership can be forged.

(4) Implementation costs

Table 3.5-1 Implementation costs of Introduction of mangrove-centered environmental education in schools

Items	Subtotal	(FCFA)	
		Year	Annual subtotal
Daily allowance of CEEM member	1,000,000	1	1,800,000
Transportation expenses of CEEM members	200,000	2	1,357,500
Daily allowance, lodging and transportation expenses of lecturers	180,000	3	1,750,000
Lecture room charge	90,000	4	1,750,000
Manual preparation (contents)	75,000	5	1,375,000
Manual preparation(date input and auditing)	25,000	6	700,000
Manual preparation (copy and binding)	1,710,000	7	1,750,000
Manual revision (contents)	25,000	8	700,000
Manual revision (date input auditing)	12,500	9	700,000
Daily allowance and transportation expenses of teachers’ training lecturers	1,650,000	10	1,750,000
Food expenses for teachers’ training	775,000		
Material preparation	1,590,000		
Costs for support to mangrove environment protection project	6,300,000		
Total	13,632,500	Total	13,632,500

3.5.3 Seminars and workshops on mangrove for CR legislators

(1) Background and purpose

Rural communities (CR), the municipalities that are the closest to residents, can be legal and practical entities to implement natural resource management. After the 2002 local legislature elections, there are more government officials (former and incumbent) and literate young people among CR legislators in the project area. Many CR are now receptive to long-term and multi-dimensional thinking on local development and ready to take on development actively. In addition, most CR in the project, supported by PROCR, are engaged in capacity building in such areas as plan formulation and operation and management of activities.

The purpose of seminars for such CR legislators and village leaders is to gain understanding and agreement of the village leadership on the “Sustainable Management Plan for Mangrove Forests”, incorporate the Local Development Plan (PLD) set by each CR, and lead to implementation of mangrove resource management by CR. Ultimately, such resource management activities as planting, empowerment activities, and regulations on smoking furnace should be implemented by CR’s own funds.

Meanwhile, workshops are to be held on a regular basis as a forum for exchanging views and experience among CR. In these workshops, each CR should have opportunities to report on examples of implementation of mangrove protection and natural resource management, motivate one another and promote partnerships.

The first workshop will be organized by an external support organization such as governmental agencies or NGO. During this workshop, the participants choose some of them members of a Secretariat which is to take the responsibility for holding the following workshops.

(2) Plan items

- 1) Seminars on the sustainable mangrove resource management plan
- 2) Support to the strengthening of operational capacity of the Environment Commission
- 3) Workshops on the implementation of mangrove resource management

(3) Methodology

Activities in 1) and 2) are to be implemented mainly in the 5CR of Djirnda, Bassoul, Dionouar, Djilor, and Toubacouta, most of which are in mangrove areas.

1) Seminars on the sustainable mangrove resource management plan

A seminar is to be held once a year at the CR level for the CR chairman, vice chairman, Environment Commission members, village organizations that engage in environmental protection activities, and resident union leaders. At the beginning, it is to ensure understanding of the importance of mangrove resources for local development and the “Sustainable Management Plan for Mangrove Forests”. Then, the following topics are to be discussed: how the Mangrove Forests Plan is to be reflected in CR’s own natural resource management plans and Local Development Plans; and how CR should take the lead in implementing mangrove resource management. Through discussions, the roles and functions of CR and villages are to be made clear. When CR begin more specific mangrove protection activities, the purpose of the seminar is to be shifted to the strengthening of needed organizations and capacities.

2) Support to the strengthening of operational capacity of the Environment Commission

Specific mangrove protection activities by CR are to include planting of *Rhizophora* and empowerment activities at a CR-sponsored sports contest. In two CR of Djirnda and Bassoul, CR should consider taking the lead in implementing regulations on the total number of smoking furnaces and transition to an improved furnace because the consumption of mangrove firewood through smoking furnaces is increasing there. These activities should be planned, implemented (by a contractor) and monitored with the Environment Commission at the center. They are aimed at improving the practical capacities of the Environment Commission through training and dispatch of advisors at each stage.

3) Workshops on the implementation of mangrove resource management

A “Workshop on the Implementation of Mangrove Resource Management” is to be held once every 3 years with representatives of CR in the “Mangrove Recovery Zone” and the “Mangrove Preservation Zone”. The workshop is to present mangrove-centered natural resource management activities, issues and special features of activities in each CR, and facilitate exchange of opinions and experiences among CR. In addition, the workshop is also to extract matters that should be addressed by entities larger than CR, and common activities and tasks among CR, and aim to be a forum that sets common policies, strategies and specific action plans that can be a basis for participatory resource management for an extensive area. The workshop is to be implemented in combination with the visits to Model Villages described below.

(4) Implementation costs

Table 3.5-2 Implementation costs of Seminars and workshops on mangrove for CR legislators

		(FCFA)	
Items	Subtotal	Year	Annual subtotal
Daily allowance and transportation expenses of seminar facilitators	750,000	1	600,000
Transportation expenses for participants in seminar	3,000,000	2	950,000
Food expenses for CR seminar	750,000	3	1,627,500
Seminar material preparation	1,500,000	4	950,000
Daily allowance, lodging and transportation expenses of lecturers for CR training	1,350,000	5	950,000
Transportation expenses for participants in CR training	900,000	6	1,627,500
Food expenses for CR training	225,000	7	950,000
Training material preparation	675,000	8	950,000
Daily allowance, lodging and transportation expenses of facilitator for practice WS	180,000	9	1,627,500
		10	950,000
Lodging and transportation expenses of participants in practice WS	1,500,000	Total	11,182,500
Food expenses for practice WS	112,500		
Conference room charge	90,000		
WS material preparation	150,000		
Total	11,182,500		

3.5.4 Visits to Model Villages of Sustainable Management of Mangrove Forests

(1) Background and purpose

With various types of outside assistance, the project area has implemented conservation activities such as planting and economic activities that utilize the mangrove ecosystem such as aquatic products and vegetation. Due to empowerment activities so far, residents have begun to recognize the importance of preserving mangrove forests as a source of means for everyday life. Consequently, a few villages have come to strike a proper balance between the preservation of mangrove resources and the utilization of the mangrove ecosystem. These villages are to be designated as “Model Villages of Sustainable Management of Mangrove Forests” and their residents are to introduce their activities and how they are implemented (e.g. establishment of an environment fund and village organizations) to visitors from government agencies, CR, resident organizations, NGOs and donors.

The purpose of visiting model villages is to gain agreement, support and cooperation of policymakers, implementing agents and fund providers to the “Model Villages of Sustainable Management of Mangrove Forests” by widely publicizing the villages and raising the awareness of the relevant people. Therefore this activity should be financed by the Direction of water and forests who promote the plan for sustainable mangrove resources management, but in reality it is much more realistic to expect some financial supports from donor agencies or NGO.

(2) Methodology

1) Model Villages

Table 3.5-3 Model Villages and their activities

Village	Mangrove resources conservation activities	Mangrove ecosystem utilization activities	Activities as financial source of environmental fund
Moundé (conservation zone)	<i>Plantation of Rhizophora</i> , Self-production of shellfish harvest protectors, Utilization of shellfish select basket	improved shellfish processing Eco-tourism Apiculture	improved shellfish processing Eco-tourism
Dassilame Sérère (conservation zone)	<i>Plantation of Avicennia</i> , Creation of village grove	Eco-tourism Apiculture	Eco-tourism (Creation of village grove)
Mbam (rehabilitation zone)	<i>Plantation of Rhizophora</i> , <i>Plantation of Avicennia</i> , Creation of village grove, improved household furnace	Shrimp fishery	Lifejacket production

2) Invitees and purpose of visits

To forge links among invitees and Model Villages, resident organizations in other areas, and NGOs, facilitate exchange of information and technology, thus extending project activities.

Table 3.5-4 Invitees and Purpose of visits

invitees	Purpose of visits	Frequency / 10 years
Representatives from government agencies	To raise the awareness of importance of mangrove resources conservation and take it into account for policymaking	3 visits
Representatives from CR in the project area	To introduce some good practice of sustainable mangrove management (on the occasion of the Workshops on the implementation of mangrove resource management)	2 visits/CR
Representatives from NGO and local associations	To introduce and extend some good practice and technique of sustainable mangrove management carried out by residents	6 visits
Representatives from donors agencies	To publish the project results and findings so as to work in partnership with these agencies for the same purpose	3 visits

3) Implementation procedures

Preparation:

Distribution of the outline of “Sustainable Management Plan for Mangrove Forests” to invitees and formulation of a brochure introducing the villages.

Implementation:

Presentation by Model Villages’ residents on project activities and how they work, and implementation of a forum to exchange opinions.

Follow-up:

Implementation of technical support to presented activities if requested by the invitees, i.e. CR legislators, resident organizations, and NGOs.

(3) Implementation costs

Table 3.5-5 Implementation costs of Visits to Model Villages of Sustainable Management of Mangrove Forests

Items	Subtotal	(FCFA)	
		Year	Annual subtotal
Lodging and transportation expenses of invitees (gov. agency)	1,500,000	1	1,752,000
Lodging and transportation expenses of invitees (donors)	750,000	2	1,254,000
Lodging and transportation expenses of invitees (NGO)	1,750,000	3	2,100,000
Lodging and transportation expenses of invitees (local associations)	1,800,000	4	1,042,000
Lodging and transportation expenses of invitees (CR representatives)	2,000,000	5	1,254,000
Daily allowance and transportation expenses of animators for visit	450,000	6	1,650,000
Presentation material preparation	255,000	7	1,254,000
Pamphlet of model village preparation	51,000	8	1,708,000
Costs for technical support	5,000,000	9	500,000
Total	13,556,000	10	1,042,000
		Total	13,556,000

3.5.5 Implementation of empowerment activities in partnerships with local sports and cultural activities

(1) Background and purpose

Local events such as football and traditional wrestling matches that attract a large number of people in and out of the villages are to be used as occasions for empowerment of the general public. Such events would help expand the geographical scope of empowering effects. In addition, means of empowerment are to be such folklore performing arts as theater, dance and songs, all of which can get messages across to people regardless of age and ethnic background. The contents of such arts are to be on the protection of mangrove and the environment, particularly on production activities in mangrove areas, issues and countermeasures for them, and local environment protection activities. The purpose of empowerment activities is to raise awareness of residents on the importance of the mangrove ecosystem in everyday life and bring about an actual change in their behavior for the better. More specifically, through empowerment activities in partnership with football and traditional wrestling matches, it would be ideal to increase the participation of youth in planting activities and utilize a portion of the earnings from such undertaking in village natural resource management activities.

(2) Plan items

- 1) Creation and performance of mangrove-themed theater and folklore performing arts
- 2) Integration of mangrove empowerment activities into local events
- 3) Integration of mangrove empowerment activities and technology dissemination into Vacances citoyennes

(3) Methodology

- 1) Creation and performance of mangrove-themed theater and folklore performing arts

Empowering theater, dance and theme music are to be created by local theater groups and folklore performing arts groups. The main theme is to be “the importance of the mangrove ecosystem in everyday life”. However, sub-themes are to be different between a “Mangrove Preservation District” and a “Mangrove Restoration District” (See table below), and demonstration of activities and technologies to be implemented in this project are to be included. This event is to be held once a year in each district and the location is to be solicited and decided among those CR and villages that meet any of the following conditions:

- It is to be held in partnership with traditional wrestling matches in villages or CR.
- CR or a village on its own can invite neighboring villages and put together a “Mangrove Evening”.
- Staff members of the Forestry and Fisheries Bureau carry out empowerment activities in an area and village that they think need empowerment on a particular theme.

Table 3.5-6 Sub themes of mangrove-themed theater

Zone	Sub themes	Local theater groups
Conservation	How to harvest mangrove Oyster with protectors (Gloves and Boots)/to introduce closed fishing period and bolongs for oysters / to extend improved household furnace and improved furnace for ethmalose smoking, etc.	Toubacouta Soukouta Djirnda
Recovery	How to create village groves (how to gain pots and seeds)/ to extend improved household furnace/ To avoid sea accidents during the shrimp fishing, etc.	Mbam Gague Cherif

- 2) Integration of mangrove empowerment activities into local events

Traditional sumo wrestling matches in Serer villages attract many spectators from the urban areas such as Dakar and villages that are far away and have great empowering effects. In addition, football matches in villages, areas and CR are the largest events for youth in the rainy season and ideal for motivating them for planting activities. Entities such as villages and CR hold these events, so empowerment activities are to be done first toward

implementing agencies such as ASC and Traditional Wrestling Committees. Then empowerment programs are to be formulated in cooperation with implementing agencies. Specific programs might include integration of football matches with planting activities, inclusion of songs and dance about mangrove as part of animation in the football final and traditional wrestling matches, and folklore performing arts on empowerment by a local theater company.

Cooperation with four events per year is to be done. Empowerment activities toward implementing agencies are to make sure that a portion of earnings of traditional wrestling matches, which is a for-profit undertaking, is allocated to environmental conservation activities. If resources such as labor and money are to be provided by villages and CR as a result of empowerment activities, the Forestry Bureau is to provide technical support, pots, seeds and nursery plants.

3) Integration of mangrove empowerment activities and technology dissemination into Vacances citoyennes

Vacances citoyennes (VC) at the CR level gathers youth representatives of villages, and it makes sense to implement empowerment activities there as stated in 1). In addition, as stated in 2-6-2, VC can be used as an opportunity to introduce proper planting technology of *Rhizophora* and *Avicennia* planting as it implements mangrove planting. Partnership with VC will require coordination with prefectural Youth and Forestry Bureaus.

(4) Implementation costs

Table 3.5-7 Implementation costs of empowerment activities in partnerships with local sports and cultural activities

		(FCFA)	
Items	Subtotal	Year	Annual subtotal
Remuneration and transportation expenses for local theater groups	7,500,000	1	1,130,000
Daily allowance and transportation expenses of animator for event	1,500,000	2	1,130,000
Rental for sound fittings	1,000,000	3	1,130,000
Rental for lighting fittings	1,000,000	4	1,130,000
Daily allowance and transportation expenses of lecturers for VC	300,000	5	1,130,000
		6	1,130,000
		7	1,130,000
		8	1,130,000
		9	1,130,000
		10	1,130,000
Total	11,300,000	Total	11,300,000

3.5.6 Implementation of technology dissemination by resident lecturers

(1) Background and purpose

In the area under study, there has been technology transfer, including this pilot project, to residents in many areas by government agencies and aid organizations. Residents with technical skills are to be designated as “resident lecturers” and actively utilized in technology dissemination plans. The foremost advantage of utilization of “resident lecturers” is that it is inexpensive. In addition, it “informs other residents of what they can accomplish on their own”, in other words, it helps disseminate appropriate technology among residents.

Technology dissemination to residents is to be done through training at the village level and maximize the number of participants in training. The contents of training are to be centered on practical lessons. Lecturers and participants are to make an actual item in a kitchen or smoking factory, and products are to be usable for residents right after the training.

Technology dissemination on improved household furnace, shellfish harvest protectors (gloves and boots), and improved furnace for ethmalose smoking is to be carried out by resident lecturers. These targeted technologies can produce positive and direct effects on mangrove resources conservation. Especially, the pilot activity has proved that improved household furnaces enable household to reduce the consumption of firewood.

(2) Plan items

- 1) Training of resident lecturers
- 2) Implementation by resident lecturers of dissemination training to neighboring villages

(3) Methodology

- 1) Training of resident lecturers

Currently, the geographical distribution of resident lecturers with technologies to be disseminated is as follows.

Table 3.5-8 geographical distribution of resident lecturers

Improved household furnace	Bangaler, Mbam, Gague Cherif, Mar Fafako
Fabrication of groves and boots	Moundé, Sandikoli, soukouta, Médina Sangako Banbougar El Haji
Improved furnace for ethmalose smoking	Plasterers in Djirnda, Bassoul

Utilizing these existing resident lecturers, new resident lecturers with technologies are to be trained mainly in CR in the mangrove preservation zone.

Table 3.5-9 villages where new resident lecturers are trained

Disseminated technologies	Number of villages where trainings of resident lecturers are organized par CR
Improved household furnace	Djirnda (2 villages), Bassoul (1 village) , Dionouar (1 village), Toubacouta (2 villages)
Fabrication of groves and boots	Djirnda (1 village), Bassoul (1 village) , Dionouar (1 village)
Improved furnace for ethmalose smoking	Djirnda (2 villages: Rofqngué, Diamniadio*, a furnace for ethmalose smoking will be constructed in each village for OJT of construction technique)

* 2 villages: Rofangué, Diamniadio are targeted for dissemination of improved furnace, because of their large number of traditional furnace

- 2) Implementation by resident lecturers of technology dissemination training to neighboring villages

In target CR in Foundiougne, existing and newly trained resident lecturers are to implement dissemination training in the following manners.

Table 3.5-10 CRs targeted for technology dissemination

Disseminated technologies	CRs targeted and number of villages targeted in each CR
Improved household furnace	CR Djirnda, Bassoul, Dionouar, Toubacouta, Diossong, Djilor : 5 villages /year in each CR
Fabrication of groves and boots	CR Djirnda, Bassoul, Dionouar: 3 villages /year in each CR
Improved furnace for ethmalose smoking	Demonstration of improved furnace will be organized to promote the conversion from traditional furnace to improved one in 4 villages (Bassoul of CR Bassoul and Djirnda, Rofqngué and Diamniadio of CR Djirnda) where improved furnace has been or will be constructed

- 3) Guidelines on training implementation

Implementation of training of resident lecturers as well as technology dissemination training is to adhere to the following guidelines:

Table 3.5-11 Number of resident lecturers and trainees for each training

Disseminated technologies	Number of resident lecturers and trainees for each training	Total amount of trainees for 10 years
Improved household furnace	5 lecturers for 20 trainees	1,000
Fabrication of groves and boots	3 lecturers for 30 trainees	900
Improved furnace for ethmalose smoking	From trained plasterers to other plasterers	

- With the exception of training on the “improved smoking furnace”, all training sessions are to gather participants regardless of residential districts, organizations, and ethnic background. Participants are required to disseminate the technologies they acquire to those who did not take part in the training.
- During the training, relations between technologies to be disseminated and mangrove resource preservation are to be explained as part of empowerment activities. One should make sure trainees fully understand that the “improved smoking furnace” is not a conventional type but a modified version of the existing furnace through the training and demonstration.
- With regard to the improved household furnace and the improved furnace for ethmalose smoking, methods for usage and maintenance as well as how to make them are to be taught.

4) Conventional type of “improved household furnace” and follow-up

The improved household furnace to be disseminated has three types: one with a metal pole, one with a three-stone pole, and one without a pole. Training is to introduce how to make all types of furnace and let residents decide which type they are going to use. For dissemination of the improved household furnace, follow-up after the rainy season is even more important than training. One should be sure to follow up on the technology dissemination training right after the subsequent rainy season.

5) Demonstration of effects of improved smoking furnace

One unit each of the improved smoking furnace was built in Rofqngué and Diamniadio villages in CR Djirnda at the time of training of resident lecturers. Accordingly, in combination with the two existing units in Bassoul in CR Bassoul, four units of the improved smoking furnace are to be used for demonstration of the furnace’s effects. At the beginning of the project, stakeholders on fish smoking (Guineans in particular) are to be invited to demonstration of fish smoking, and take part in the entire smoking process. This is to be done twice a year per unit for three years. The goal of this undertaking is to let the invitees see and experience for themselves the advantages of the improved furnace such as firewood consumption, workability, yield rate, and products, and motivate them to adapt the improved version when they acquire a new unit. At this point, plasterers in the four target villages have acquired how to construct the improved furnace, and it is possible to disseminate the new technology with the know-how that is already in the villages.

(4) Implementation costs

Table 3.5-12 Implementation costs of technology dissemination by resident lecturers

		(FCFA)	
Items	Subtotal	Year	Annual subtotal
Improved household furnace		1	4,374,000
Daily allowance, lodging and transportation expenses of resident lecturers	7,830,000	2	3,280,000
Daily allowance, lodging and transportation expenses of animator for training	1,980,000	3	3,990,000
Metallic supports	2,140,000	4	3,280,000
Buckets	510,000	5	3,280,000
Sieves	204,000	6	3,100,000
Fabrication of groves and boots		7	3,100,000
Daily allowance, lodging and transportation expenses of resident lecturers	2,700,000	8	3,100,000
Daily allowance, lodging and transportation expenses of animator for training	1,200,000	9	3,100,000
Materials (see 4-3-9)	15,000,000	10	3,100,000
Improved furnace for ethmalose smoking		Total	33,704,00
Daily allowance, lodging and transportation expenses of resident lecturers	200,000		
Plasterers wages	80,000		
Daily allowance, lodging and transportation expenses of animator for training	560,000		
Materials (see 4-3-5)	700,000		
Raw materials for demonstration	600,000		
Total	33,704,000		

3.6 Implementation System for Sustainable Management of Mangrove Forests

3.6.1 Underlying Concept for Establishment of Implementation System

The Master Plan aims at the implementation of the self-reliant sustainable management of mangrove forests by local residents who will become aware of the importance of mangrove resources for the conservation of the said mangrove resources in accordance with the Master Plan.

To achieve this self-reliant sustainable management of mangrove forests by local residents, an implementation system which reflects the local conditions and which is truly effective must be established. Under the Master Plan, the establishment of a realistic implementation system is aimed at.

(1) Basic Policies

The basic policies for the establishment of the desirable implementation system are explained below.

- ① Mangrove forest management activities in the Project Areas will, in principle, be conducted by each village acting as the basic unit. Each village will formulate a management

implementation plan and will conduct the actual management activities in accordance with this plan. As it is currently difficult for the villagers to formulate this plan by themselves, the assistance of the DEFCCS will be required.

- ② The DEFCCS will be responsible for the implementation of the Master Plan as the management body of the entire forest resources, including mangrove forests, and as the party responsible for the formulation of the Master Plan. In the case of the formulation of the management implementation plan for each village, villagers will prepare the draft plan and the DEFCCS will provide advice for each village to ensure that the finalised management implementation plan based on the draft plan is in line with the Master Plan. The DEFCCS will also provide technical as well as administrative assistance when necessary by monitoring the progress of the activities incorporated in each management implementation plan.
- ③ As each RC has, in principle, been transferred the authority to manage mangrove forests and national land within its territory, the RC will be responsible for the allocation of land which is required for the management implementation plans at the village level.
- ④ For the implementation of the management implementation plans, the priority will be given to the establishment of a self-reliant activity cycle in each village. Meanwhile, the management of activities by the RC will be set as a future goal. In the immediate future, each RC will provide monitoring and administrative assistance concerning the mangrove forest management activities in each village in collaboration with the DEFCCS.

(2) Divisions for Management Purposes

As described in 3.1.6, the Project Areas are divided into management units for the smooth implementation of mangrove forest management activities and subsequent follow-up activities.

- The management unit is the region of which the administrative area coincides with the area of jurisdiction of a forest management bureau.
- Each “municipality” (city) or “rural community” (RC) as a local public body is set forth as an improvement unit or a management sub-unit.
- Each village forms an implementation unit for management activities.

3.6.2 Implementation System

The management implementation plans to be formulated in accordance with the Master Plan will actually be implemented under the activity execution system to be directly conducted by villagers and the external support system which assists (i) the formulation of individual management implementation systems and (ii) monitoring.

(1) Activity Execution System

Each village will conduct mangrove forest management activities based on a village-level management implementation plan. As the villagers will play the main role in these activities, villagers' organizations will be set up to execute various activities.

If suitable organizations already exist in villages to conduct mangrove forest management activities, these organizations will be strengthened and used. If such organizations do not exist, new organizations will be set up in each village to conduct the said activities. New organizations will be a management committee (or development committee) to oversee various activities and activity committees in charge of specific activities.

The main roles of the management committee are listed below.

- Formulation of a village-level management plan and reporting of the plan to the organizations concerned
- Thorough publicity of the village-level management plan to all villagers
- Execution of activities based on the village-level management plan
- Recording of the activities executed and monitoring of activities in progress
- Management of the fund to finance activities and the environment fund
- Negotiations with external bodies
- Other matters relating to activities

The roles of each activity committee are to assist the management committee, to execute the type of activity for which it is responsible, to record the activity and to management the relevant funds.

As the management implementation plan envisages the combined implementation of primarily mangrove forest conservation activities and other natural resources management activities which only involve expenditure and economic activities which produce an income, fund management (activity fund and environment fund) is extremely important.

(2) External Assistance System

Technical and administrative assistance for the formulation of the village-level management implementation plan, execution of the planned items and monitoring of activities, etc. will be mainly provided by the DEFCCS at the central level, the forest management bureau at the regional level and the forest management station and forestry official's office at the departmental level. The forest management bureau will also liaise and coordinate with the regional governor, regional council and other regional-level organizations concerned while the forest management station and the forestry official's office will liaise and coordinate with the departmental governor, district heads, mayors, municipal councils, RC councils and other departmental-level organizations concerned.

Each RC will allocate the land required for the village-level activities to be implemented within its geographical area of jurisdiction and will also provide support for the activities in collaboration with the forest management station and forestry official's office.

(3) Funds for Activities

The Master Plan envisages the implementation of sustainable as well as self-reliant mangrove forest management activities by local residents. The implementation of activities will involve initial investment for the purchase of the necessary tools and materials, etc. at the start of the activities and further expenditure to continue the activities. As the management of mangrove forests will only be feasible with continued self-reliant activities by local residents, the Master Plan intends the establishment of a mechanism by which local residents can bear the necessary expenditure to conduct the activities. To be more precise, it is planned to combine economic activities to generate income with the natural resources management activities in each village so that some of the income generated by the former can be used for the latter.

The Master Plan envisages the establishment of an environment fund in each village conducting activities to ensure the proper functioning of this mechanism. The original capital of this fund will be made available by saving some of the income from economic activities. Other sources of funding will include (i) some of the income from such sporting events as wrestling tournaments and football tournaments and cultural events with the consent of local people and (ii) personal donations.

This environment fund will be established at the onset of activities with the consent of local residents after full discussions by local residents. The environment fund will have an exclusive account. The management committee (or development committee) in each village will control both the account for economic activities and the account for the environment fund.

The flow of funds from economic activities to the environment fund will be made in the following manner.

① Village Forest

Planting to create a village forest will be completed in six years, producing a yield from the seventh year. In the immediate future, the harvested wood is expected to be mainly consumed in the village. However, as the sale of logs and firewood is expected in the future, income from such sales will constitute a funding source for the environment fund from this time onwards.

② Improved Smoking Kilns

The sale of smoked products using the improved smoking kilns will generate income which will constitute a funding source for the environment fund from the first year of operation of the kilns.

③ Life Jackets

If life jackets are made and sold for a profit, this activity can be considered to constitute another source of funding for the environment fund from the first year.

④ Eco-Tourism

If income is generated by the visits of tourists to eco-routes, some of this income can constitute the original capital of the environment fund.

The concept of the implementation system is shown in Fig. 3.6-1.

Activities Implementation System

Monitoring/Assistance System

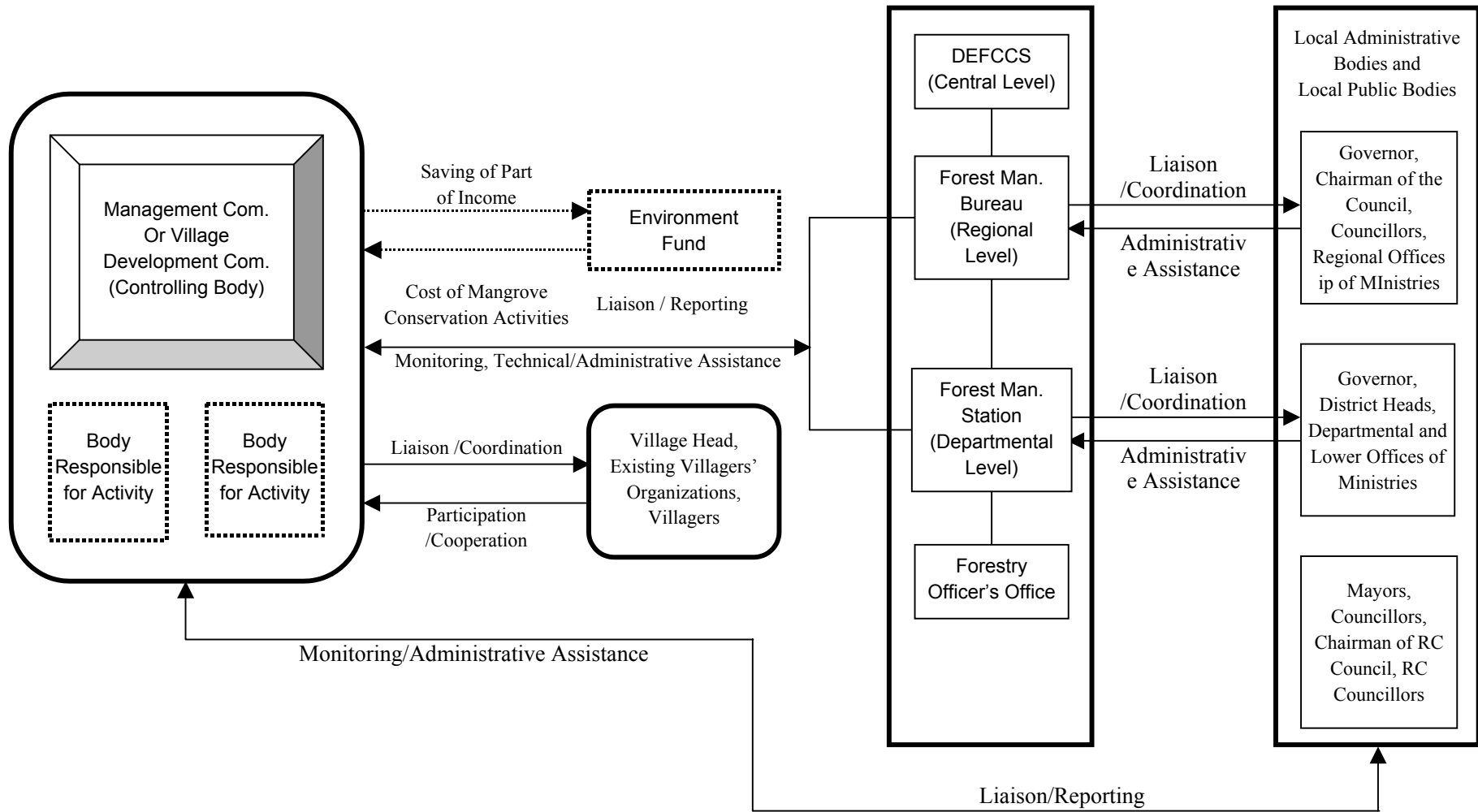


Fig. 3.6-1 Conceptual Diagramme of Implementation System

(4) Model Funding Plans for Village-Level Management Implementation Plan

The village-level implementation plan led by local residents will be implemented in a sustainable manner using, in principle, the environment fund saved by local residents through income-generating activities while conducting the rehabilitation/conservation of mangrove forests. Based on this concept, two model villages are assumed to fund the various activities.

1) Model Villages

The assumed activities of each of the two model villages are as follows.

- Model Village 1 : Introduction of improved smoking kilns for ethomaroze; planting of *Rhizophora*; creation of a village forest
- Model Village 2 : Introduction of eco-tourism; planting of *Avicennia*; creation of a village forest

In Model Village 1, three activities will be introduced, i.e. the planting of *Rhizophora* to rehabilitate mangrove forests, the introduction of improved smoking kilns to generate income and the creation of a village forest as an alternative source of firewood supply to mangrove wood. It is assumed that the conservation of local mangrove forests can be achieved in a sustainable manner by implementing these three activities as a group.

Three activities will also be introduced in Model Village 2, i.e. the planting of *Avicennia* to rehabilitate mangrove forests, eco-tourism to generate income and the creation of a village forest as an alternative source of wood to mangrove wood for consumption.. It is assumed that the conservation of local mangrove forests can be achieved in a sustainable manner by implementing these three activities as a group.

2) Preconditions for Funding Plan

① Plan Period

10 years in line with the Master Plan

② Planning Policy

The income and expenditure regarding the planned activities for a period of 10 years are calculated in accordance with the Master Plan. The activity plan will be repeatedly modified based on the actual income and expenditure so that activities can be conducted within the funding capacity of the village.

3) Plan Contents

The plan contents of each activity envisaged in the village-level management implementation plan are reproduced here.

① Planting of *Rhizophora*

The village in question will plant *Rhizophora* over an area of 0.25 ha a year, creating 2.5 ha of *Rhizophora* forest in 10 years. The number of seedlings to be planted a year is 10,000 with a planting distance of 50 cm x 50 cm. Planting-related activities will be conducted in accordance with the planting manual and the *Rhizophora* planting sub-committee will be responsible for the progress of the planting-related activities.

② Planting of *Avicennia*

The village in question will plant *Avicennia* over an area of 0.1 ha a year, creating 1 ha of *Avicennia* forest in 10 years. The seedlings will be nursed in pots and 4,000 seedlings a year will be planted with a planting distance of 50 cm x 50 cm. Planting-related activities will be conducted in accordance with the planting manual and the *Avicennia* planting sub-committee will be responsible for the progress of the planting-related activities.

③ Creation of Village Forest

The village in question will plant an area of 0.5 ha a year, creating 3.0 ha of village forest in six years. The species will be eucalyptus and 555 seedlings will be planted a year with a planting distance of 3 m x 3 m.

In the seventh year, the trees planted in the first year will be cut, followed by the subsequent cutting of 0.5 ha a year. Regeneration after cutting will be by sprouting. Planting-related activities will be conducted in accordance with the planting manual and the village forest creation sub-committee will be responsible for the progress of the village forest-related activities.

After the creation of a 3.0 ha village forest in six years, 16.5 m³ of firewood a year can be produced in the seventh year onwards. As the annual consumption of firewood by one improved smoking kiln for ethomaroze is approximately 5 m³ (133 kg x 7 times x 3 months/(550 kg/m³)) (volume weight of eucalyptus), the produced firewood will be able to meet the demand for the full operation of three kilns provided that it is entirely allocated to smoking operation.

④ Improved Smoking Kilns for Ethomarose

Here, it is assumed that one improved kiln constructed under the Pilot Project will be used at a model village to produce and sell smoked ethomarose from the first year. A second kiln will be constructed in the third year.

The improved smoking kiln management sub-committee will be responsible for all of the work ranging from the construction of the kiln and the purchase of raw fish and firewood to kiln maintenance while the village development committee will be in charge of the fund management relating to the work.

⑤ Eco-Tourism

The village where eco-tourism was introduced under the Pilot Project are assumed to act as model villages and, therefore, the initial investment is regarded as already having been made. The eco-tourism sub-committee will lead this activity while the village development committee will be responsible for fund management.

4) Income and Expenditure

The income and expenditure required for the implementation of activities are assumed in the Master Plan as follows.

① Planting of *Rhizophora*

The following annual expenditure is anticipated.

First year : 54,000 FCFA

Second year onwards : 44,000 FCFA

② Planting of *Avicennia*

The following annual expenditure is anticipated.

First year : 266,000 FCFA

Second year onwards : 84,000 FCFA

③ Creation of Village Forest

i. Expenditure

The following annual expenditure is anticipated.

From first year to sixth year : 141,000 FCFA

ii. Sales Income

The following sales income is anticipated.

From seventh year to tenth year : 260,000 FCFA

④ Improved Smoking Kiln

i. Expenditure

The construction cost of one kiln is 450,000 FCFA. The smoking cost is 55,711 FCFA per operation, costing 1,170,000 FCFA a year (55,711 FCFA x 7 times/month x 3 months).

Smoked fish production cost per operation

Raw fish cost	55 FCFA/kg	x 950kg	=	52,250FCFA
Firewood cost	4,250 FCFA/lot (250kg)	x 133kg	=	2,261FCFA
<u>Packing cost</u>	<u>200 FCFA/pack</u>	<u>x 6 packs</u>	=	<u>1,200 FCFA</u>
				Total 55,711 FCFA

ii. Sales Income

One smoking operation produces 247 kg of smoked products from 950 kg of raw fish. As 19,950 kg of raw fish (950 kg x 7 times/month x 3 months) is used a year, the annual production volume of smoked ethomaroze is 5,187 kg. Assuming a sales price of 300 FCFA/kg, the net annual sales total 1,556,000 FCFA.

iii. Annual Gross Profit

The annual gross profit, i.e. the annual net sales minus the annual expenditure, is 386,000 FCFA.

⑤ Eco-Tourism

The annual expenditure and income per village are inferred to be 936,000 FCFA and 1,300,000 FCFA respectively, producing an annual gross profit of 364,000 FCFA.

5) Environment Fund

In Model Village 1, the income generating activity will be the sale of smoked ethomaroze. Firstly, the amount of expenditure must be deducted from the amount of net sales. Further deductions should be made to meet the operating expenses of the management committee and the depreciation cost. The remaining balance will then be saved in the environment

fund. In regard to the village forest, the balance of the sales income from produced wood in the seventh year onwards (no planting cost will be incurred from the seventh year onwards because of regeneration by sprouting) and the operating expenses will be saved in the environment fund. The cost of planting *Rhizophora* and creating the village forest will be paid by the environment fund.

In Model Village 2, the income generating activity will be eco-tourism. Firstly, the amount of expenditure must be deducted from the amount of income. Further deductions should be made to meet the operating expenses of the management committee and the depreciation cost. The remaining balance will then be saved in the environment fund. In regard to the village forest, the balance of the sales income from produced wood in the seventh year onwards will be saved in the environment fund. The cost of planting *Avicennia* and creating the village forest will be paid by the environment fund. Assuming the allocation of 30% of the net profit to cover the operating expenses, etc. and 70% to the environment fund, the resulting figures are shown in Table 3.6-1.

Table 3.6-1 Annual Allocation to Operating Expenses, etc. and Environment Fund

(Unit: FCFA)

Activity	Net Profit	Operating Expenses, etc.	Environment Fund	Remarks
Operation of one improved smoking kiln	386	116,000	270,000	1 st – 10 th year
Eco-tourism	364	109,000	255,000	1 st – 10 th year
Village forest	26	8,000	18,000	7 th – 10 th year

6) Fund Flow

① Model Village 1

Funds (working funds) to support the planned activities will be required in the first year before the generation of income from sales of smoked ethomaroze. These funds should be provided in the form of borrowing from the village's mutual financial aid group, micro-credit from a NGO and/or the collection of money from villagers depending on the conditions and situation of external assistance in each village.

In the second year, the borrowed money will not be repaid and the income in the first year will be used to sustain the activities.

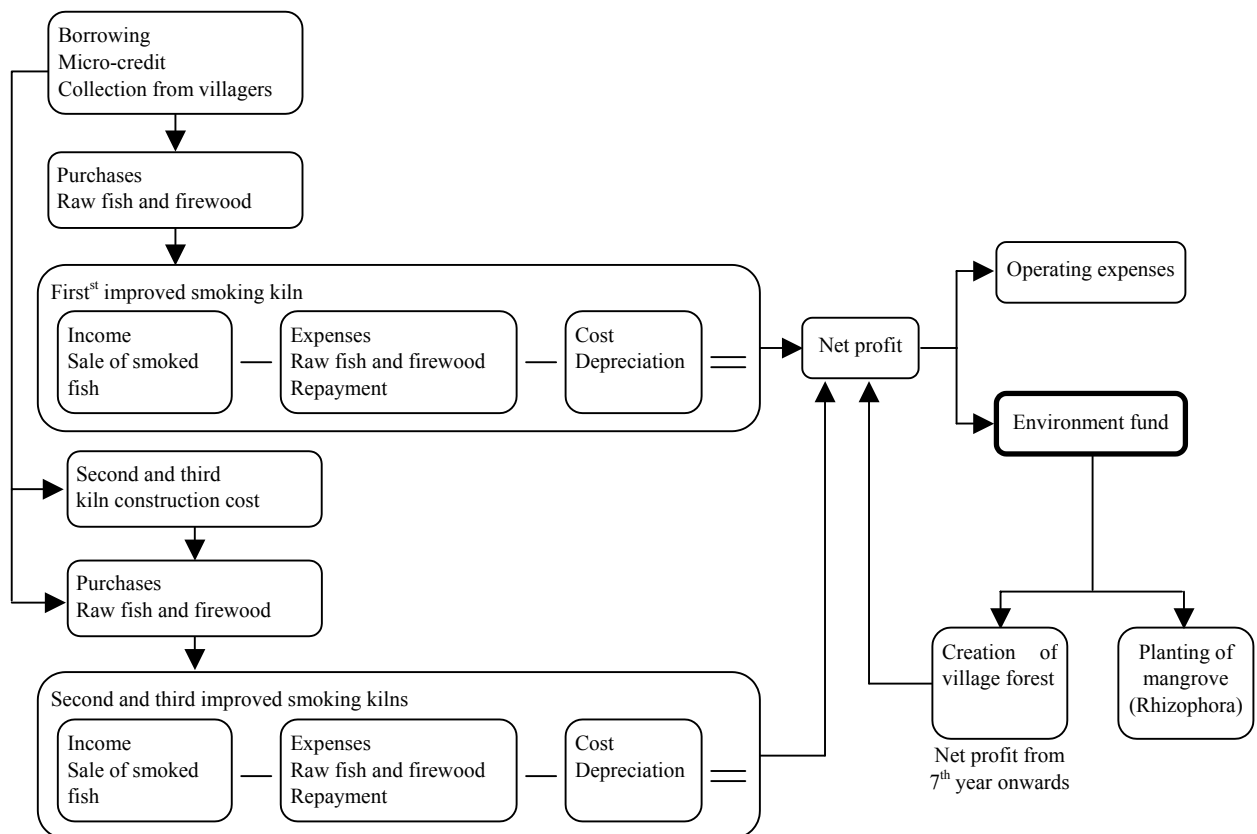
In the third year, further working funds and money to construct a second kiln will be borrowed. Repayment of the borrowed amount, including the amount borrowed in the first year, will gradually start in the third year.

In the sixth year, the working funds and money to construct a third kiln will be borrowed. Repayment will be gradually made with the completion of repayment in the tenth year.

② Model Village 2

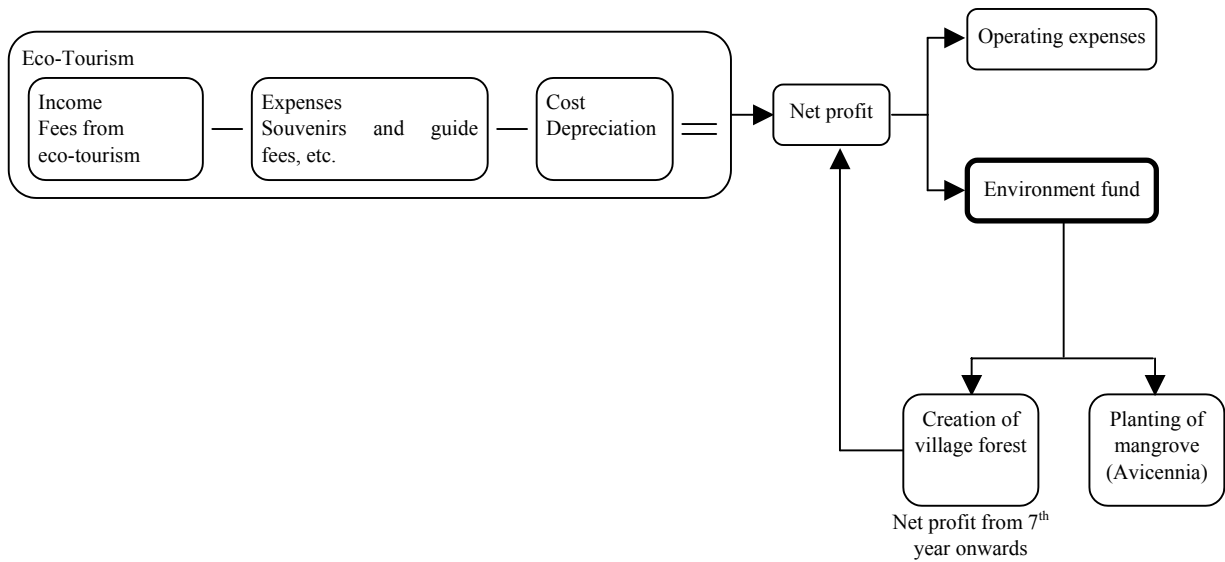
Eco-tourism will not require any working funds and the expenditure will be met by the income in the first year. The expenditure will consist of remuneration for those in charge of souvenirs, eco-guidance, operation of a pilogue/kayak and operation of a horse-drawn carriage after their completion of the work.

As some money will be saved in the environment fund each year in both Model Village 1 and Model Village 2 as shown in the table above, it will be possible to expand planting activities of *Rhizophora* or *Avicennia* if suitable sites are available and also to enlarge the village forest if additional land for this purpose is available. The fund flow for Model Village 1 is shown in Fig. 3.6-2 and Table 3.6-2 while the fund flow for Model Village 2 is shown in Fig. 3.6-3 and Table 3.6-3.



Note: The smoking kiln sub-committee will handle the depreciation cost, etc. while the village development committee will handle the operating expenses of villagers’ organizations and the environment fund.

Fig. 3.6-2 Fund Flow for Model Village 1
(Mainly Focusing on Income from Improved Smoking Kiln)



Note: The eco-tourism sub-committee will handle the depreciation cost, etc. while the village development committee will handle the operating expenses of villagers' organizations and the environment fund.

Fig. 3.6-3 Fund Flow for Model Village 2 (Mainly Focusing on Income from Eco-Tourism)

Table 3.6-2 Fund Flow: Model Village 1

(Unit: '000 FCFA)

Year	Item	Income	Expenditure	Remaining Borrowing	Balance (Environment Fund)	Breakdown of Income						Breakdown of Expenditure								
						Kiln 1	Kiln 2	Kiln 3	Village Forest	Borrowing	Sub-Total	Rhizophora	Village Forest	Kiln 1	Kiln 2	Kiln 3	Operating Expenses, etc.	Repayment	Sub-Total	
1	Borrowing to finance activities	1,481		1,481	1,481				1,481	1,481									1,481	
	Expenditure for activities		1,481	1,481	0						54	141	1,170			116			1,481	
	Income	1,556		1,481	1,556	1,556				1,556									1,556	
	Repayment of borrowing			1,481	1,556															
2	Expenditure for activities		1,471	1,481	85						44	141	1,170			116			1,471	
	Income	1,556		1,481	1,641	1,556				1,556									1,556	
	Repayment of borrowing			1,481	1,641															
3	Borrowing to finance activities	1,116		2,597	2,757				1,116	1,116									1,116	
	Borrowing to construct second kiln	450		3,047	3,207				450	450									450	
	Construction of second kiln		450	3,047	2,757								450						450	
	Expenditure for activities		2,757	3,047	0						44	141	1,170	1,170		232			2,757	
	Income	3,112		3,047	3,112	1,556	1,556			3,112										3,112
	Repayment of borrowing			350	2,762													350	350	
4	Expenditure for activities		2,757	2,697	5						44	141	1,170	1,170		232			2,757	
	Income	3,112		2,697	3,117	1,556	1,556			3,112									3,112	
	Repayment of borrowing			350	2,767												350	350		
5	Expenditure for activities		2,757	2,347	10						44	141	1,170	1,170		232			2,757	
	Income	3,112		2,347	3,122	1,556	1,556			3,112									3,112	
	Repayment of borrowing			2,347	3,122															
6	Borrowing to finance activities	921		3,268	4,043				921	921									921	
	Borrowing to construct third kiln	450		3,718	4,493				450	450									450	
	Construction of third kiln		450	3,718	4,043									450					450	
	Expenditure for activities		4,043	3,718	0						44	141	1,170	1,170	1,170	348			4,043	
	Income	4,668		3,718	4,668	1,556	1,556	1,556		4,668										4,668
	Repayment of borrowing			900	3,768												900	900		
7	Expenditure for activities		3,761	2,818	7						44		1,123	1,123	1,123	348			3,761	
	Income	4,668		2,818	4,675	1,556	1,556	1,556		4,668									4,668	
	Repayment of borrowing			900	3,775												900	900		
8	Expenditure for activities		3,761	1,918	14						44		1,123	1,123	1,123	348			3,761	
	Income	4,668		1,918	4,682	1,556	1,556	1,556		4,668									4,668	
	Repayment of borrowing			900	3,782												900	900		
9	Expenditure for activities		3,761	1,018	21						44		1,123	1,123	1,123	348			3,761	
	Income	4,668		1,018	4,689	1,556	1,556	1,556		4,668									4,668	
	Repayment of borrowing			900	3,789												900	900		
10	Expenditure for activities		3,761	118	28						44		1,123	1,123	1,123	348			3,761	
	Income	4,668		118	4,696	1,556	1,556	1,556		4,668									4,668	
	Repayment of borrowing			118	4,578												118	118		
Total							15,560	12,448	7,780	4,418	40,206	450	846	11,512	9,622	6,112	2,668	4,418	35,628	

- Notes 1) No construction cost will be required for the first kiln as it is assumed that this kiln was already constructed under the Pilot Project.
2) No rate of inflation and interest repayment, etc. are considered here because these figures are rough estimates.
3) The cost of firewood to be supplied from the village forest is deducted from the expenditure in the seventh year onwards for smoking kiln operation.

Table 3.6-3 Fund Flow for Model Village 2

(Unit: '000 FCFA)

Year	Item	Income	Expenditure	Balance (Environment Fund)	Breakdown of Income				Breakdown of Expenditure				
					Eco-Tourism	Village Forest	Borrowing	Sub-Total	<i>Rhizophora</i>	Village Forest	Eco-Tourism	Operating Expenses, etc.	Sub-Total
1	Income	1,300		1,300	1,300			1,300					
	Expenditure for activities		1,240	60					54	141	936	109	1,240
2	Income	1,300		1,360	1,300			1,300					
	Expenditure for activities		1,230	130					44	141	936	109	1,230
3	Income	1,300		1,430	1,300			1,300					
	Expenditure for activities		1,230	200					44	141	936	109	1,230
4	Income	1,300		1,500	1,300			1,300					
	Expenditure for activities		1,230	270					44	141	936	109	1,230
5	Income	1,300		1,570	1,300			1,300					
	Expenditure for activities		1,230	340					44	141	936	109	1,230
6	Income	1,300		1,640	1,300			1,300					
	Expenditure for activities		1,230	410					44	141	936	109	1,230
7	Income	1,326		1,736	1,300	26		1,326					
	Expenditure for activities		1,097	639					44		936	117	1,097
8	Income	1,326		1,965	1,300	26		1,326					
	Expenditure for activities		1,097	868					44		936	117	1,097
9	Income	1,326		2,194	1,300	26		1,326					
	Expenditure for activities		1,097	1,097					44		936	117	1,097
10	Income	1,326		2,423	1,300	26		1,326					
	Expenditure for activities		1,097	1,326					44		936	117	1,097
Total		13,104	11,778	-	13,000	104	0	13,104	450	846	9,360	1,122	11,778

Note: The rate of inflation is not considered because the above is a rough estimate.

3.7 Financial and Economic Analysis

(1) Financial analysis

1) Underlying assumptions

Under the Study, a number of different activities have been undertaken, reflecting diversified use of the mangrove. For some of those activities, profitability and viability will be calculated below with the following underlying assumptions:

① Selected undertakings

Financial analysis will be carried out only for the enterprises that produce marketable goods and services. Most of fishery activities and ecotourism are typically revenue generating whereas environmental education does not produce the marketable, and hence will not be financially analyzed. Forestry-related activities are somewhere in between.

② Prices of goods and services

Prices of goods and services as of October 1, 2004 will be employed for the purpose of evaluation and prices prior to that date will be adjusted accordingly, incorporating inflation rates. Prices that are used for the analysis are constant prices, which do not contain any future inflations impacts.

③ Foreign exchange rates

The exchange rate as of October 1, 2004 will be used for evaluation.

④ Project life

Project life is set in accordance with economic life of the Project equipment.

⑤ Distribution of some costs

Costs of technical assistance and saplings provided by the government are treated as a grant and will not be born by the beneficiaries. The cost of initial equipment will not be born by the beneficiaries either. Training and technical assistance offered by NGOs and others will considered gratis.

2) Feasibility of individual enterprises

① Forest conservation

i. Mangrove forestation

Forestation will be planned mainly around the Recovery Zone, but the Conservation Zone will be also targeted to ensure sustainable utilization and conservation of the mangrove. 127.5 ha of *Rhizophora* will be planted in the area with low salinity level and 15 ha of *Avicennia* in the area with relatively high salinity.

Since the mangrove is not to be timbered, FIRR will not be calculated.

ii. Conservation of natural mangrove

Likewise, FIRR will not be computed.

iii. Village forest

In the Conservation Zones II and III and Recovery Zones I and II, 126 ha of village forests will be established as alternatives to the mangrove during 6 years. Cutting will start from Year 6, but logs will be self-consumed within the villages. FIRR will not be therefore calculated.

iv. Bee-keeping

Three villages will be selected in the Conservation Zone III, and 5 bee-keepers will be selected to supplement their incomes. Equipment and training will be provided in Years 1 and 2. It is assumed that one box will produce 7.5 kg of honey in Year 3 and production will increase gradually until 15 kg per box is reached.

It shows a high profitability, as FIRR is 23.5% with training cost included for 10 years, and 29.5% without it.

② Fisheries

i. Life vests

This enterprise is profitable, as FIRR is 14.5% for 10 years even with the costs of initial training and demonstration.

ii. Improved oven

Even under the assumption of replacement every two years, FIRR is very high at 33.2%.

iii. Oyster culture

FIRR shows a negative value when the substantial cost of technical assistance is included. FIRR is marginal without it.

③ Ecotourism

As the financial burden of eco-guide training, brochure printing and marketing is very heavy, all-inclusive FIRR is negative at -4.2%. But if the cost of training and marketing is excluded, FIRR would jump to 22.3%.

3) Feasibility for the entire Project

Cash flow for the entire project has been estimated by combining individual cashflow for forestation, beekeeping, ecotourism, fishery enterprises, fishery awareness campaign and environmental education. It shows constantly negative flow throughout 10-year project period.

(2) Economic analysis

1) Underlying assumptions

Profitability and feasibility has been explained in the previous section. Impacts of all the activities, including no-revenue-generating ones, upon the national economy will be analyzed in this section with following assumptions:

① With and Without Project

A fundamental framework for economic analysis is to deliberate 2 scenarios: one with Project and another without it. Costs and benefits will be calculated on a marginal basis between the two scenarios.

② Costs and benefits

In financial analysis, labor offered by village people is not included, but all the labor will be included as costs in economic analysis. Further, all the products to be produced under forestry enterprises will be recognized as benefits, regardless of whether self-consumed or not.

③ Conversion from financial prices to economic prices

Because of the existence of taxes, duties and subsidies or government intervention, market prices in financial analysis are often deviated from international prices. Economic analysis endeavors to remove these market distortions to reach international-price base to the extent possible.

2) Economic viability of individual enterprises

① Forest conservation

In view of peculiar vegetation in the Saloum Delta, assumption is simplified in that the mangrove is only foliage for firewood and logs.

i. Mangrove forestation

Newly planted 142.5 ha of mangrove forest will be an economic outcome, and inputs such as collection of seedlings, planting, maintaining and nursing will be recognized as costs.

ii. Conservation of natural mangrove

Since the mangrove would not be logged with or without the sustainable management plan, there would be no marginal benefits or costs.

iii. Village forest

As village forests of 126 ha will be established and utilized, damage to the mangrove would be mitigated. It can be translated that the same area of mangrove forests would be saved, which is an economic outcome, and inputs used would constitute costs.

All the forestation and forest conservation attempts produce negative cash flow, even with the benefits of CO₂ sequestration (valued at US\$ 1.5/mt).

iv. Bee-keeping

Honey to be produced from Year 3 is an economic benefit and cost for initial training and required equipment as well as operating costs are economic costs. EIRR is calculated at 23.5%.

② Fisheries

EIRR for life vests manufacturing is 14.5% for 10 years, EIRR for improved oven is 33.2%, and that for oyster culture is negative.

③ Ecotourism

Including economics costs of eco-guide training, brochure printing and marketing, EIRR for eco-tourism is negative.

3) Feasibility for the entire Project

Cash flow for the entire project has been estimated by combining individual cashflow for forestation, beekeeping, ecotourism, fishery enterprises, fishery awareness campaign and environmental education. It shows constantly negative flow throughout 10-year project period.

Table 3.7-1 Economic Analysis of Project

(FCFA)

Plantation Project	Year	1	2	3	4	5	6	7	8	9	10	
	Costs	56,543	53,203	53,203	53,203	53,203	53,203	53,203	62,586	62,586	62,586	62,586
Benefits	391	783	1,174	1,566	1,957	2,348	24,947	25,006	25,066	25,125		108,363
Apiculture	Costs	2,592	0									2,592
	Benefits		0	563	750	938	1,125	1,125	1,125	1,125	1,125	7,875
Eco-tourism	Costs	5,294	6,230	7,166	2,808	2,808	2,808	2,808	2,808	2,808	2,808	38,346
	Benefits	1,300	2,600	3,900	3,900	3,900	3,900	3,900	3,900	3,900	3,900	35,100
Fishery Project	Costs	10,123	10,180	10,238	11,804	10,823	15,741	16,144	17,088	16,384	18,061	136,586
	Benefits	10,661	10,881	11,051	11,751	12,021	16,909	17,609	17,779	18,099	19,975	146,733
Extension of Fishery	Costs	6,389	6,389	6,389	9,079	9,079	9,079	11,769	11,769	11,769	11,769	93,480
	Benefits											0
Extension and Empowerment	Costs	9,656	7,972	10,598	8,152	7,989	8,208	8,184	7,588	7,058	7,972	83,375
	Benefits											
Total	Costs	90,597	83,974	87,593	85,046	83,902	89,038	101,491	101,839	100,604	103,196	927,281
	Benefits	12,352	14,263	16,687	17,966	18,815	24,282	47,581	47,810	48,190	50,125	298,071
	Net Cashflow	-78,245	-69,711	-70,906	-67,080	-65,087	-64,756	-53,910	-54,029	-52,415	-53,071	-629,210

Table 3.7-2 Economic Analysis of Plantation project

Plan for mangrove plantation			1	2	3	4	5	6	7	8	9	10	Total
Plan for mangrove plantation 1	Area of plantation	R (ha)	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	127.5
		A (ha)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	15
	Cost of plantation	FCFA	21,909	18,669	18,669	18,669	18,669	18,669	18,669	18,669	18,669	18,669	189,930
Plan for mangrove plantation 2	Area of plantation	ha	2	2	2	2	2	2	2	2	2	2	20
	Cost of plantation	FCFA	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	33,000
Labor force		man-day	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055	
Cost of labor force		3,000	15,165	15,165	15,165	15,165	15,165	15,165	15,165	15,165	15,165	15,165	
Stock of CO ₂		mt	81	163	244	325	407	488	569	650	732	813	4,472
Value of CO ₂ stock		729.36	59	119	178	237	297	356	415	474	534	593	3,262
Cost		FCFA	40,374	37,134	37,134	37,134	37,134	37,134	37,134	37,134	37,134	37,134	
Benefit			59	119	178	237	297	356	415	474	534	593	
Plan for Community forest													
Plan for Community forest	Area of plantation	ha	21	21	21	21	21	21					
	Area of cutting	ha							21.0	21.0	21.0	21.0	84.0
	Cost of plantation	FCFA	9,239	9,139	9,139	9,139	9,139	9,139	18,522	18,522	18,522	18,522	129,022
	Selling amount								24,532	24,532	24,532	24,532	98,128
Labor force		man-day	2,310	2,310	2,310	2,310	2,310	2,310	1,386	1,386	1,386	1,386	
Cost of labor force		3,000	6,930	6,930	6,930	6,930	6,930	6,930	6,930	6,930	6,930	6,930	
Stock of CO ₂		mt	455	911	1,366	1,821	2,277	2,732					
Value of CO ₂ stock		729.36	332	664	996	1,328	1,660	1,992					
Cost		FCFA	16,169	16,069	16,069	16,069	16,069	16,069	25,452	25,452	25,452	25,452	
Benefit			332	664	996	1,328	1,660	1,992	24,532	24,532	24,532	24,532	
Total Cost			56,543	53,203	53,203	53,203	53,203	53,203	62,586	62,586	62,586	62,586	572,902
Total Benefits			391	783	1,174	1,566	1,957	2,348	24,947	25,006	25,066	25,125	108,363.2
Net Cash Flow			-56,152	-52,420	-52,029	-51,637	-51,246	-50,855	-37,639	-37,580	-37,520	-37,461	

ha 35.25

Table 3.7-3 Economic Analysis of Apiculture project

(FCFA)

Year	1	2	3	4	5	6	7	8	9	10	Total
Number of target village	3	3	3	3	3	3	3	3	3	3	3
Cost	2,592	0									2,592
Income		0	563	750	938	1,125	1,125	1,125	1,125	1,125	7,875
Annual profit	-2,592	0	563	750	938	1,125	1,125	1,125	1,125	1,125	5,283

Table 3.7-4 Economic Analysis of Eco-tourism project

(FCFA)

Year	1	2	3	4	5	6	7	8	9	10	Total
Number of new eco-route	1	1	1	0	0	0	0	0	0	0	3
Total of eco-route	1	2	3	3	3	3	3	3	3	3	
Cost of investment	4,358	4,358	4,358	0	0	0	0	0	0	0	13,074
Cost	936	1,872	2,808	2,808	2,808	2,808	2,808	2,808	2,808	2,808	25,272
Total	5,294	6,230	7,166	2,808	2,808	2,808	2,808	2,808	2,808	2,808	38,346
Income	1,300	2,600	3,900	3,900	3,900	3,900	3,900	3,900	3,900	3,900	35,100
Annual profit	364	728	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	9,828

Table 3.7-5 Economic Analysis of Fisheries project

(FCFA)

Lifejacket workshop	1	2	3	4	5	6	7	8	9	10	Total
Number of workshop	2	2	2	2	2	2	2	2	2	2	20
Operation cost	1,153	1,211	1,268	1,326	1,384	1,441	1,499	1,557	1,614	1,672	14,124
Sales amount	1,400	1,470	1,540	1,610	1,680	1,750	1,820	1,890	1,960	2,030	17,150
Annual profit	247	259	272	284	296	309	321	333	346	358	3,026

Value added with selffish processing improvement											Total
target village	1	1	1	2	2	2	3	3	3	3	3
Cost of facilities	0	0	0	276	0	0	276	0	0	0	552
Producing cost	70	70	70	140	140	140	210	210	210	210	1,470
Sales amount	480	480	480	960	960	960	1,440	1,440	1,440	1,440	10,080
Annual profit	410	410	410	820	820	820	1,230	1,230	1,230	1,230	8,610

Project of conversion to the improved smoking furnace											Total
Number of conversion	5	5	5	5	5	8	8	8	8	9	66
Constraction cost	2,250	2,250	2,250	2,250	2,250	3,600	3,600	3,600	3,600	4,050	29,700
Producing cost	5,850	5,850	5,850	5,850	5,850	9,359	9,359	9,359	9,359	10,529	77,215
Sales amount	7,781	7,781	7,781	7,781	7,781	12,449	12,449	12,449	12,449	14,005	102,703
Annual profit	1,931	1,931	1,931	1,931	1,931	3,089	3,089	3,089	3,089	3,476	25,487

Project for establishment and extension of culture technique in Saloum Delta											Total
Number of culture parks	4	4	4	6	6	6	6	8	8	8	8
Constraction cost	0	0	0	762	0	0	0	762	0	0	1,524
Maintenance cost	800	800	800	1,200	1,200	1,200	1,200	1,600	1,600	1,600	12,000
Sales Quantity (dozen)	1,000	1,150	1,250	1,400	1,600	1,750	1,900	2,000	2,250	2,500	16,800
Annual profit	800	950	1,050	1,200	1,400	1,550	1,700	1,800	2,050	2,300	14,800

Grand Total	1	2	3	4	5	6	7	8	9	10	Total
Constraction cost	2,250	2,250	2,250	3,288	2,250	3,600	3,876	4,362	3,600	4,050	31,776
Producing cost	7,873	7,930	7,988	8,516	8,573	12,141	12,268	12,726	12,784	14,011	104,810
Subtotal	10,123	10,180	10,238	11,804	10,823	15,741	16,144	17,088	16,384	18,061	136,586
Sales amount	10,661	10,881	11,051	11,751	12,021	16,909	17,609	17,779	18,099	19,975	146,733
Annual profit	3,388	3,550	3,663	4,235	4,447	5,768	6,340	6,453	6,715	7,364	51,923

Table 3.7-6 Economic Analysis of Fisheries Extension project

Extension of shellfish harvest protectors		1	2	3	4	5	6	7	8	9	10	Subtotal
Village held workshops	Number of village	3	3	3	3	3	3	3	3	3	3	30
	Number of participants	90	90	90	90	90	90	90	90	90	90	900
Annual cost (FCFA'000)		1,499	1,499	1,499	1,499	1,499	1,499	1,499	1,499	1,499	1,499	14,990
Legal Enforcement of Shrimp Resource Management												Subtotal
No. of session		4	4	4	4	4	4	4	4	4	4	40
Unit cost (FCFA'000)		250	250	250	250	250	250	250	250	250	250	250
Annual cost (FCFA'000)		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Support to the Beach Committees												Subtotal
Target villages		4	4	4	4	4	4	4	4	4	4	4
Cost per village		300	300	300	300	300	300	300	300	300	300	
Annual cost (FCFA'000)		1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	12,000
Introduction of a New System for Mangrove Oyster Management												Subtotal
Target villages	Target areas	1	1	1	2	2	2	3	3	3	3	
Annual cost (FCFA'000)		2,690	2,690	2,690	5,380	5,380	5,380	8,070	8,070	8,070	8,070	56,490
Total		6,389	6,389	6,389	9,079	9,079	9,079	11,769	11,769	11,769	11,769	93,480

Table 3.7-7 Economic Analysis of Extension and Empowerment project

Visits to Model Villages of Sustainable Management of Mangrove Forests	1	2	3	4	5	6	7	8	9	10	Subtotal
(FCFA '000)	1,752	1,254	2,100	1,042	1,254	1,650	1,254	1,708	500	1,042	13,556
Implementation of empowerment activities in partnerships with local sports and cultural activities											Subtotal
(FCFA '000)	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	11,300
Implementation of technology dissemination by resident lecturers											
(FCFA '000)	4,374	3,280	3,990	3,280	3,280	3,100	3,100	3,100	3,100	3,100	33,704
Mangrove-centered environmental education											Subtotal
(FCFA '000)	1,800	1,358	1,750	1,750	1,375	700	1,750	700	700	1,750	13,633
Seminars and workshops on mangrove for CR legislators											
(FCFA '000)	600	950	1,628	950	950	1,628	950	950	1,628	950	11,183
Total (FCFA '000)	9,656	7,972	10,598	8,152	7,989	8,208	8,184	7,588	7,058	7,972	83,375

RECOMMENDATIONS

RECOMMENDATIONS

1. Objectives of the Master Plan and Significance of Its Implementation

The principal objective of the Master Plan is the conservation/rehabilitation of mangrove forests. It is intended to achieve this conservation/rehabilitation based on approaches involving activities in the forest/forestry sector, fisheries sector and tourism sector, all of which are linked to mangrove forests. At the same time, the Master Plan aims at improving and stabilising the livelihoods of local residents who directly and indirectly coexist with mangrove forests. It is essential for not only local residents but also the DEFCCS and other central government offices and related organizations of local public bodies to fully understand the necessity for the implementation of income-generating economic activities to make the planting of mangrove feasible.

2. Implementing Body of the Master Plan

It is anticipated that the Master Plan will be implemented with the participation of local residents who will act as the main implementers in accordance with a village-level management implementation plan formulated for each village or RC to reflect the particular characteristics and/or situation of each village or RC. For this reason, central government offices and local public bodies must create an environment in which local residents can implement various activities put forward by the Master Plan based on their own initiative.

3. Assistance by the DEFCCS and Other Administrative Organizations

The Master Plan will serve the entire areas subject to the planning of mangrove forest conservation/rehabilitation in the Saloum Delta and conforms to the Forest Law and other laws in Senegal. As the Master Plan will be implemented in a participatory manner and in accordance with the village-level management implementation plan for each village or RC, The DEFCCS, DOPM and Working Group should provide administrative and technical assistance to ensure the smooth implementation of the Master Plan (activities) by local residents.

4. Financial Assistance

Under the Master Plan, *Rhizophora* and *Avicennia* will be planted to conserve and rehabilitate mangrove forests. Even though the Master Plan will be implemented in a participatory manner involving local residents, external financial assistance will be required to meet the cost of planting designed to restore the natural environment.

Assistance in the form of micro-credit, etc. will be required to cover the initial investment, working funds and/or cost of raw materials, etc. in the case of income-generating activities.

5. Sustainable Use of Man-Made Mangrove Forests

To start with, *Rhizophora* will be planted to rehabilitate mangrove forests. It will be necessary for these man-made *Rhizophora* forests to be used in a sustainable manner to produce wood products as sources of income for local residents. For this reason, the DEFCCS should play a leading role in the monitoring of these forests, including the collection of data on the growth situation and site conditions over a long period of time. These man-made mangrove forests for sustainable use will be managed by the RCs situated outside national forests. Meanwhile, the DEFCCS will conduct the conservation and management work for mangrove forests (natural forests and plantations) other than man-made mangrove forests designated as production forests.

6. Planting of *Avicennia*

A nursing and planting experiment involving *Avicennia* has been conducted for the purpose of rehabilitating mangrove forests in Rehabilitation Sub-Zone I where mangrove trees have almost disappeared because of the high salinity. This experiment lasted for nearly two years and clarified the basic issues relating to nursing and planting. The DEFCCS should continue this experiment based on the newly acquired knowledge on the basic issues so that it can establish reliable planting techniques for *Avicennia*.

7. Assistance and Cooperation of NGOs

The planned participatory implementation of the Master Plan (activities) makes the cooperation of NGOs, which have been closely working with local communities in the area, essential. On their part, NGOs will be able to provide effective cooperation/assistance for the implementation of the Master Plan in local villages and extend the planned activities to other areas by effectively utilising the skills and experience obtained through the Pilot Project under the present Study.

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BIBLIOGRAPHIE (DOCUMENTS DE REFERENCE)

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APPENDICES

APPENDIX 1 STUDY TEAM MEMBERS

(1) Study Team

Matters in Charge	Name	Field Survey Period	Affiliation
Team Leader	Tadao OHARA	2002. 1.14~2002.2.17 2002. 7. 1~2002.7.30 2002.10. 1~2002.10.30 2003. 4.30~2003.5.14 2003. 7. 1~2003.7.14 2003.11.16~2003.11.30 2004. 1.17~2004.2.6 2004. 9.11~2004.10.10 2004.12.13~2004.12.24	Japan Forest Technology Association
Mangrove Resources Management	Hiroaki MASUI	2002. 1.14~2002. 3.14 2002. 6. 1~2002. 7.30 2002.10. 1~2002.11.14 2003. 2. 1~2003. 2.15 2003. 4.30~2003. 5.29 2003. 7. 1~2003. 7.30 2003.11. 1~2003.11.30 2004. 1.17~2004. 2. 6 2004. 6. 2~2004. 6.16 2004. 9. 1~2004.10.15 2004.12.13~2004.12.24	Japan Forest Technology Association
Sea Conditions/Coastal Erosion	Takaki KURATA	2002. 2.13~2002. 3.14 2002. 6. 6~2002. 7. 5 2002.10.16~2002.11.14	Kokusai Kogyo Co., Ltd.
Fisheries Resources Management/Fish Culture	Tokio KITAMADO	2002. 1.14~2002. 3.14 2002. 6. 1~2002. 7.30 2002.10. 1~2002.11.14 2003. 4.30~2003. 5.29 2003. 7.10~2003. 8.18 2003.11. 1~2003.11.30 2004. 1.17~2004. 2. 6 2004. 6. 2~2004. 6.16 2004. 9. 1~2004.10.10 2004.12.13~2004.12.24	IC Net Co., Ltd.
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	Takaharu IKEDA	2004. 1.17~2004. 2. 6	IC Net Co.

Matters in Charge	Name	Field Survey Period	Affiliation
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Coordination (2)	Mahop Eric Allen	2002. 2.24~2002. 3.24	IC Net Co., Ltd.
Coordination (3)	Akiko MOCHIZUKI	2004. 9. 1~2004.10.15	Japan Forest Technology Association
Interpreter	Tomoyuki OHTANI	2002. 1.14~2002. 3.14 2002. 6. 1~2002. 7.30 2002.10. 1~2002.11.14 2003. 4.30~2003. 5.29 2003. 7.20~2003. 8.18 2003.11. 1~2003.11.30 2004. 1.17~2004. 2. 6 2004. 9. 1~2004.10.15 2004.12.13~2004.12.24	Okubo Co., Ltd.

(2) Domestic Support and Supervisory Team

Matters in Charge	Name	Field Survey Period	Affiliation
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Study Supervision	Masaru HONDA	2002.10. 1~2002.10.14	Forestry and Fisheries Department Study Division, JICA
Study Supervision	Takayuki NISHIZAKI	2003. 5.11~2003. 5.21	Forestry and Fisheries Department Study Division, JICA
Study Supervision	Michiko MAEKAWA	2004. 1.23~2004. 2. 1	Forestry and Fisheries Department Study Division, JICA
Study Supervision	Toshio OGAWA	2004.12.13~2004.12.23	Global Environment Department, Group1 (Forest/Natural Environment, Forest Conservation No.2 Team), JICA

APPENDIX 2 LIST OF PERSONS INVOLVED IN THE PROJECT

(Titles Omitted)

1. Government of eEnegal

Department of Water, Forest, Hunting and Soil Conservation, Ministry of Youth, Environment and Public Hygiene (When the Study started)

(Renamed to Ministry of Environment and Soil Protection, then, further renamed to Ministry of Environment)

(1) Department of Water, Forest, Hunting and Soil Conservation

- Mattar CISSE : Director of Department of Water, Forest, Hunting and Soil Conservation
- Ndiawar DIENG : Former Director of Department of Water, Forest, Hunting and Soil Conservation
- Amadou NDIAYE : Assistant Director of Department of Water, Forest, Hunting and Soil Conservation
- Cheikh Oumar DIOP : Technical Advisor for the DEFCCS / Coordinator for the Study
- Souleymane GUEYE : Head of Reforestation and Soil Conservation
- Babacar NDIAYE : Former Head of Reforestation and Soil Conservation
- Papa NDIAYE : Former Head of Reforestation and Soil Conservation / Coordinator for the Study
- Ibrahima NDIAYE : Head of Monitoring and Evaluation Division
- Samba THIAM : Coordinator for the Coastal Area Afforestation Project
- Shozo KITAMURA : Former Principal Advisor for the DRCS / JICA Expert
- Takeshi FUJIMURA : Former Principal Advisor for the DRCS / JICA Expert
- Malang KIDIERA : Head of Fatick Regional Forest Management Bureau
- Mame Balla GUEYE : Former Head of Fatick Regional Forest Management Bureau
- Dibacor DIONE : Former Head of Hunting Division of Fatick Forest Management Bureau
- Dame KANE : Head of Foundiougne Forest Management Station
- Sountoukoun SAMBOU : Former Head of Foundiougne Forest Management Station
- Mamadou DIOUF : Head of Djilor Forest Management Office
- Aliou GANO : Head of Niodior Forest Management Office
- Abdou DIATTA : Head of Toubacouta Forest Management Office
- Bakary R. TRAORE : Former head of Sokone Branch of Foundiougne Forest Management Station
- Ibrahima DIALLO : Head of Joal Forest Management Office

Amacoumba MBODJI : Head of Nguekhokh Forest Management Office

Abdou DEALLO : Head of Fimela Forest Management Office

(2) Department of National Parks, MJEHP

Mame Balla GUEYE : Director of Department of National Parks

Demba Mamadou BA : Former Director of Department of National Parks

Boucar NDIAYE : Formerly in charge of Conservation of Saloum Delta National Park

(3) Department of Oceanography and Ocean Fisheries

Moustapha THIAM : Assistant Director

Ibrahima SECK : Engineer

Babacar N'DOYE : Head of Fatick Reginal Ocean Fisheries Bureau

Abdou Salam FALL : Head of Foundiougne Ocean Fisheries Station

Mamadou Eric DIOP : Head of Foundiougne Ocean Fisheries Office

Mame Birame DIOUF : Head of Missirah Ocean Fisheries Office

Lamine Kane DIOUM : Head of Fimela Ocean Fisheries Office

(4) Union mondiale pour la nature (UICN)

Abdoulaye KANE : Head of Senegal Office

Matar DIOUF : Deputy Head of Senegal Office

Ndour NGOR : Engineer

(5) West African Association For Marine Environment (WAAME)

Abdoulaye DIAME : President of WAAME

Oumar DIEDHIOU : Engineer of WAAME

Amie SOW : Engineer of WAAME

Ameth DIOP : Engineer of WAAME

Cheikh KANDJI : Engineer of WAAME

2. Japanese Side

(1) Japanese Embassy in Senegal

Akira NAKAJIMA : Ambassador

Tetsuro KAWAGUCHI : Councillor

Yositaka IIZAWA : Former Coucillor

Shinya IWATA : First Secretary

Junko KUMATA : second Secretary

Toshiya SORIMACHI : Former Second Secretary

(2) JICA Senegal Office

Kiyofumi KONISHI : Manager

Tsuneo KUROKAWA : Former Manager

Ryuichi KATO : Assistant Manager

Mayumi AMANO : Former Assistant Manager

Kenji INOUE : Staff

Njai Mayumi ANDO : Staff

Tadashi KAGYAMA : Staff

Mitsutaka UCHIJIMA : Former Staff

Hitoshi KANAZAWA : Assistant Councillor

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A-2-2-1 Areas of Mangrove Forests (High, Low) and Tanne in the Study Area

【Inside Biosphere Reserve】

District	Category	Area (ha)			
		High Mangrove Forest	Low Mangrove Forest	Mangrove Total	Tanne
Fimela	National Park	76	53	129	0
	Foret classée	0	0	0	0
	Others	0	27	27	28
	Sub-Total	76	80	156	28
Djilor	National Park	0	0	0	0
	Foret classée	0	0	0	0
	Others	912	5,662	6,574	5,154
	Sub-Total	912	5,662	6,574	5,154
Toubacouta	National Park	633	3,961	4,594	313
	Foret classée	3,370	7,868	11,238	2,250
	Others	963	4,306	5,269	1,111
	Sub-Total	4,966	16,135	21,101	3,673
Niodior	National Park	279	718	996	313
	Foret classée	8,944	13,477	22,420	4,157
	Others	1,089	5,981	7,070	1,167
	Sub-Total	10,312	20,175	30,487	5,638
Total		16,266	42,051	58,317	14,494

【Outside Biosphere Reserve, Fatic】

District	Category	Area (ha)			
		High Mangrove Forest	Low Mangrove Forest	Mangrove Total	Tanne
Fimela	National Park	0	0	0	0
	Foret classée	0	0	0	0
	Others	0	4,775	4,775	10,600
	Sub-Total	0	4,775	4,775	10,600

【Outside Biosphere Reserve, Mbour】

District	Site	Area (ha)			
		High Mangrove Forest	Low Mangrove Forest	Mangrove Total	Tanne
Tiadiaye	JOAL	0	1,081	1,081	-
Nguekokh	SOMONE	0	113	113	-
	Sub-Total	0	1,194	1,194	-

Grand Total	Area (ha)			
	High Mangrove Forest	Low Mangrove Forest	Mangrove Total	Tanne
	16,266	48,020	64,286	25,094

Notes: Each area is measured using the Carté d'Occupation du Sol of the Reserve de Ela Biosphere du Delta du Saloum prepared by the UICN.

The reference height is 6 - 14 m for high forest and 2 - 6 m for low forest.

In the case of Mbour Department located outside the Biosphere Reserve, a topographical map (scale: 1 to 50,000) and aerial photographs were used and the tree height was tentatively classified in the low forest category.

A-2-2-2 Summary of the Sample Plot Survey

Department		Unit	Fatick	Foundiougne									
District			Fimela	Djilor	Niodior		Djirnda		Toubakouta				
RC			Fimela	Djilor	Dionouar	Bassoul	Djirnda	Djirnda	Toubakouta	Toubakouta	Toubakouta	Toubakouta	
Village			Mar fafako	Felane	Dionouar	Bassoul	Munde	Djirnda	Sangako	Tobakouta	National Park 1	National Park 2	
Plot Shape		m	5×2	10×5	5×5	5×5	5×2	5×5	10×5	10×5	20×5	10×10	
Plot Size		m ²	10	50	25	25	10	25	50	50	100	100	
No. of Trees Surveyed			3	20	12	12	1	10	10	12	6	6	
No. of Stems Surveyed			20	56	50	22	21	12	18	12	22	15	
Mean Height of Four Tallest Trees		m	3.4	2.5	4.5	6.3	6.0	5.0	5.0	11.3	14.3	17.5	
Tallest Tree		m	3.4	2.5	4.5	7.0	6.0	6.0	5.0	12.5	15.8	19.5	
Mean Height		m	3.3	2.2	3.5	4.3	6.0	3.9	3.5	9.8	9.4	11.7	
Mean Length of Four Longest Trees		Because of Leaning Stem	m	-	-	-	-	11.0	6.3	-	-	17.1	18.8
Length of Longest Tree			m	-	-	-	-	15.0	7.0	-	-	15.8	19.5
Mean Tree Length			m	-	-	-	-	5.0	5.1	-	-	10.0	13.2
Mean Stem Length, Excluding Basal Height		m	2.3	1.3	2.6	3.1	5.0	2.9	2.3	7.3	7.6	10.7	
Mean Basal Height		m	1.0	0.9	0.9	1.2	1.0	1	1.2	2.5	1.8	2.5	
Mean DBH of Four Tallest Trees		cm	3	3.4	3	5.3	7.8	6	4	15	16.3	22.3	
DBH of Tallest Tree		cm	3	4	3	6	9	8	4.5	17	17	27	
Mean Basal Diameter		cm	4.6	3.3	3.8	5.2	5.4	6.1	4.5	11.8	11.8	16.2	
Mean DBH		cm	2.9	1.4	2.2	3.3	4.4	4.9	2.2	10.9	10.5	14.1	
No. of Trees		/ha	3,000	4,000	4,800	4,800	1,000	4,000	2,000	2,400	600	600	
No. of Stems		/ha	20,000	11,200	20,000	8,800	21,000	4,800	3,600	2,400	2,200	1,500	
Stem Volume		m ³ /ha	20	5	14	20	76	37	5	110	135	179	
Branch Volume (Estimated from Cut Branches)		m ³ /ha	15	2	9	11	49	41	7	11	14	18	
Stem Volume + Branch Volume		m ³ /ha	35	7	23	31	125	78	12	121	148	197	
N Location			14°02'780	14°00'625	13°54'637	13°56'164	13°57'110	13°58'494	13°49'288	-	13°38'840	13°37'753	
W Location			16°38'348	16°28'120	16°43'001	16°35'770	16°39'350	16°36'636	16°27'432	-	16°30'007	16°30'066	
Note			Some Cutting	No Cutting	Some Cutting	Some Cutting	No Cutting	Heavy Cutting	Heavy Cutting	Some Cutting	No Cutting	No Cutting	

A-2-2-3 Survey on the Situation of Planted Mangrove (Rhizophora) (June, 2002)

Department	Fatick				Foundiougne				
District	Femela				Djilor				
RC	Fimela				Djilor				
Village	Mar fafako	Mar Soulou	Simal	Simal 2	Mbam	Mbam2	Kamatane	Gague Cherif 1	Gague Cherif 2
Date of Planting	2000.9	2000.9	2001.9	1997.9	2000.9	1999.9	2000.9	2000.9	2001.9
Tree Age (months)	21	21	9	57	21	33	21	21	9
Planted Area	Approx.1	Approx.0.5	Approx.0.5	Approx.1.0	Approx.1.5	Approx.9	Approx.1	Approx.1.5	Approx.3.5
Planting Distance	Approx.50cm×50 cm adequate	Approc.50cm×1 m adequate	Approx.80cm×50 cm	Approx.2m×4m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m
Total Tree Height	37	40	38	57	43	65	42	47	47
Height of Viviparous Seeds	17	22	18	20	10	22	19	20	22
Upper Height of Seeds	20	18	20	37	33	43	23	27	25
Upper Diameter of Seeds	0.6	0.5	0.5	1.9	0.7	1.1	0.6	0.8	0.5
No. of Trees	7	6	5	-	12	17	8	11	5
No. of Leaves	7	11	9	93	27	96	12	19	4
Prop Aerial Root	None	None	None	Some	None	Few	None	None	None
Soil Conditions	Cohesive mud	Strong cohesive mud	Cohesive mud	Sandy mud	Cohesive mud	Cohesive mud	Strong cohesive mud	Cohesive mud	Sandy mud
Salinity	4.2	4.6	5.3	5.3	4.2	4.2	5.7	6.5	7.8
Barnacles	Some	Some	Some	Many	Many	Many	Many	Some (few)	Some (few)
Survival Rate	2~3	80	95	70	90	90	60	80	2~3
Location N	14°02' 887	14°02' 117	14°08' 672	14°08' 680	14°08' 584	similar to the left	14°08' 017	14°07' 820	14°07' 776
Location W	16°38' 329	16°39' 840	16°37' 794	16°37' 834	16°25' 984	"	16°16' 703	16°21' 936	16°21' 938
Seed Production Area	Locally	Locally	Munde,Dirnda	Munde,Dirnda	Bagadadji	Bagadadji	Bagadadji	Bagadadji	Bagadadji
Vigour of Planted Trees	Poor	Good	Fair	Good	Good	Good	Poor	Good	Poor
Planting Organization and Participants, etc.	Planted by two groups called Fummi and Nanor (both consisting of men and women.				There is an Asprobres. Some 20 participants in planting.		Some 50 (all men).	Planted by the CVRM (many men and women participants)	
Note	Mostly eaten by oxen.	Low ground elevation and long duration of flooding.	Only several lines near the beach died.	Hard surface with soft clay below.	The survival rate is poor at sites with a high elevation and short flooding time.		The survival rate of those planted in September, 1999 is approx. 30%.	Some stems have branched out.	Most have died and the remaining ones lack vigour.
	Dense roots of mangrove below the bed.	Dense roots of mangrove below the bed.	The muddy cohesive soil is thin mixed with sand.	Almost all of the trees have branched out with some prop aerial roots.	The survival rate coincides with the distribution of natural Avicennia.		The survival rate of those planted in September, 2001 is approx. 5%.	The river is cut off by the road and the narrow channel restricts the water flow.	The high elevation of the ground means a short flooding time; high salinity; little water flow.
			The water temperature near the beach is extremely high.	Poor height growth due to the high salinity.	Most have died on the land side while most have survived on the river side.		As planting was conducted at a dipped site, salt appears to be leaching out; salinity of 6.5%	Local flow from Saloum River.	Much sand disposed of at the time of road construction.

Department	Fatick				Foundiougne				
District	Femela				Djilor				
RC	Fimela				Djilor				
Village	Mar fafako	Mar Soulou	Simal	Simal 2	Mbam	Mbam2	Kamatane	Gague Cherif 1	Gague Cherif 2
Date of Planting	2000.9	2000.9	2001.9	1997.9	2000.9	1999.9	2000.9	2000.9	2001.9
Tree Age (months)	21	21	9	57	21	33	21	21	9
Planted Area	Approx.1	Approx.0.5	Approx.0.5	Approx.1.0	Approx.1.5	Approx.9	Approx.1	Approx.1.5	Approx.3.5
Planting Distance	Approx.50cm×50 cm adequate	Approc.50cm×1 m adequate	Approx.80cm×50 cm	Approx.2m×4m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m
Total Tree Height	37	40	38	57	43	65	42	47	47
Height of Viviparous Seeds	17	22	18	20	10	22	19	20	22
Upper Height of Seeds	20	18	20	37	33	43	23	27	25
Upper Diameter of Seeds	0.6	0.5	0.5	1.9	0.7	1.1	0.6	0.8	0.5
No. of Trees	7	6	5	-	12	17	8	11	5
No. of Leaves	7	11	9	93	27	96	12	19	4
Prop Aerial Root	None	None	None	Many	None	Few	None	None	None
Soil Conditions	Cohesive mud	Strong cohesive mud	Cohesive mud	Sandy mud	Cohesive mud	Cohesive mud	Strong cohesive mud	Cohesive mud	Sandy mud
Salinity	4.2	4.6	5.3	5.3	4.2	4.2	5.7	6.5	7.8
Barnacles	Many	Many	Many	Many	Many	Many	Many	Some (few)	Some (few)
Survival Rate	2~3	80	95	70	90	90	60	80	2~3
Location N	14°02' 887	14°02' 117	14°08' 672	14°08' 680	14°08' 584	similar to the left	14°08' 017	14°07' 820	14°07' 776
Location W	16°38' 329	16°39' 840	16°37' 794	16°37' 834	16°25' 984	"	16°16' 703	16°21' 936	16°21' 938
Seed Production Area	Locally	Locally	Munde,Dirnda	Munde,Dirnda	Bagadadji	Bagadadji	Bagadadji	Bagadadji	Bagadadji
Vigour of Planted Trees	Poor	Good	Fair	Good	Good	Good	Poor	Good	Poor
Planting Organization and Participants, etc.	Planted by two groups called Fummi and Nanor (both consisting of men and women.				There is an Asprobres. Some 20 participants in planting.		Some 50 (all men).	Planted by the CVRM (many men and women participants)	
Note	Mostly eaten by oxen.	Low ground elevation and long duration of flooding.	Only several lines near the beach died.	Hard surface with soft clay below.	The survival rate is poor at sites with a high elevation and short flooding time.		The survival rate of those planted in September, 1999 is approx. 30%.	Some stems have branched out.	Most have died and the remaining ones lack vigour.
	Dense roots of mangrove below the bed.	Dense roots of mangrove below the bed.	The muddy cohesive soil is thin mixed with sand.	Almost all of the trees have branched out with some prop aerial roots.	The survival rate coincides with the distribution of natural Avicennia.		The survival rate of those planted in September, 2001 is approx. 5%.	The river is cut off by the road and the narrow channel restricts the water flow.	The high elevation of the ground means a short flooding time; high salinity; little water flow.
			The water temperature near the beach is extremely high.	Poor height growth due to the high salinity.	Most have died on the land side while most have survived on the river side.		As planting was conducted at a dipped site, salt appears to be leaching out; salinity of 6.5%	Local flow from Saloum River.	Much sand disposed of at the time of road construction.

Department	Foundiougne								
District	Djilor				Niodior				
RC	Djilor				Dionouar		Bassoul	Djirnda	
Village	Sadioga 1	Sadioga 2	Niamdiarok	Foundiougne	Niodior	Niodior2	Dionouar	Bassoul	Mounde
Date of Planting	2000.9	2001.9	2000.9	2000.9	2001.9	1998.9	2001.9	2000.9	2001.6
Tree Age (months)	21	9	21	21	9	45	9	36	12
Planted Area	Approx.1.5	Approx.2	0.5	Approx.1ha	Approx.1	Single tree	Approx.5	0.5	Approx.0.5
Planting Distance	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	Approx.1m×2m	40cm×~1.5madequate	7 trees	1m×2madequate	Approx.1m×2m	Approx.20cm×70cm adequate
Total Tree Height	55	40	45	60	55	240	35	40	40
Height of Viviparous Seeds	17	18	20	20	15	-	15	20	17
Upper Height of Seeds	38	12	25	45	40	-	20	20	23
Upper Diameter of Seeds	0.9	0.4	1	1.5	0.8	1.5	0.5	1.0	0.6
No. of Trees	13	4	12	20	7	Many	5	11	6
No. of Leaves	23	4	45	60	14	Many	11	2	15
Prop Aerial Root	None	None	None	Some	None	Many	None	None	None
Soil Conditions	Sandy mud	Sandy mud	Mud	Sandy mud	Cohesive mud	Cohesive mud	Sandy mud	Sandy cohesive mud	Cohesive mud
Salinity	5.6	5.6	6.1	4.5	3.5		3.5	3.8	4.1
Barnacles	Many	Some (few)	Some	Many	Some		Hardly any	Many	Some
Survival Rate	60	2~3	60	80	50		90	20	90
Location N	14°03' 347	14°03' 413	14°11' 531	14°08' 048	13°56' 643		13°54' 705	13°56' 034	13°57' 273
Location W	16°23' 624	16°23' 475	16°27' 158	16°28' 339	16°43' 231		16°42' 952	16°35' 675	16°39' 287
Seed Production Area	Bagadadji	Bagadadji	Bagadadji	Bagadadji	Locally	Locally	Locally	Locally	Locally
Vigour of Planted Trees	Fair	Fair	Good	Fair	Good	Good	Good	Poor	Good
Planting Organization and Participants, etc.	Planted by the CVRM (many men and women participants)				Planted by the women's group and the beach committee; some 150 participants.			Planted mainly by the women's group.	Planted mainly by the women's group.
Note	The tree vigour is better on the land side of the natural Avicennia zone.	Most have died and the remaining ones lack vigour.	Cohesive soft soil.	The survival rate at the site with a slightly higher elevation is extremely poor.	The trees planted at shallow sites with a high elevation have been mostly eaten by goats.	A group of isolated trees, recording very good growth.	The survival rate is poor at shallow sites with a high elevation (approx. 5%)	Mostly eaten by oxen.	The survival rate is slightly poorer at sites with a high elevation and shorter flooding time.
		Fine ground and lack of oxygen in the ground is suspected; sedimentation of sand from inland.	The survival rate at the slightly off-shore site of 35% is poor.	Many have survived.	The trees at deep sites have survived (survival rate: approx. 95%).		The trees at deep sites have survived (survival rate: approx. 95%)	The initial growth of potted seedlings is good.	Not much damage by animals.
		There is an opinion that failure was due to heating of the seeds at the time of collection.	Slight dominance of sand.		Good sites are those which are flooded to a depth of some 50 cm at the time of normal full tide.		The survival rate is poor in places where natural regeneration has not taken place.	The tree age is 36 months because of the planting of 15 month old potted seedlings.	

Department	Foundiougne						
District	Niodior						Toubakouta
RC	Djirnda						Toubakouta
Village	Djirnda	Djirnda2	Djirnda 3	Djirnda 4	Djirnda 5	Djirnda 6	Bagadaji
Date of Planting	2001.10	2001.10	Around 1989	Around 1989	Around 1996	2001.10	2001.6
Tree Age (months)	9	9	156	156	72	8	12
Planted Area	Approx.1	Approx.1	Approx.0.5ha	Approx.0.5ha	Approx.0.5ha	Approx.0.5ha	Nursery
Planting Distance	1m×2madequate	1m×1madequate	1m×1madequate	1m×1madequate	1m×1madequate	1m×1madequate	
Total Tree Height	53	48	140	250	100	40	62
Height of Viviparous Seeds	23	13	-	-	-	20	20
Upper Height of Seeds	30	35	-	-	-	20	42
Upper Diameter of Seeds	0.5	0.8	2.5	4	1.0	0.7	0.6
No. of Trees	7	8	Many	Many	Many	6	7
No. of Leaves	16	29	Many	Many	Many	31	14
Prop Aerial Root	None	None	Many	Many	Many	None	None
Soil Conditions	Cohesive mud	Cohesive mud	Cohesive mud	Cohesive mud	Cohesive mud	Cohesive mud	Sandy mud
Salinity	4.3	4.2	4.2	4.5	4.5	4.5	3.6
Barnacles	Hardly any	Hardly any	Hardly any	None	None	None	None
Survival Rate	60	90	90	90	90	30	95
Location N	13°58' 573	13°58' 550	similar to the left	13°58' 492	similar to the left	similar to the left	13°38' 785
Location W	16°36' 643	16°36' 648	"	16°36' 734	"	"	16°29' 686
Seed Production Area	Locally	Locally	Locally	Locally	Locally	Locally	Locally
Vigour of Planted Trees	Fair	Good	Good	Good	Good	Poor	Good
Planting Organization and Participants, etc.	Planted mainly by the women's group.						
Note		Fairly vigorous with some branching out.	Memory of the year of planting is unclear.	Planted voluntarily by the women's group.		High elevation and short flooding time.	Favourable growth of the potted seedlings.
				Memory of the year of planting is unclear.			
				The growth situation is very favourable.			

A-2-2-4 Area of Mangrove Forests by Zone and RC

Unit: ha

National Forest			National Park			Others			Total
High	Low	Sub-Total	High	Low	Sub-Total	High	Low	Sub-Total	
			633	3,961	4,594				4,594
400	675	1,075	279	718	997				2,072
400	675	1,075	912	4,679	5,591				6,666
3,370	7,868	11,238							11,238
						1,089	3,689	4,778	4,778
3,370	7,868	11,238				1,089	3,689	4,778	16,016
						600	3,175	3,775	3,775
						963	4,306	5,269	5,269
558	2,286	2,844							2,844
5,402	2,967	8,369							8,369
329	2,126	2,455					1,542	1,542	3,997
2,255	5,423	7,678							7,678
8,544	12,802	21,346				1,563	9,023	10,586	31,932
							1,081	1,081	1,081
						312	2,487	2,799	2,799
							113	113	113
							750	750	750
							300	300	300
						312	4,731	5,043	5,043
			76	53	129		3,300	3,300	3,429
							700	700	700
							500	500	500
			76	53	129		4,500	4,500	4,629
12,314	21,345	33,659	988	4,732	5,720	2,964	21,943	24,907	64,286

A-2-2-5 Volume of Mangrove Forests by Zone and RC

Unit: m³

Zone	RC or Commune	National Forest	National Park	Others	Total	
		Sub-Total	Sub-Total	Sub-Total		
Conservation	I	Toubacouta	152,217		152,217	
		Dionouar	35,619	33,034	68,653	
		Sub-Total	35,619	185,251	220,870	
	II	Toubacouta	372,358		372,358	
		Others		158,313	158,313	
		Sub-Total	372,358	158,313	530,671	
	III	Diossong			125,080	125,080
		Toubacouta			174,582	174,582
		Bassoul	94,233			94,233
		Dionouar	277,297			277,297
		Djirnda	81,343		51,092	132,436
		Others	254,401			254,401
	Sub-Total	707,274		350,754	1,058,029	
Rehabilitation	I	Commune Joal		35,818	35,818	
		Djilor		92,742	92,742	
		Nguekokh		3,744	3,744	
		Djirnda		24,850	24,850	
		Djilass		9,940	9,940	
		Sub-Total		167,094	167,094	
	II	Fimela		4,274	109,342	113,616
		Palmarin Fakao			23,194	23,194
		Djirnda			16,567	16,567
		Sub-Total		4,274	149,102	153,376
Total		1,115,251	189,525	825,264	2,130,039	

A-2-2-6 Annual Volume Increment of Mangrove Forests by Zone and RC

Unit: m³

Zone	RC or Commune	National Forest	National Park	Others	Total	
		Sub-Total	Sub-Total	Sub-Total		
Conservation	I	Toubacouta		5,053		5,053
		Dionouar	1,183	1,097		2,279
		Sub-Total	1,183	6,150		7,333
	II	Toubacouta	12,362			12,362
		Others			5,256	5,256
		Sub-Total	12,362		5,256	17,618
	III	Diossong			4,153	4,153
		Toubacouta			5,796	5,796
		Bassoul	3,128			3,128
		Dionouar	9,206			9,206
		Djirnda	2,701		1,696	4,397
		Others	8,446			8,446
		Sub-Total	23,481		11,645	35,125
	Rehabilitation	I	Commune Joal			1,189
Djilor					3,079	3,079
Nguekokh					124	124
Djirnda					825	825
Djilass					330	330
Sub-Total					5,547	5,547
II		Fimela		142	3,630	3,772
		Palmarin Fakao			770	770
		Djirnda			550	550
		Sub-Total		142	4,950	5,092
Total		37,025	6,292	27,398	70,715	

A-2-2-7 Amount of the Biomass of Mangrove Forests
Above the Ground by Zone and RC (Dry Weight)

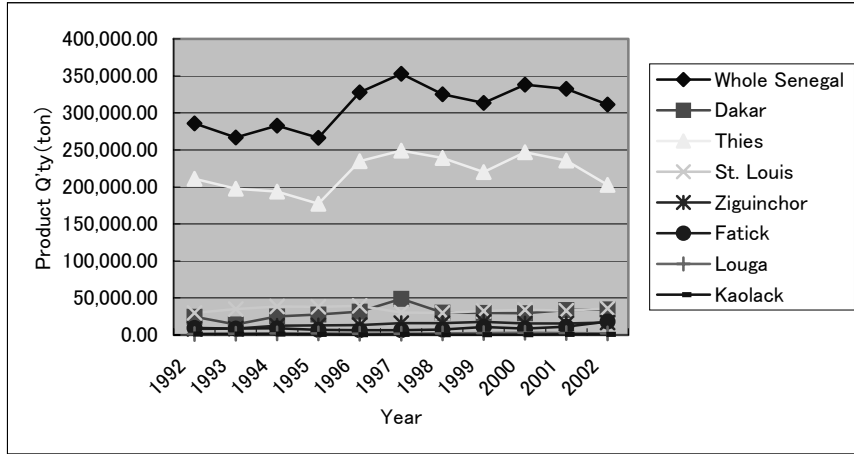
Dry Unit: m³=t

Zone		RC or Commune	National Forest	National Park	Others	Total
			Sub-Total	Sub-Total	Sub-Total	
Conservation	I	Toubacouta		174,572		174,572
		Dionouar	40,850	37,886		78,736
		Sub-Total	40,850	212,458		253,308
	II	Toubacouta	427,044			427,044
		Others			181,564	181,564
		Sub-Total	427,044		181,564	608,608
	III	Diossong			143,450	143,450
		Toubacouta			200,222	200,222
		Bassoul	108,072			108,072
		Dionouar	318,022			318,022
		Djirnda	93,290		58,596	151,886
		Others	291,764			291,764
		Sub-Total	811,148		402,268	1,213,416
Rehabilitation	I	Commune Joal			41,078	41,078
		Djilor			106,362	106,362
		Nguekokh			4,294	4,294
		Djirnda			28,500	28,500
		Djilass			11,400	11,400
		Sub-Total			191,634	191,634
	II	Fimela		4,902	125,400	130,302
		Palmarin Fakao			26,600	26,600
		Djirnda			19,000	19,000
		Sub-Total		4,902	171,000	175,902
Total			1,279,042	217,360	946,466	2,442,868

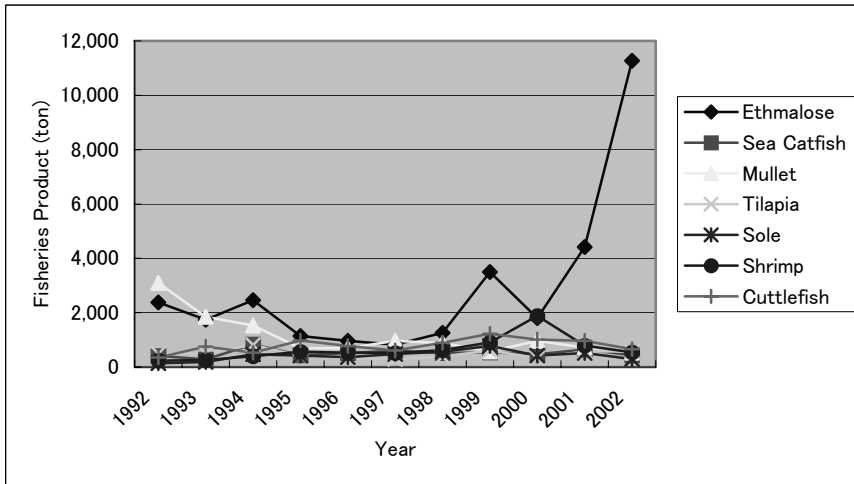
A-2-2-8 Annual Increment of the Biomass of Mangrove Forests
Above the Ground by Zone and RC (Dry Weight)

Dry Unit: m³=t

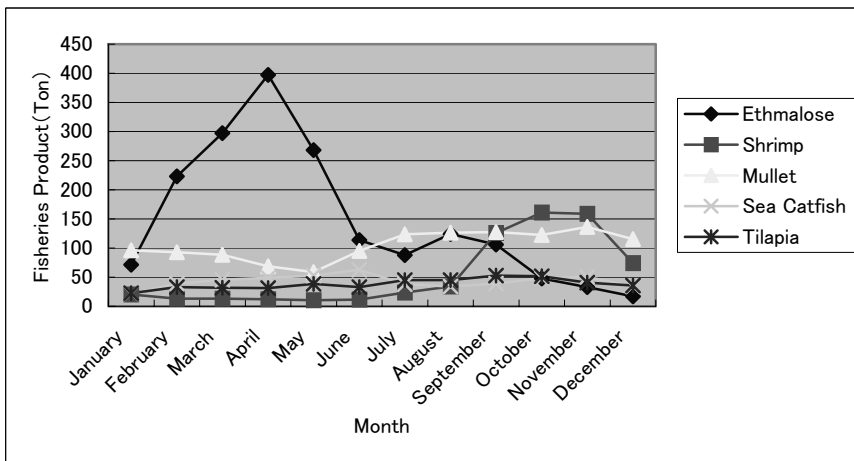
Zone	RC or Commune	National Forest	National Park	Others	Total	
		Sub-Total	Sub-Total	Sub-Total		
Conservation	I	Toubacouta		5,821		5,821
		Dionouar	1,362	1,263		2,625
		Sub-Total	1,362	7,084		8,446
	II	Toubacouta	14,239			14,239
		Others			6,054	6,054
		Sub-Total	14,239		6,054	20,293
	III	Diossong			4,783	4,783
		Toubacouta			6,676	6,676
		Bassoul	3,603			3,603
		Dionouar	10,604			10,604
		Djirnda	3,110		1,954	5,064
		Others	9,728			9,728
		Sub-Total	27,045		13,413	40,458
Rehabilitation	I	Commune Joal			1,370	1,370
		Djilor			3,546	3,546
		Nguekokh			143	143
		Djirnda			950	950
		Djilass			380	380
		Sub-Total			6,389	6,389
	II	Fimela		163	4,181	4,344
		Palmarin Fakao			887	887
		Djirnda			634	634
		Sub-Total		163	5,702	5,865
Total		42,646	7,247	31,558	81,451	



Fisheries Product by Regions

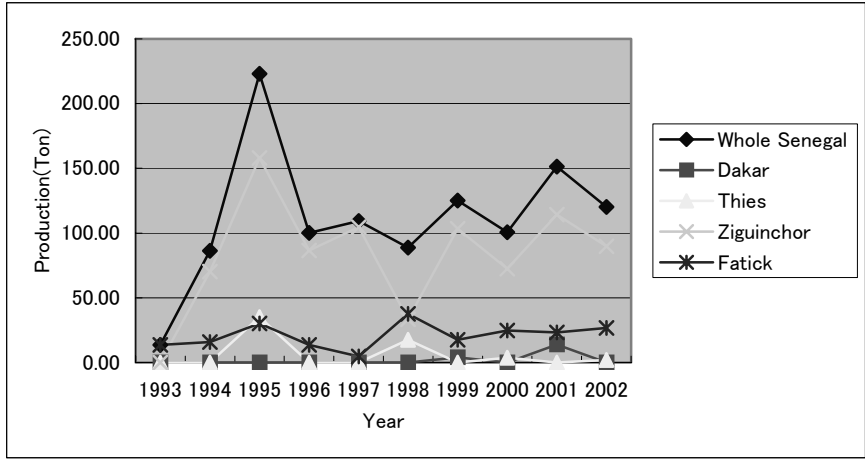


Fisheries Product by Species in Fatick Region

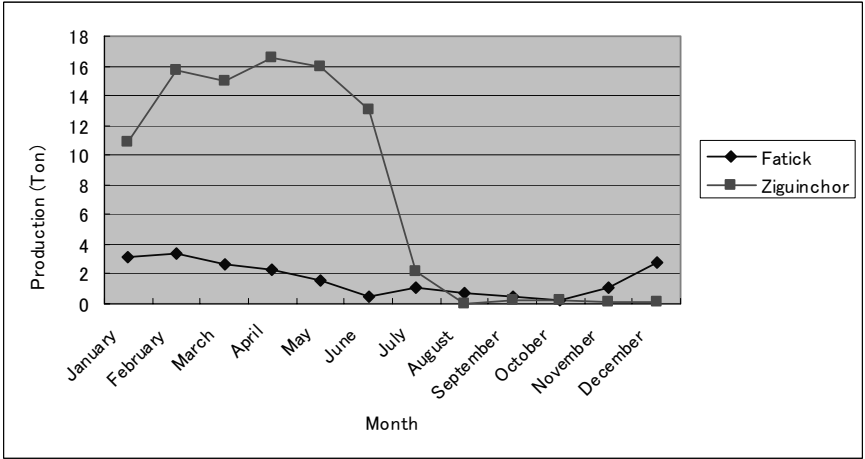


Seasonal Fluctuation of Fisheries Product by Species in Fatick Region

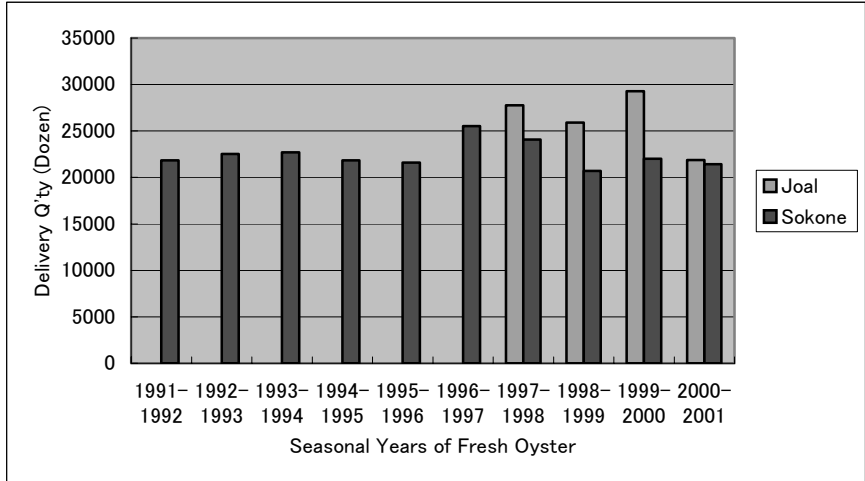
A-2-3-1 Marine Resources (1)



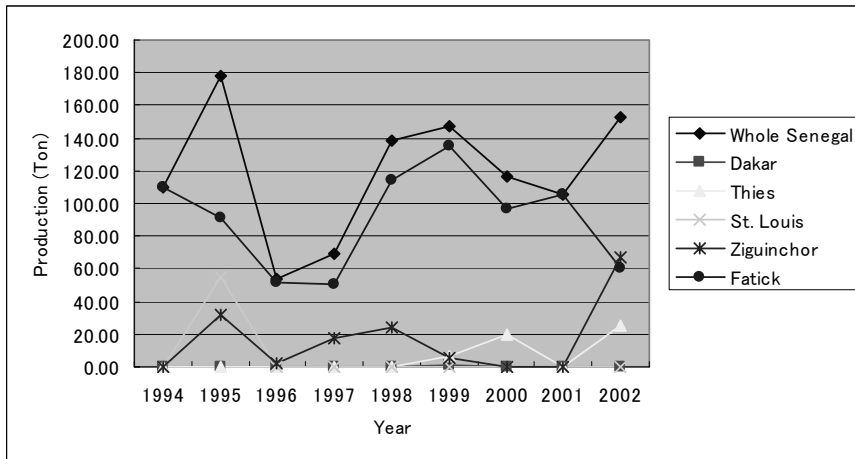
Annual Fluctuation of Oyster Production by Regions



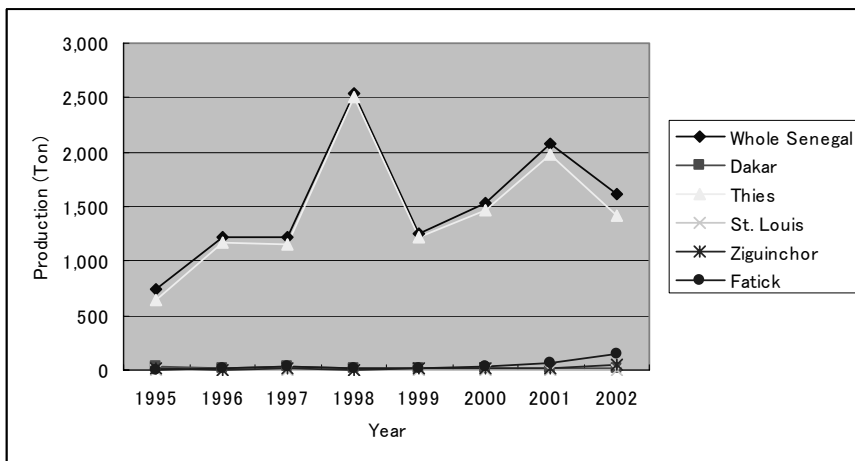
Seasonal Fluctuation of Oyster Production



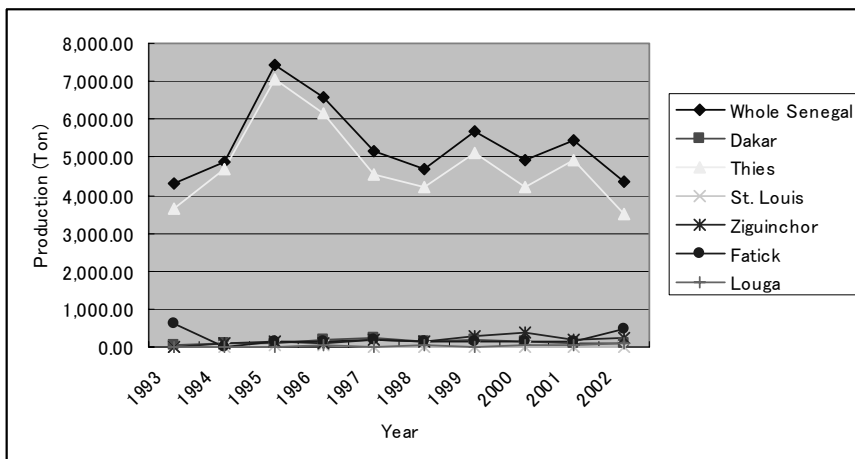
Annual Fluctuation of Fresh Oyster Production



Annual Fluctuation of Ark Production

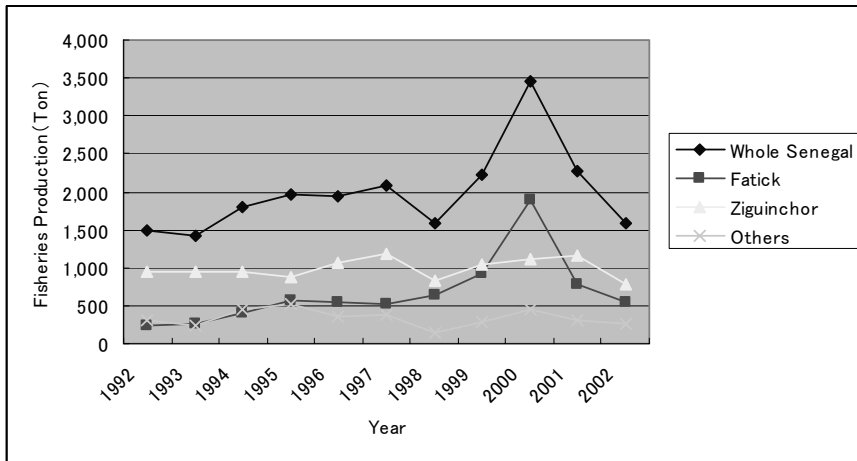


Annual fluctuation of Giant Hairy Melongena Production



Annual Fluctuation of Volutes Production

A-2-3-1 Marine Resources (3)



Annual Shrimp Production in Senegal

A-2-3-1 Marine Resources (4)

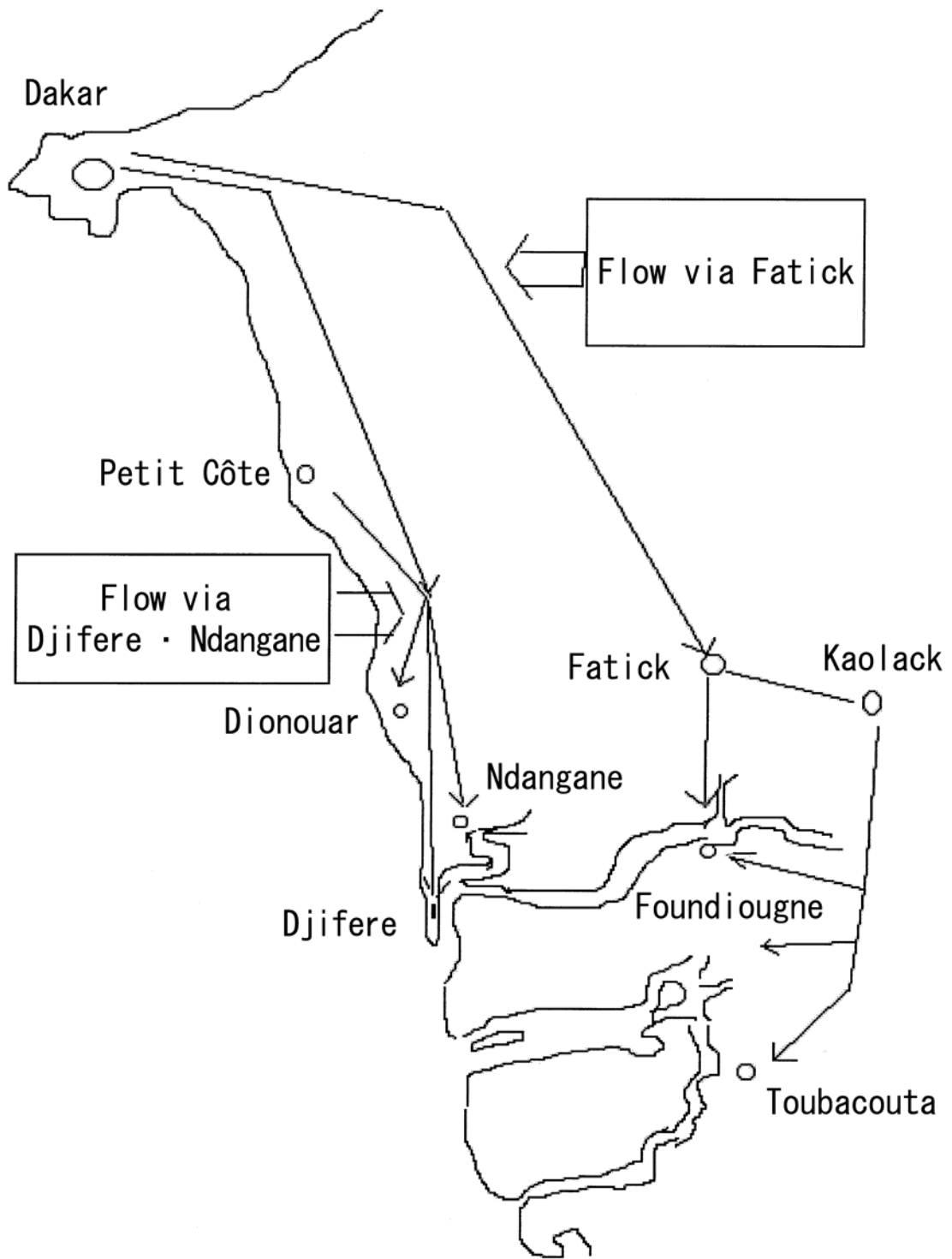
A-2-3-2 Shrimp Catching Quantity by Killi in Gaue Mody (November 6~25, 2001)

No.	Date	Operating Gear (units)	Catching Q'ty (kg)	Purchasing Q'ty (kg)	Average Catching Q'ty per Unit (kg/unit)	Average Purchasing Q'ty per Unit (kg/unit)	Loss Rate (%)
1	2001/11/6	22	143	133.5	6.5	6.1	7.1
2	2001/11/7	14	71	65.5	5.1	4.7	8.4
3	2001/11/8	1	5	4	5.0	4.0	25.0
4	2001/11/9	19	141	138	7.4	7.3	2.2
5	2001/11/10	6	40.5	38	6.8	6.3	6.6
6	2001/11/11	13	148.5	131.5	11.4	10.1	12.9
7	2001/11/12	15	68.5	65.5	4.6	4.4	4.6
8	2001/11/13	20	120.5	114.5	6.0	5.7	5.2
9	2001/11/14	27	140	134.5	5.2	5.0	4.1
10	2001/11/15	16	83.5	77.5	5.2	4.8	7.7
11	2001/11/16	20	73	73	3.7	3.7	0.0
12	2001/11/17	14	67	62.5	4.8	4.5	7.2
13	2001/11/18	7	36	34	5.1	4.9	5.9
14	2001/11/19	6	33.5	31	5.6	5.2	8.1
15	2001/11/20	19	83.5	81	4.4	4.3	3.1
16	2001/11/21	8	80.5	67.5	10.1	8.4	19.3
17	2001/11/22	22	134	133.5	6.1	6.1	0.4
18	2001/11/23	15	76.5	76	5.1	5.1	0.7
19	2001/11/24	16	62.6	61.9	3.9	3.9	1.1
20	2001/11/25	13	161	159	12.4	12.2	1.3
Total		293	1769.1	1681.9	6.0	5.7	5.2

A-2-3-3 Occupation Calendar at Batanty

Kinds of Fisheries	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Shrimp Drag Net (Killi)			shrimp									
Surrounding Gill Net			Ethmalose									
Drift Net		Threadfins, Croaker					Barracuda					
			Croaker			Spanish mackerel						
Bottom Gill Net						Ray						
	Croaker, Grunt		Plectorhinchus mediterraneus								Croaker, Grunt	
						Sea catfish						
Mullet Gill Net						Mullet						
Long Line		Grouper, Shovelnose ray					Shovelnose ray				Grouper, Shovelnose ray	
Beach Seine						Trevally						
Cast Net												
Millet (Male)												
Rice (Female)												
Rany Season												

Source; Oral study at Batanty



A-2-4-1 Flow of Tourists

A-2-5-1 List of Villages in RCs with Mangrove Resources or Access to Mangrove Resources

	RC Diossong				RC Toubacouta		RC.Djirnda		RC. Bassoul	
	Village	Population	Village	Population	Village	Population	Village	Population	Village	Population
1	Keur Mbousse	42	Darou sader	293	Dago Ansou	5	Velingara	63	Siwo	483
2	Diogo serere 2	59	Thiamene Ndiagnene	294	Bandiagaro	20	Rofangué	146	Diogane	780
3	Daga Birame1	63	Thianda Thiamene	294	Santhié El Masse	22	Felir	274	Thialiane	834
4	Ndiobene Thianda	68	Daga birame2	310	Sipo	42	Fambine	315	Bassar	1536
5	Keur Babou Coumba	71	Kheur Tamsir khodia	315	Toubo Nding	59	Fayako	315	Bassoul	3723
6	Keur Momar Fana	96	Ndiogone Ndiack	315	Bakadadji	88	Baouth	612		
7	Diogo serere 1	105	Keur aly gueye	337	Keur Babou Diouf	88	Diomniadio	684		
8	Keur Layine Ndity	122	Fass matar	346	Firdaousy	91	Ngadior	690		
9	Keur Babou Kanny	128	Dialaba Santhie	353	Karantaba	102	Djirnda	1252		
10	Keur Khalifa	135	Ndiantha Aly	353	Dago Béré	106	Moundé	1291		
11	Thiamene Sathiebo	145	Ngayene Daour	361	Sabouya	112				
12	Keur Seet Nioukhoub	157	Keur Layine Fatime	379	Tabo Nding	118				
13	Thioguene	162	Ndiagnene Youssoub	384	Sangako	118				
14	Ndiomborel	165	Tallene	431	Boutilimith	118				
15	Thiekene	174	Ndrame Macoumba	438	Keur Sambel	130				
16	Ndiobene Ndiafe	177	Thiamene Diogo	472	K. Lahine Socé	138				
17	Ndiaye Ndiaye Serere	179	Bambougar malick ndiaye	491	Djinack Diattaco	144				
18	Thianda Thisse	180	Thiakho Malamine	493	Sourou	168				
19	Medina Kebe	181	Darou K. M. Khoredia	497	Sadio Salla	178				
20	Bambougar Momar	188	Niassene	510	Ngadior Missirah	201				
21	Keur Mbaye Maty	192	Diagane sader	512	Didaro	210				
22	Passy Mbittayene	194	Kebe koude	520	Batamar	221				
23	Keur B. Mansata	197	Lerane Sambou	531	Samé	223				
24	Keur MB. Gueye	197	Ndong Ouolof	543	Médina Santhié	224				
25	Thiamene Birane	199	Kebe ansou	562	Dago Babou	254				
26	Keur Malao	202	Ndong Serere	567	Daga Diaodine	266				
27	Ndiogone Boure	210	Ndiaffé Ndiaffé	574	Saroudia	267				
28	Keur Ndiol	211	Lerane Coly	609	Dielmon	271				
29	Ndianka Youssoupha	211	Mbouloum	614	Boussouro	282				
30	Nianene	211	Keur Elimane	616	Taiba	306				
31	Ndiagnene Omar	213	Sorom	627	Ndiambang	308				
32	Keur Math	219	Keur Mbangou	655	Santaba	336				
33	Dialaba boumack	223	Daga diery	665	Soucouta	342				
34	Mbowene Ibra	223	Keur Birane Khoureidia	949	Dioufène Limane	345				
35	Ngayene Momar	223	Ndiaye Ndiaye Ouolof	1006	Dassilame Sérère	346				
36	Keur Samba Khodia	230	Diossong	1083	Ndoffane	364				
37	Ndienghene Malick	230			K. Aliou Guèye	368				

3		
8	Diogane Barka	231
3		
9	Bambougar Massamba	237
4	Keur Mamadou	
0	Fatouma	237
4		
1	Loumene	238
4		
2	Keur Fafa Wely	239
4		
3	Keur abdou fana	240
4		
4	Keur Bacary	241
4		
5	Ainoumane	245
4		
6	Mbowene Souleye	245
4		
7	Bouly	256
4		
8	Ndienghene Mady	263
4		
9	Passy Aly Die	263
5		
0	Thiouroum	263
5		
1	Keur Bacary Ly	269
5		
2	Daga ndoup	273
5		
3	Keur A. Yacine	290
5		
4	Ndiourbel	292

Sandi Coly	380
Djinack Baro	467
Badoudou	513
Dassilamé	526
Missirah	528
Néma Nding	552
Diaglé	602
Ndouboudji	602
Bany	627
Bossikang	766
Médina Sangako	852
Nema Bah	951
Toubacouta	1142
Missirah	1239
Bettenty	3644

	RC. Dionouar		CR Fimela		RC. Djilass		RC. Palmarin Fakao		RC Djilor		RC. Nguekokh	
	Village	Population	Village	Population	Village	Population	Village	Population	Village	Population	Village	Population
1	Falia	586	Kobongoye 2	152	Soumbel	99	Palmarin Diakhanor	353	Santhié Demba	34	Somone	1493
2	Dionouar	3953	Ndangane campement	229	N'dibinding	103	Palmarin Nguethie	412	Keur Mbar	56	Guéréo	3771
3	Niodior	5517	Sambe Diallo	248	Soudiane Bala	154	Palmarin Ngallou	777	Keur Pathe	57		
4			Mar Soulou	343	Roh	176	Palmarin Facao	810	Diamaguene	62		
5			Ndiédieng	416	Ngarigue	178	Palmarin Sessène	1012	Goudeme Sonar	67		
6			Mbissel	458	Sorobougou	219			Keur N'ghary	92		
7			Baboucar Toumba	481	Faoye	834			Keur Bakari Diambang	96		
8			Djilor	589	Soudiane Thielem	1766			Keur Waly Ndiaye	103		
9			Kobongoye 1	659	Djilass	2013			Keur Djindake	105		
10			Ndangane	795					Keur Mathioro	109		
11			Yayena	1078					Keur Bondji	123		
12			Mar Lothie	1316					Ngamsa	125		
13			Fimela	1668					Diagle - Djilor	149		
14			Simal	1749					Baye	150		
15			Mar Fafaco	2022					Dagassoukoum	153		
16			Simbe Die	2134					Sapp	154		
17									Keur Thieneke	156		
18									Keur Niaouth	157		
19									Yerwago	190		
20									Ndiassane Saloum	196		
21									Keur Gory	203		
22									Kamatane MBambara	212		
23									Keur Yoro	234		
24									Ndour Ndour	240		
25									Bolly	246		
26									Mbelane	250		
27									Keur Mandao	254		
28									keur cheikhou	259		
29									Diagane Senghane	270		
30									Lambaye	278		
31									Gagué Chérif	286		
32									Kamatane Mbaar	286		
33									Péthié	289		
34									Keur Omar	366		
35									Ndiomdy	395		
36									Bangalere	431		
37									Keur Dabo	432		
38									N'doffane Ndary	470		
39									Gagué Bocar	484		
40									Goudeme Sidy	516		
41									Nguekhokh	519		
42									Keur Mor Diop	594		
43									Bandandar	602		
44									Keur Farba	609		
45									Ndorong Log	618		
46									Sadioga	713		
47									Gagué Mody	736		
48									Félane	748		
49									Thiaré	944		
50									Soum 1	1124		
51									Mbassis	1277		
52									Mbam	1793		
53									Djilor	1865		
54									Soum 2	2460		

A-2-5-2 Target Villages of the Questionnaire Survey and Number of Sample Households

Grade	Population Class	(Population Size)	Number of Villages	Population	Number of Households	Planned Number		Selected Village and Distribution of Samples		
						Required Number of Sample Households	Number of Villages Selected	Village	Number of Households	Number of Sample Households
I	A	~199	63	7050	705	29	1	Kamatane Mambara	15	10
	B	200~249	34	7880	788	32	1	Rofangué	21	10
	C	250~299	25	6870	687	28	1	Gagué Chérif	29	10
	D	300~399	25	8750	875	36	2	Scouta	34	20
								Sandi Coly	38	25
	E	400~499	16	7200	720	30	1	Bambougar Malick	49	25
	Sub-total		163	37750	3775	155	7		186	100
II	F	500~599	17	9350	935	38	1	Falia	59	25
	G	600~699	15	9750	975	40	2	Diarniadio	68	25
	H	700~999	14	11900	1190	49	2	Gagué Mody	74	25
								Félane	75	25
								Ngallou	78	25
								Faoye	83	25
								Médina Sangako	85	25
	I	1000~1499	11	13750	1375	56	2	Djirnda	125	25
Moundé								129	25	
	Sub-total		57	44750	4475	183	7		776	225
III	J	1500~	15	39617	3962	162	6	Toubacouta	114	25
								Simal	175	25
								Mar Fafako	202	25
								Bettenty	364	25
								Bassoul	372	25
								Niodior	552	25
								Guéréo	377	25
		Sub-total		15	39617	3962	162	6		2156
	Total		235	122117	12212	500	20		3118	500

A-2-5-3 Estimated Consumption of Mangrove Building Timber

CR	Average per Village		Number of Villages		Consumption Volume		
	Mainland	Island	Mainland	Island	Mainland	Island	Entire RC
Toubacouta	3.5m ³	8.5m ³	19	2	3.5m ³ x19=66.5m ³	8.5m ³ x2=17.0m ³	83.5m ³
Djilor	0.6m ³		28		0.6m ³ x28=16.8m ³		16.8m ³
Dissong	15.5m ³		7		15.5m ³ x7=108.5m ³		108.5m ³
Djilass	0m ³		2		0m ³ x2=0m ³		0m ³
Fimela	0m ³		7	3	0m ³ x7=0m ³	0m ³ x3=0m ³	0m ³
Djirnda		2.1m ³		9		2.1m ³ x9=18.9m ³	18.9m ³
Bassoul		0.5m ³		5		0.5m ³ x5=1.5m ³	1.5m ³
Dionouar		0.4m ³		3		0.4m ³ x3=1.2m ³	1.2m ³
Palmarin Fakao	0m ³		5		0m ³ x5=0m ³		0m ³
Nguekokh	0m ³		2		0m ³ x2=0m ³		0m ³
Malicouda I	0m ³		3		0m ³ x3=0m ³		0m ³
Sokone	3.5m ³		1		3.5m ³ x1=3.5m ³		3.5m ³
Foundiougne	0.6m ³		1		0.6m ³ x1=0.6m ³		0.6m ³
Joal-Fadiouth	0m ³		1		0m ³ x1=0m ³		0m ³
						Total	234.5m ³
						234.5m ³ x1.4ton=328.3ton	

The estimation result is 234.5m³x1.4ton=328.3ton.

A-2-5-4 Estimated Consumption of Mangrove Posts

Estimated Consumption Volume For Posts by RC/Commune							
Mainland	Palmarin Fakao	34m	60	0.008ton	0.48ton	5	0.48x5=2.40ton
Mainland	Djilass	95m	200	0.008ton	1.60ton	2	1.6x2=3.20ton
Mainland	Djilor	63m	120	0.008ton	0.96ton	9	0.96x9=8.64ton
Mainland	Diossong	59m	120	0.008ton	0.96ton	7	0.96x7=6.72ton
Mainland+Island	Fimela	69m	140	0.008ton	1.12ton	10	1.12x10=11.20ton
Mainland+Island	Toubacouta	111m	220	0.008ton	1.76ton	21	1.76x21=36.96ton
Island	Bassoul	62m	120	0.008ton	0.96ton	5	0.96x5=4.80ton
Island	Dionouar	60m	120	0.008ton	0.96ton	3	0.96x3=2.88ton
Island	Djirnda	59m	120	0.008ton	0.96ton	9	0.96x9=8.64ton
	Nguekokh	35m	60	0.008ton	0.48ton	2	0.48x2=0.96ton
	Malicouda I	Assumed to be the same as for Nguekokh			0.48ton	3	0.48x3=1.44ton
	Sokone	Assumed to be the same as for Toubacouta			1.76ton	1	1.67x1=1.76ton
	Foundiugne	Assumed to be the same as for Djilor			1.60ton	1	1.60x1=1.60ton
	Joal-Fadiouth	Assumed to be the same as for Palmarin Fakao			0.48ton	1	0.48x1=0.48ton
							91.68ton

- It is assumed that fencing posts are replaced every two years.
- The estimated mangrove consumption for posts by all RCs in the Project Area is estimated to be 45.8 tons/year.

A-2-5-5 Estimated Consumption Volume of Mangrove Firewood for Cooking

CR	Average consumption/day/ household		Number of User Households		Consumption/day by RC		Annual Consumption by RC (ton)		Total
	Mainland	Island	Mainland	Island	Mainland	Island	Mainland	Island	
Toubacouta	4.62kg	9.50kg	448	345	2069.8kg	3277.5kg	755.5	1196.3	1951.8
Djilor	5.45kg		669		3646.1kg		1330.8		1330.8
Diossong	3.97kg		206		817.8kg		298.5		298.5
Djilass	0.00kg		19		0kg		0		0
Fimela	Assumed to be 50% of Island =4.02kg	8.03kg	180	240	723.6kg	1927.2kg	264.1	703.4	967.5
Palmarin Fakao	5.19kg		261		1354.6kg		494.4		494.4
Djirnda		6.67kg		510		3401.7kg		1241.6	1241.6
Bassoul		8.95kg		666		5960.7kg		2175.7	2175.7
Dionouar		6.32kg		958		6054.6kg		2209.9	2209.9
Nguekokh	3.97kg assumed			25	99.3kg		36.2		36.2
Malicouda I	3.97kg assumed			1	4.0kg		1.5		1.5
Sokone	4.62kg assumed			460	2125.2kg		775.7		775.7
Fondiougne	5.45kg assumed			132	719.4kg		262.6		262.6
Joal-Fadiouth	4.02kg assumed			608	2444.2kg		892.1		892.1
									12638.3

The annual consumption volume of mangrove firewood for cooking in the entire Study Area is estimated to be 12,638 tons.

A-2-5-6 Basic Data for Estimation of Mangrove Firewood Consumption for Shellfish Processing

RC/Commune	Population	Female Working Population (Population x Female Ratio x Working Population Ratio)	Proportion of Work in Shellfish Processing (Questionnaire Result)	Number of People Engaged in Shellfish Processing	Consumption Volume (t)
Nguekokh	5264	$5264 \times 0.50 \times 0.54 = 1421$	4.3%	61	74
Fimela	9321	$9321 \times 0.49 \times 0.54 = 2466$	2.4%	59	72
Palmarin Fakao	3364	$3364 \times 0.47 \times 0.54 = 1583$	5.6%	89	108
Djilass	1010	$1010 \times 0.44 \times 0.54 = 240$	3.8%	9	11
Bassoul	7356	$7356 \times 0.50 \times 0.54 = 1986$	4.8%	95	115
Dionouar	10056	$10056 \times 0.50 \times 0.54 = 2715$	38.0%	1032	1251
Djirnda	5327	$5327 \times 0.45 \times 0.54 = 1294$	34.9%	452	548
Toubacouta	12737	$12737 \times 0.45 \times 0.54 = 3095$	40.9%	1266	1535
Djilor	16977	$16977 \times 0.49 \times 0.54 = 4492$	15.2%	683	828
Diossong	2466	$2466 \times 0.50 \times 0.54 = 666$	41.7%	278	337
Malicounda	1261	$1261 \times 0.50 \times 0.54 = 340$	4.3% (Assumed)	15	18
Sokone	8552	$8552 \times 0.45 \times 0.54 = 3853$	27.6% (Assumed)	1063	1289
Foundiougne	3354	$3354 \times 0.49 \times 0.54 = 887$	15.2% (Assumed)	135	164
Joal-Fadiouth	19003	$19003 \times 0.49 \times 0.54 = 5028$	2.4% (Assumed)	121	147
Total				5358	6497

A-2-5-7 Detailed Results of the Questionnaire on Amount Willing to Pay

Monthly Amount	Sex	Sindia	Fimela	Palmarin Fakao	Djilass	Bassoul	Dionouar	Djirnda	Toubacouta	Djilor	Diossong	Total
Less than 100CFA	Male (persons)	0	2	2	1	1	1	1	10	9	7	34
	Female (persons)	3	4	0	0	3	3	9	13	9	4	48
	Sub-total (persons)	3	6	2	2	4	4	10	23	18	11	83
100~250CFA	Male (persons)	3	8	8	1	5	5	12	16	9	5	72
	Female (persons)	5	11	4	4	3	6	15	31	25	8	112
	Sub-total (persons)	8	19	12	5	8	11	27	47	34	13	184
250~500CFA	Male (persons)	4	9	2	7	1	4	10	19	15	4	75
	Female (persons)	12	7	4	8	0	5	8	27	21	7	99
	Sub-total (persons)	16	16	6	15	1	9	18	46	36	11	174
500~750CFA	Male (persons)	2	5	0	4	0	2	1	12	7	4	37
	Female (persons)	0	0	0	5	0	1	2	7	6	1	22
	Sub-total (persons)	2	5	0	9	0	3	3	19	13	5	59
750~1000CFA	Male (persons)	4	7	1	4	1	2	6	11	16	2	54
	Female (persons)	1	6	0	3	1	3	3	11	1	1	30
	Sub-total (persons)	5	13	1	7	2	5	9	22	17	3	84
1000~1500CFA	Male (persons)	3	1	1	2	0	1	0	9	4	0	21
	Female (persons)	1	0	1	2	0	1	0	3	1	0	9
	Sub-total (persons)	4	1	2	4	0	2	0	12	5	0	30
1500~2000CFA	Male (persons)	3	1	0	1	0	1	1	2	0	0	9
	Female (persons)	0	2	0	0	0	2	0	0	0	0	4
	Sub-total (persons)	3	3	0	1	0	3	1	2	0	0	13
2000~3000CFA	Male (persons)	2	1	1	0	0	1	1	2	1	0	9
	Female (persons)	0	2	0	2	0	1	0	1	0	1	7
	Sub-total (persons)	2	3	1	2	0	2	1	3	1	1	16
3000~5000CFA	Male (persons)	1	1	0	2	0	1	1	3	5	0	14
	Female (persons)	1	3	1	0	1	0	2	3	0	1	12
	Sub-total (persons)	2	4	1	2	1	1	3	6	5	1	26
5000CFA higher	Male (persons)	1	2	1	0	0	3	5	5	1	0	18
	Female (persons)	0	0	0	0	0	2	3	0	0	1	6
	Sub-total (persons)	1	2	1	0	0	5	8	5	1	1	24
Don't Know	Male (persons)	1	8	5	2	8	11	19	19	2	1	76
	Female (persons)	0	3	4	0	9	11	16	4	1	0	48
	Sub-total (persons)	1	11	9	2	17	22	35	23	3	1	124
Toral	Male (persons)	24	45	21	24	16	32	57	108	69	23	419
	Female (persons)	23	38	14	24	17	35	58	100	64	24	397
Grand Total		47	83	35	48	33	67	115	208	133	47	816

A-2-5-8 Socioeconomic Infrastructure of RCs in the Study Area

RC	Village	Population		Medical Facilities		Educational Facilities			Water Supply Facilities		Commercial Facilities		Villagers' Organizations		Key Industry
		Male	Female	Poste*	Case*	Secondary	Primary	Literacy Centre	Borehole	Shallow Well	Permanent Market	Weekly Market	GPF**	GIE**	
FATICK REGION FOUNDIUGNE DEPARTMENT															
Toubacouta	51	11 104	8 786	4	19	1	19	5	3	204	1	1	13	9	Agriculture
K. Samba Gueye	45	10 909	8 476	2	8	0	14	4	3	41	1	0	18	15	Agriculture
Djilor	54	11 201	12 136	2	13	1	20	14	7	83	1	2	23	45	Agriculture
Diossong	90	14 977	13 826	2	26	0	22	30	3	91	1	0	49	53	Agriculture
Djirnda	10	3 024	2 793	1	7	0	8	2	6	3	0	0	10	15	Fisheries
Dionewar	3	5 098	5 078	2	1	1	3	2	0	50	2	0	3	36	Fisheries
Bassoul	5	3 410	4 299	2	3	0	5	2	4	5	0	0	5	14	Fisheries
FATICK REGION FATCK DEPARTMENT															
Fimela	14	17 165	4	12	1	16	N.A	2	10	3	2	25	18	Agriculture	
Djilass	9	7 210	1	1	0	7	N.A	2	3	1	0	10	16	Agriculture	
Loul Sessene	14	18 570	1	5	1	10	N.A	6	6	1	0	18	25	Agriculture	
Palmarin Fafaco	5	4 604	2	1	1	5	N.A	1	N.A	0	0	16	7	Agriculture	
Tattaguine	15	23 286	3	8	N.A	6	N.A	7	N.A	2	1	N.A	N.A	Agriculture	
Diarrere	23	24 102	2	10	N.A	14	N.A	3	N.A	2	1	N.A	N.A	Agriculture	
Diourop	9	18 455	3	4	N.A	11	N.A	4	N.A	1	1	N.A	N.A	Agriculture	
THIES REGION MBOUR DEPARTMENT															
Sessene	19	14 860	15 640	0	5	0	16	2	16	3	0	0	18	17	Agriculture
Sandiara	22	9 547	9 897	2	7	0	18	0	21	3	1	1	21	20	Agriculture
Ngueniene	23	12 542	12 467	1	6	1	19	2	15	11	1	0	20	15	Agriculture
Malicounda	22	17 561	18 440	9	11	1	15	9	14	241	4	0	30	16	Agriculture
Diass	19	15 645	16 553	5	8	1	18	10	6	61	2	0	22	18	Fisheries
Sindia	19	15 726	16 342	5	11	0	18	5	4	287	0	0	34	20	Agriculture

Source : Annual Report 2001 of CERP, Fatik Region/Statistical Data for RCs in Ties Province in 2000

* "Poste" de Sante is a primary medical facility but it cannot cover the entire villages. The government is calling for the establishment of a facility run by villagers called "Case" de Sante in villages more than 5 km distance from the Poste de Sante.

** GPF : Groupement de Promotion Féminine

GIE : Groupement d'Intérêt Economique

A-2-5-9 Production Activities in the Villages under Study

Fimela County, Fatick Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Fimela	1	Djilor	1. Agriculture (peanut, food); 2. Fisheries	1. Small shops; 2. Agriculture 3. Shellfish gathering and processing (Sarbo, Toufa, oyster)	There is a tourist camp. Every woman has a souvenir shop for tourists.
	2	Mar Fafako	1. Fisheries; 2. Agriculture (peanut, millet, rice) 3. Firewood gathering and selling; 4. Livestock farming (Small-scale)	1. Shellfish gathering and processing (oyster, Toufa, Yieet) 2. Agriculture (vegetables, rice); 3. Provision of labor; 4. small shops	Villages used to live mainly on fisheries, but declined as young people left. Since around 1997 Guineans and villagers have begun fish smoking.
	3	Mar Lodji	1. Fisheries; 2. Agriculture	1. Small shops; 2. Firewood gathering and selling; 3. Shellfish gathering and processing (oyster, Sarbo, Toufa), 4. Agriculture	There is a tourist camp. There is a request for fish smoking.
	4	Simal	1. Agriculture (peanut, millet, vegetables) 2. Fisheries (shrimp, fish); 3. Livestock farming	1. Small shops; 2. Vegetable cultivation; 3. Peanut cultivation 4. Aquatic products processing	There is a tourist camp. People take Mondays and Thursdays off during the rainy season.
Palmarin	5	Difere	1. Fisheries	1. Aquatic products processing	More than 60% of residents relocate on periodically (staying in a place for nearly 10 months). Since 1995 Guineans and others have begun fish smoking.

Djilor County, Foudiougne Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Djilor	6	Felane	1. Fisheries; 2. Shellfish gathering; 3. Aquatic products brokering 3. Peanut cultivation; 4. Food cultivation 5. Fruit cultivation	1. Shellfish gathering and processing (Sarbo, Toufa, oyster) 1. Small shops; 2. Vegetable cultivation; 3. Rice cultivation	Both men and women move to camp in village on a seasonal basis for shellfish gathering. As peanut harvest was poor, they shifted to vegetable and cashew nut cultivation. During the rainy season (July to September), road condition is bad and access is difficult.
	7	Gague Bocar Interviews only with Serer fisher folk	1. Fisheries	1. Small shops (aquatic products); 2. Shellfish gathering and processing (Sarbo, Toufa)	During the dry season, shellfish gathering is nearly impossible due to many jellyfish in the water.
	8	Gague Cherif (Serer)	1. Food and peanut cultivation; 2. Fisheries (shrimp) 3. Vegetable cultivation	1. Food and peanut cultivation; 2. Vegetable cultivation 3. Help with husband's field; 4. Small shops	Residents consist of 3 ethnic groups. 2 of them were interviewed separately. There is no production activity during the dry season.
		(Tyacre)	1. Fisheries (shrimp); 2. Food and peanut cultivation	1. Removing shrimp shells; 2. Small shops; 3. Vegetable cultivation 4. Food and peanut cultivation	Water quality is bad (too much salt), inhibiting vegetable cultivation. They take Monday off.
	9	Goudeme Sidy	1. Livestock farming; 2. Vegetable cultivation; 3. Food and peanut cultivation 4. Small shops 5. Fruit cultivation	1. Small shops; 2. Food and peanut cultivation 3. Vegetable cultivation (only in groups)	Due to poor peanut harvest, more than half the men started vegetable cultivation. There is little activity in mangrove areas. A few young people began fishing with throwing net.
	10	Kamatane Mbam.	1. Fisheries (shrimp); 2. Food and peanut cultivation 3. Livestock farming	1. Vegetable cultivation; 2. small shops; 3. Peanut cultivation	As peanut harvest was poor, people shifted to shrimp fishing. Vegetable cultivation is done mainly in the rainy season when road condition is bad and access is difficult.
	11	Mbassi	1. Fisheries (mainly shrimp); 2. Agriculture (peanut, food); 3. Livestock farming; 4. Vegetable cultivation	1. Small shops; 2. Vegetable cultivation; 3. Shellfish gathering and processing (Sarbo, oyster); 4. Poultry farming	People take Mondays off during the rainy season. Men also cultivate vegetables as peanut cultivation is not faring well.

Djilor County, Foudiougne Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Djilor	12	Sadioga	<ol style="list-style-type: none"> 1. Agriculture (peanut, food); 2. Vegetable cultivation 3. Livestock farming 	<ol style="list-style-type: none"> 1. Vegetable cultivation; 2. Rice and millet cultivation; 3. Fruit cultivation 4. Shellfish gathering and processing (Toufa, oyster) 	People take Mondays off during the rainy season.
	13	Soum No.1	<ol style="list-style-type: none"> 1. Agriculture (peanut, food); 2. Fisheries 	<ol style="list-style-type: none"> 1. Vegetable cultivation; 2. Small shops; 3. Rice cultivation 	A large village, which is rare by Senegalese standards
		Soum No.2		<ol style="list-style-type: none"> 4. Oyster gathering and processing; 5. Salt production; 6. Poultry farming 	A new village with many newcomers from the outside.
	14	Mbam	<ol style="list-style-type: none"> 1. Agriculture (grains such as peanut, millet); 2. Livestock farming 3. Fisheries (shrimp); 4. small shops; 5. Fruit cultivation 	<ol style="list-style-type: none"> 1. Small shops; 2. Vegetable cultivation; 3. Rice cultivation 4. Fish processing; 5. Fruit gathering, selling and processing 	<p>There are many native fruit trees and women make many products out of the fruits.</p> <p>There is the Applied Development Technology Center but it is not functioning now.</p>
Diossong	15	Bambougar Mlc.	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture; 3. Aquatic products brokering 4. Fresh oyster production and sales 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (Sarbo, Toufa, oyster) 2. Fishing and processing; 3. Food production; 4. Peanut cultivation 	Water shortage is driving people away from rice cultivation.

Niodior County, Fouta Djallon Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Dionewar	16	Niodior	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (millet and rice) 3. Livestock farming (mainly cows) 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (Sarbo, Toufa, oyster) 2. Vegetable cultivation; 3. Fish processing; 4. Rice cultivation; 5. Small shops 	People take Mondays and Thursdays off during the rainy season. There is a tourist camp.
	17	Dionewar	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (millet and rice) 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (Sarbo, Toufa, oyster) 2. Vegetable cultivation; 3. Fish processing; 4. Rice cultivation; 5. Small shops 	There is a four-star hotel.
	18	Falia	<ol style="list-style-type: none"> 1. Fisheries; 2. Shellfish gathering (oyster, Sarbo) 3. Food production 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (Sarbo, oyster; 2. Small business 3. Rice cultivation 	The oldest village in islets (the second is 16) There are famous shell mounds and tombs, attracting many tourists. Depending on the ebb tide time, men and women take turns gathering shellfish.
Bassoul	19	Bassoul	<ol style="list-style-type: none"> 1. Fisheries; 2. Plastering, joinery, ship building 3. Shellfish gathering 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo); 2. Agriculture 3. Fish smoking; 4. Salt making 	Most large fishing boats of the village make Joal the home port. The village builds 60 to 70 % of the boats it uses. It has quit rice cultivation and concentrates on fisheries. Both men and women move to camp on a seasonal basis for shellfish gathering. Fish smoking had begun circa 1999 before Guineans came.
	20	Bassar	<ol style="list-style-type: none"> 1. Fisheries; 2. Food production; 3. Shellfish gathering 4. Plastering, wood carpentry; 5. Small shops 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing; 2. Gathering and sales of firewood for fish smoking; 3. Fish processing; 4. Small shops; 5. Agriculture 	Most large fishing boats of the village make Joal and The Gambia the home ports. Both men and women move to camp on a seasonal basis for shellfish gathering. Guineans began fish smoking in 2001.

Niodior County, Fouta Djallon Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Bassoul	21	Diogane	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (millet and maize) 3. Livestock farming 	<ol style="list-style-type: none"> 1. Oyster gathering and processing; 2. Gathering and processing of other shellfish 	Previously, palm oil and rice cultivation were the main production activities of women, but now oyster gathering and processing took their place.
Djirnda	22	Djirnda	<ol style="list-style-type: none"> 1. Fisheries; 2. Gathering and sales of firewood for fish smoking; 3. Business 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo, Yieet); 2. Firewood collection and sales; 3. Fish processing; 4. Agriculture 	Farmland decreased due to incoming seawater. In the rainy season, people take Mondays and Fridays off. Guineans began fish smoking in 1999.
	23	Mounde	<ol style="list-style-type: none"> 1. Fisheries; 2. Food production; 3. Firewood gathering and sales 4. Shell sales; 5. Small shops 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing; 2. Fish processing; 3. Search for and sales of firewood 4. Small shops; 5. Agriculture 	Women also move on a seasonal basis for shellfish gathering. In the rainy season, people take Mondays and Thursdays off. Guineans began fish smoking in 1996.
	24	Diameniadio	<ol style="list-style-type: none"> 1. Fisheries; 2. Aquatic product brokering; 3. Gathering and sales of firewood for fish smoking; 4. Agriculture (millet, rice) 	<ol style="list-style-type: none"> 1. Helping Guineans (carrying fish, peeling) 2. Aquatic products processing; 3. Gathering and sales of firewood for fish smoking 4. Agriculture (, rice) 	Cultivation is virtually impossible due to argilliferous soil and salt damage. A main fish smoking location for Guineans. People take Mondays and Thursdays off during the rainy season.
	25	Rofangue	<ol style="list-style-type: none"> 1. Fisheries; 2. Aquatic products brokering; 3. Livestock farming 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (Toufa); 2. Fish processing 3. Helping Guineans (peeling); 4. Small shops 	People used to be farmers, but salt damage made cultivation impossible. Guineans began fish smoking in 2000. A large sightseeing ship comes here for a tour.

Toubacouta County, Foudiougne Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Toubacouta	26	Soucouta	<ol style="list-style-type: none"> 1. Fisheries; 2. Business; 3. Beekeeping 4. Agriculture (millet, peanut) 	<ol style="list-style-type: none"> 1. Food processing; 2. Shellfish gathering and processing (including fresh oyster production) 3. Small shops; 4. Salt making 	Agricultural work is limited due to shortage of farmland and water. Guineans in Missira come here to buy smoked fish.
	27	Sandi Coly	<ol style="list-style-type: none"> 1. Agriculture (peanut, grain such as millet); 2. Livestock farming; 3. Fisheries; 4. Fruit cultivation; 5. Beekeeping 	<ol style="list-style-type: none"> 1. Small shops; 2. Shellfish gathering and processing; 3. Fish processing 4. Cashew nut processing; 5. Agriculture 	Oyster gathering and processing is to begin this season (as it is profitable). Sun-dried bricks are made from lime out of shellfish gathered in the village and argilliferous red soil.
	28	Medina Sangako	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (food, peanut); 3. Vegetable cultivation; 4. Sales of (forest) wood 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo, Toufa) 2. Small shops; 3. Vegetable cultivation; 4. Fish processing 	It is next to 29 and forms a single residential compound, but the two villages do not get along. The number of people who gather and process oysters is growing (as oysters are a quick source of income).
	29	Sangako	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (food, peanut); 3. Provision of labor; 4. Sales of (forest) wood 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo, Toufa) 2. Iodized salt; 3. Gathering and sales of (forest) firewood; 4. Small shops 	The village is located between a national forest and a mangrove forest. Agricultural production is very difficult due to shortage of farmland and salt damage (about 10 % of the families have arable land). Agricultural production is very difficult (about 10 % of the families have arable land).
	30	Nema Ba	<ol style="list-style-type: none"> 1. Fisheries; 2. Agriculture (food, peanut); 3. Fruit cultivation; 4. Small shops; 5. Vegetable cultivation 	<ol style="list-style-type: none"> 1. Vegetable cultivation; 2. Aquatic products processing (oyster); 3. Agriculture (food, peanut); 4. Fruit cultivation; 5. Small shops 	Agriculture is being diversified into such areas as vegetables as peanut production is poor. People take Fridays off.

Toubacouta County, Foudiougne Prefecture					
CR	No.	Village	Men's production activities	Women's production activities	Remarks
Toubacouta	31	Bettenty	<ol style="list-style-type: none"> 1. Fisheries; 2. Business; 3. Agriculture (millet) 	<ol style="list-style-type: none"> 1. Shellfish gathering; 2. Business; 3. Agriculture (rice, vegetables) 	There are many shrimp fisher folk from the outside from April to July.
	32	Bossinkang	<ol style="list-style-type: none"> 1. Fisheries; 2. Production of cash crops 3. Food production; 4. Aquatic products brokering 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo); 2. Vegetable cultivation 3. Food production; 4. Production and sales of dried fish 	Access to the village is very limited. (At full tide one can reach the village directly from Missira, but usually one has to go there via Bettenty)
	33	Djinack Baro		<ol style="list-style-type: none"> 1. Shellfish gathering and processing (oyster, Sarbo, Toufa) 2. Vegetable cultivation; 3. Rice cultivation 	There is the annex to a Toubacouta hotel. During the rainy season people take Wednesdays and Fridays off (men take only Fridays off).
	34	Djinack Diattaco	<ol style="list-style-type: none"> 1. Peanut cultivation; 2. Food production; 3. Fisheries 	<ol style="list-style-type: none"> 1. Shellfish gathering and processing; 2. Vegetable cultivation; 3. Rice cultivation 	Close social and economic ties with The Gambia

Islet

Bold: Major source of income

A-2-5-10 NGOs Engaged in Mangrove Planting in the Area under Study

M planting : mangrove planting

MC : microcredit

Villages where UICN is working (Part 1)

No.	Village	Activities	Other supporting organizations	Remarks
1	Betenty	M planting, villagers bank, vegetable cultivation, fruit cultivation, milling machine, support to CP Branch of the National Park Bureau to be built	WAAME, Yungal	Plan for smoking platform and ecotourism camp
2	Bossingkang	Villagers bank, milling machine, 4 wells, literacy, support to setting up CP		
3	Sipo	Vegetable cultivation		
4	Missira	M planting, villagers bank, milling machine	WAAME	
5	Nema Ba	M planting, dike against salt damage, vegetable cultivation, literacy, support to village beautification		Plan to convert to public rural village finance in villages in 5 to 9*
6	Soukouta	M planting, beekeeping, villagers bank, well, measures against erosion, support to CP		UICN pilot village and UICN is working hard on it.
7	Sangako	M planting, well		Plan to support beekeeping activities in 5 and 7 to 10.
8	Medina Sangako	M planting		
9	Sandi Coly	Well, support to village beautification		
10	Dassilame Serere	CC in 5 to 10		
11	Gague Bacar	M planting, measures against erosion	WAAME	
12	Gague Mody	Measures against erosion		
13	Nda Khonge	M planting		
14	Felir	M planting	WAAME	
15	Fayako	M planting	WAAME	
16	Faoye	M planting	Yungal	
17	Sakhor	M planting		
18	Fimela	M planting, support to shrimp fishing		Done through CAREM?
19	Ndangane	M planting	Yungal	
20	Palmarin Ngallou	M planting, bridge building, sea turtle protection, and support to setting of no-fishing zone	Yungal	Support to transition to public rural village finance in 20 to 24.
21	Palmarin Sessene		Yungal	
22	Palmarin Nguethie		Yungal	
23	Palmarin Fafako		Yungal	

No.	Village	Activities	Other supporting organizations	Remarks
24	Djifere	Smoking platform, drying platform, sensitization training, and support to setting of no-fishing zone	Yungal	
25	Niodor	M planting, smoking platform, drying platform, vegetable cultivation, support to CP / CC in 25 to 27		
26	Dionouar	Smoking platform, drying platform, vegetable cultivation, provision of processing tools, setting up toilets		
27	Falia	M planting, smoking platform		Plan for beekeeping, ecotourism, well, and vegetable cultivation in 27 to 32.
28	Siwo	M planting, eucalyptus planting, well / CC in (27), 28 to 32		Plan for setting up public rural village finance.
29	Diogane	M planting, smoking platform, well, eucalyptus planting		Eucalyptus planting failed in 28 to 32 due to lack of monitoring.
30	Mounde	M planting, eucalyptus planting, smoking platform, well, provision of shellfish gathering and processing tools	WAAME, Yungal	
31	Tialane	M planting, eucalyptus, smoking platform		
32	Bassar	M planting, eucalyptus, smoking platform, well		

Villages where UICN is working (Part 2)

No.	Village	Activities	Other supporting organizations	Remarks
33	Bassoul	M planting, eucalyptus planting, smoking platform, well	WAAME	
34	Nghadior	M planting / CC in 33 (plus 2 branches of 33), 34	WAAME	Plan for smoking platform
35	Djirnda	M planting, smoking platform / CC in 35 to 40	WAAME	
36	Fambine	M planting, smoking platform	WAAME	Plan for ecotourism camp
37	Maya	M planting		
38	Baout	M planting, smoking platform	WAAME	
39	Rofangue	Sensitization training under implementation	WAAME	
40	Diamniadio	Sensitization training under implementation	WAAME	
41	Djinack Bara	Support to setting up CP, villagers bank, well (all activities in cooperation with 42)	WAAME	Plan for support to vegetable cultivation
42	Djinack Diattaco		WAAME	Plan for support to vegetable cultivation

Has a natural resource management plan at the village level. CP: Beach committee
CC: Member village of the intervillage conference

*credit mituel

Villages where WAAME is working (Part 1)

WAAME activities include the following:

1. M planting;
2. setting up a participatory natural resource management plan;
3. literacy class (planting 1 ha per classroom X 44 classrooms);
4. environmental education and sensitization activities;
5. fishery-related support;
6. MC;
7. Ecotourism activities (to be started in 2002) / with financial aid from EU starting in 2002, activities are to be spread to Dionouar, Dilor, Djirnda, Bassoul, and Toubacouta.

Bold: village that is the base of activities CVGM: Mangrove management committee set upA (/): Animator (total number / number of women among them)

No	Village	Activities	Other supporting organizations	Remarks
1	Niamdiarokh	M planting in villages in 1 to 31 (including villages where M planting is planned)		Camp, not a settled village
2	Fayako	CVGM, A (2/1)	UICN	After RRA implementation, formulating a participatory resource management plan.
3	Felir	A (1/0)	UICN	
4	Mbam	CVGM, A (3/1), support to shrimp fishing, setting up Environmental and Development Support Fund (FAED)		Main village of WAAME / plan for setting up a nursery field in grade school.
5	Sap	CVGM, A (1/0) / village union in 4 to 11		
6	Tiare	CVGM, A(1/0)		
7	Soum1,2	CVGM, A (1/0), support to shrimp fishing		
8	Nodrong Log	A(1/0)		
9	Mbassi	CVGM, A (1/0)		
10	Gague Modi			
11	Gague Bokar	CVGM, support to shrimp fishing	UICN	
12	Gague Cherif	CVGM, A (1/0), support to shrimp fishing / village union in 12 to 15		Center village for WAAME
13	Keur Ngari	A		
14	Keur Omar	A		
15	Boly			

Villages where WAAME is working (Part 2)

No	Village	Activities	Other supporting organizations	Remarks
16	Keur Yoro	CVGM, A (1/0), support to shrimp fishing / village union in 16 to 19		
17	Keur Djindake	A		
18	Keur Pate	A		
19	Keur Bondji	A		
20	Kamatane Mbam.	CVGM, A (1/0), support to shrimp fishing / village union in 20 to 24		
21	Kamatane Mbar	A		
22	Ngamsa	A		
23	Keur Tieneke	CVGM, A(1/0)		
24	Ndiassane Saloum	A		
25	Ndiomdi	CVGM, A(2/0) / village union in 25 to 30		
26	Keur Cheikhou	A(1/0), support to shrimp fishing		
27	Sadioga	CVGM, A(1/0)		
28	Pethie	A		
29	Mbelane	CVGM, A(1/0), support to shrimp fishing		
30	Felane	Environmental education, sensitization training		There is a plan for literacy education.
31	Keur Gory	A		
32	Djirnda	Mainly M preservation activities and environmental education in 32- 38	UICN	
33	Fambine	A (1/0), literacy	UICN	
34	Rofangue	A (1/1)	UICN	After RRA implementation, formulating a participatory resource management plan.
35	Diamnadio	A (3/1)	UICN	After RRA implementation, formulating a participatory resource management plan.
36	Mounde	A (1/1)	UICN, Yungal	Animator died in 2001 and successor is being sought.
37	Vellingara			
38	Nghadior		UICN	
39	Baout	M planting, CVGM (1/0)	UICN	

No	Village	Activities	Other supporting organizations	Remarks
40	Bassoul	M planting, setting up M nursery plant field, CVGM(3/1), FAED 1 pirogue provided, environmental education, oyster culture test	UICN	Center of activity in Bassoul district
41	Missira	Environmental education and literacy class in 41 to 44	UICN	
42	Toubacouta			
43	Betenty		UICN, Yungal	
44	Djinack	A (2/1)	UICN	Interaction with Mbam such as visits to each other.

Has a natural resource management plan at the village level.
Member village of the WAAME intervillage organization

Villages where CAREM is working

Union of 39 women's groups and 2 educated youth groups / hope to extend activities to Ndangane

No	Village	Activities	Other supporting organizations	Remarks
1	Fimela	M planting, literacy, MC	PRODEFI, Yungal	Location of the CAREM office
2	Dilor	M planting, literacy, MC, vegetable cultivation and processing	PRODEFI, Yungal	
3	Simal	M planting, MC	FIOD, Yungal	

Villages where FIOD is working

Union of 30 GIE in 3 villages and carries out M planting in 3 villages under WFP-backed Food for Work scheme (including Avicennia)

No	Village	Activities	Other supporting organizations	Remarks
1	Diofior	In 3 villages, M planting, village forest, construction of dike against salt damage (5.2 km), literacy class	Yungal	Location of the FIOD office
2	Simal	Well digging and support to vegetable cultivation (12 ha of farmland secured)	CAREM, Yungal	
3	Rho			

Villages where Yungal is working

Organization run by 130 rural groups and individual members. In 64 villages, activities include:

1. farming;
2. environmental protection (forest, wetland: including M planting);
3. fisheries;
4. education.

The following is only on villages with access to mangrove. M planting villages need to be checked.

No	Village	Activities	Other supporting organizations	Remarks
1	Dilor	M planting, dye, support to fisheries and oyster, support to organic farming, environmental education	PRODEFI, CAREM	
2	Mar Lodji	M preservation, environmental education		Mar Island Development Committee (Cellule de réflexion du
3	Mar Fafako	Eucalyptus planting, environmental education		développement de l'île de Mar) was set up in 2 to 4.
4	Mar Soulou	Environmental education		
5	Fimela	Support to fisheries and oyster, environmental education	PRODEFI, CAREM	Yungal office located
6	Ndangane	M planting, environmental education	UICN	
7	Diofior		FIOD	
8	Simal	Support to fisheries and oyster, environmental education	CAREM, FIOD	
9	Faoye		UICN	
10	Palmarin Ngallou	Support to fisheries and oyster	UICN	
11	Palmarin Diakhanor	M planting	UICN	
12	Palmarin Nguethie		UICN	
13	Palmarin Fafako		UICN	
14	Djifere		UICN	
15	Joal			
16	Betenty	M preservation, environmental education	UICN, WAAME	
17	Mounde		UICN, WAAME	

Source: Study mission's field survey

A-2-5-11 Support Organizations that Work in the Villages under Study

(For the Contents of Assistance by UICN and WAAME, See Table A-2-5-10)

	Village	Population	Support organizations
Fimela County, Fatick Prefecture (Population data as of 1998-1999)			
Fimela	Dilor	589	CAREM (mangrove planting, MC, farm product processing), Yungal (Aquatic products processing, soap production, dye, MC)
	Mar Fafako	2022	Yungal (eucalyptus planting, environmental education), UICN
	Mar Lodji	1316	UICN, Yungal (MC, provision of fishnet, mangrove planting)
	Simal	1749	CAREM (mangrove planting, MC), FIOD (mangrove planting, village forestry, dike against salt damage, literacy class)
Palmarin	Difere	?	UICN
Djilor County, Foudiougne Prefecture (Population data as of 2001)			
Djilor	Felane	748	PAGERNA (dike against salt damage, eucalyptus planting, introduction of new rice species), WAAME (sensitization training under implementation)
	Gague Cherif	286	CARITAS (MC, technical training), PAGERNA (MC?), WAAME
	Goudeme Sidy	516	WAAME (sensitization training under implementation)
	Kamatane Mbam.	212	Action Plus (MC), PAGERNA (improved furnace), WAAME, UICN (recently visited village)
	Mbassi	1277	WAAME, CARITAS (vegetable cultivation, MC)
	Sadioga	713	WAAME, PAGERNA (mangrove planting for salt damage prevention, vegetable cultivation)
	Soum No.1	1124	FAO/Vietnam (support to vegetable cultivation, provision of farm equipment, well digging), Pais (literacy), PAGERNA, WAMME
	Soum No.2	2460	CARITAS (dike against salt damage)
	Mbam	1793	CARITAS (MC, literacy teaching materials, assistance to poultry farming), FAO/Vietnam (support to vegetable cultivation, provision of farm equipment, well digging), WAAME
Diossong	Bambougar Mlc.	491	CARITAS (MC)
Niodior County, Foudiougne Prefecture (Population data as of 1999)			
Dionewar	Niodior	5517	FENAGIE (MC), CMGA (MC), ADF (MC), JOCV, UICN
	Dionewar	3953	ADF (MC), FENAGIE (MC), UICN
	Falia	586	ADF (MC), UICN
Bassoul	Bassoul	3723	WAAME, UICN, FENAGIE (MC, smoking platform, warehouse, drying platform), CARITAS (well, milling machine)
	Bassar	1536	CARITAS (well), FENAGIE (MC, smoking platform, drying platform), UGIS (MC), UICN
	Diogane	780	UGIS(MC)
Djirnda	Djirnda	1252	UGIS (MC), FENAGIE (smoking platform), UICN, WAAME (study only)
	Mounde	1291	FENAGIE (MC, smoking platform, drying platform), UGIS (MC), UICN, FAO (drying platform)
	Diameniadio	684	FENAGIE (MC, warehouse, toilets, smoking platform, drying platform), UGIS (MC), WAAME, UICN (sensitization training under implementation)
	Rofangue	146	UGIS (MC), ULGP (MC), FENAGIE (drying platform), CARITAS (well), WAAME, UICN (sensitization training under implementation)

Toubacouta County, Foudiougne Prefecture (Population data as of 1998)			
Toubacouta	Soucouta	342	MDS (landing place development, support to beekeeping), PROMER (support to salt production), FENAGIE (ship with outboard motor, warehouse, work station, drying platform, fishnet), JOCV (oyster association), UICN
	Medina Sangako	852	FENAGIE (MC), EGAT (MC), PROMER (MC), JOCV (oyster association), UICN (sensitization training)
	Sangako	118	JOCV, PROMER (beekeeping, implementing training on iodized salt), UICN
	Sandi Coly	380	FENAGIE (provision of fish gathering equipment, technical training, MC), PROMER (technical training, MC), JOCV (oyster association), UICN
	Nema Ba	951	UICN, EGAT (MC), SAPAD (sensitization activities, setting up toilets)
	Bettenty	3644	UICN, WAAME (to understand the current state only)
	Bossikang	766	UICN
	Djinack Baro	467	UICN, WAAME (to understand the current state only)
	Djinack Diattaco	144	

Islet

MC : Microcredit

CP : Beach committee

Source : Study mission's field survey (all population data were from county CERP)

A-2-5-12 Resident Organizations in Villages under Study

CP : Beach Committee

G : Group

Assistant : A literate young person who has stayed in a village for years and helps its elderly chief and women's group

Fimela County, Fatick Prefecture (Population data as of 1998 - 1999)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Fimela	1	Djilor	589	<ul style="list-style-type: none"> The woman leader is quite vigorous. Young male leader with a command of French is active. 	<ul style="list-style-type: none"> 4 women's groups, 3 gender-mixed groups 1 ASC 	<ul style="list-style-type: none"> It is the site village of the Japanese PRODEFI project and has village-level natural resource management organization.
	2	Mar Fafako	2022	<ul style="list-style-type: none"> Both village chief and assistant have leadership skills. Caliber of the elderly woman leader remains to be seen. 	<ul style="list-style-type: none"> In 3 villages in Mar island, island development committee is formed and beach committee is being formulated. More than 10 GPF, 1 ASC 	<ul style="list-style-type: none"> There are village-level organization of Yungal-backed island development committee and village management committee as well as environment section.
	3	Mar Lodji	1316	<ul style="list-style-type: none"> The woman leader is active and competent. No information is available on village chief and others. 	<ul style="list-style-type: none"> 12 women's groups, 1 men's group In 3 villages in Mar island, island development committee is formed. 	
	4	Simal	1749	<ul style="list-style-type: none"> CAREM animator has high potential as an assistant and young leader. No info on woman leader. 	<ul style="list-style-type: none"> 17 women's GIE, 5 mixed GIE, and 3 men's GIE. 1 ASC 	<ul style="list-style-type: none"> Women's group is divided into many parts as it functions as recipient of MC.
Palmarin	5	Difere	?	<ul style="list-style-type: none"> Village leader is unknown. 	<ul style="list-style-type: none"> 6 women processors groups 	<ul style="list-style-type: none"> It is hard to organize groups in residences of seasonal movers.
Djilor County, Foudiougne Prefecture (Population data as of 2001)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Djilor	6	Felane	748	<ul style="list-style-type: none"> Village chief is patriarch type and not much of a leader. Young people are united, but that is not the case with the village as a whole. 	<ul style="list-style-type: none"> 2 Men's fishery and shellfish gathering Gs, 1 mixed shellfish gathering G 7 mixed cashew nut cultivation Gs, 1 ASC 	<ul style="list-style-type: none"> Previously, shellfish gathering was done by individuals, but now it is done by groups to rent a ship.
	7	Gague Bocar	484	<ul style="list-style-type: none"> The Serer woman GIE head is highly competent. 	<ul style="list-style-type: none"> 3 or 4 Pular women vegetable cultivators Gs 1 Serer women processor G with overseeing GIE. 	<ul style="list-style-type: none"> Pular farmers and Serer fisher folk (a small number) live separately and divide their labor.

Djilor County, Foudiougne Prefecture (Population data as of 2001)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Djilor	8	Gague Cherif	286	<ul style="list-style-type: none"> The Serer leader is the head of the village WAAME, and has impeccable leadership skills and character. In Tyaracre, the boss is a big merchant (aquatic products broker). 	<ul style="list-style-type: none"> 1 Serer/Wolof women G, 1 ASC 1 Tyaracre women G. All women take part in it. G saves profit from labor provision and common farm and lends it to members. 	<ul style="list-style-type: none"> Etnic groups live separately and Serer and Tyaracre do not have much interaction. Aid is directed toward Serer, the indigenous inhabitants. Women's group is trying to buy a milling machine.
	9	Goudeme Sidy	516	<ul style="list-style-type: none"> A village led by a famous Marabou of Tiegany. Both village chief and woman leader have leadership skills. 	<ul style="list-style-type: none"> All women belong to a GPF that saves profit from common farm and allocates it to fund for fixing milling machines and buying seeds. 1 ASC. 	<ul style="list-style-type: none"> Marabou takes the lead in village development and women also started group work under his leadership. GPF has been organized for 20 years and women are united.
	10	Kamatane Mbam.	212	<ul style="list-style-type: none"> Marabou/village chief is highly competent. So are assistant and woman leader. 	<ul style="list-style-type: none"> 1. 1 fishermen GIE; 2. 1 GPF (all women take part in it). 3. 1 women G; 4. 1 ASC 	<ul style="list-style-type: none"> A village of decendants of immigrants from Mali. WAAME supports 1 and 2.
	11	Mbassi	1277	<ul style="list-style-type: none"> The male WAAME animator is very active. Women as a whole have no sense of unity. 	<ul style="list-style-type: none"> 2 women groups (set up as recipients of CARITAS and WAAME assistance) 	<ul style="list-style-type: none"> Women's groups who receive aid from different organizations tend to exclude one another. There is a youth theater company.
	12	Sadioga	713	<ul style="list-style-type: none"> A traditional village with the patriarch system and age groups. PAGERNA has organized a Djiffa village protection cell with neighboring 3 villages, and the cell leader is the village youth leader. 	<ul style="list-style-type: none"> All women belong to 3 age Gs. Earnings from each group's common farm are saved as mutual aid funds. 	<ul style="list-style-type: none"> Women are united with elderly in the middle. WAAME animator and women's representative have a communication problem.
	13	Soum No.1	1124	<ul style="list-style-type: none"> Soum 1 has a young and dynamic village chief; Soum 2 has a patriarch-type village chief. 	<ul style="list-style-type: none"> In each resident district, 7 women Gs cultivate vegetables and save profits in group safe. 	<ul style="list-style-type: none"> Christians live in 1, and Muslims live in 2.
		Soum No.2	2460	<ul style="list-style-type: none"> There is no woman leader and women are not united. 		<ul style="list-style-type: none"> There is a youth theater company.
	14	Mbam	1793	<ul style="list-style-type: none"> It is the central village in WAAME and has plenty of competent men and women. 	<ul style="list-style-type: none"> In each resident district, 7 women Gs (three of which are GIE) 1 ASC; there is also an environmental protection association with all village groups in it. 	<ul style="list-style-type: none"> The village is a trailblazer in resident-led environmental protection. Village forest is in each residential district./There is a youth theater company.

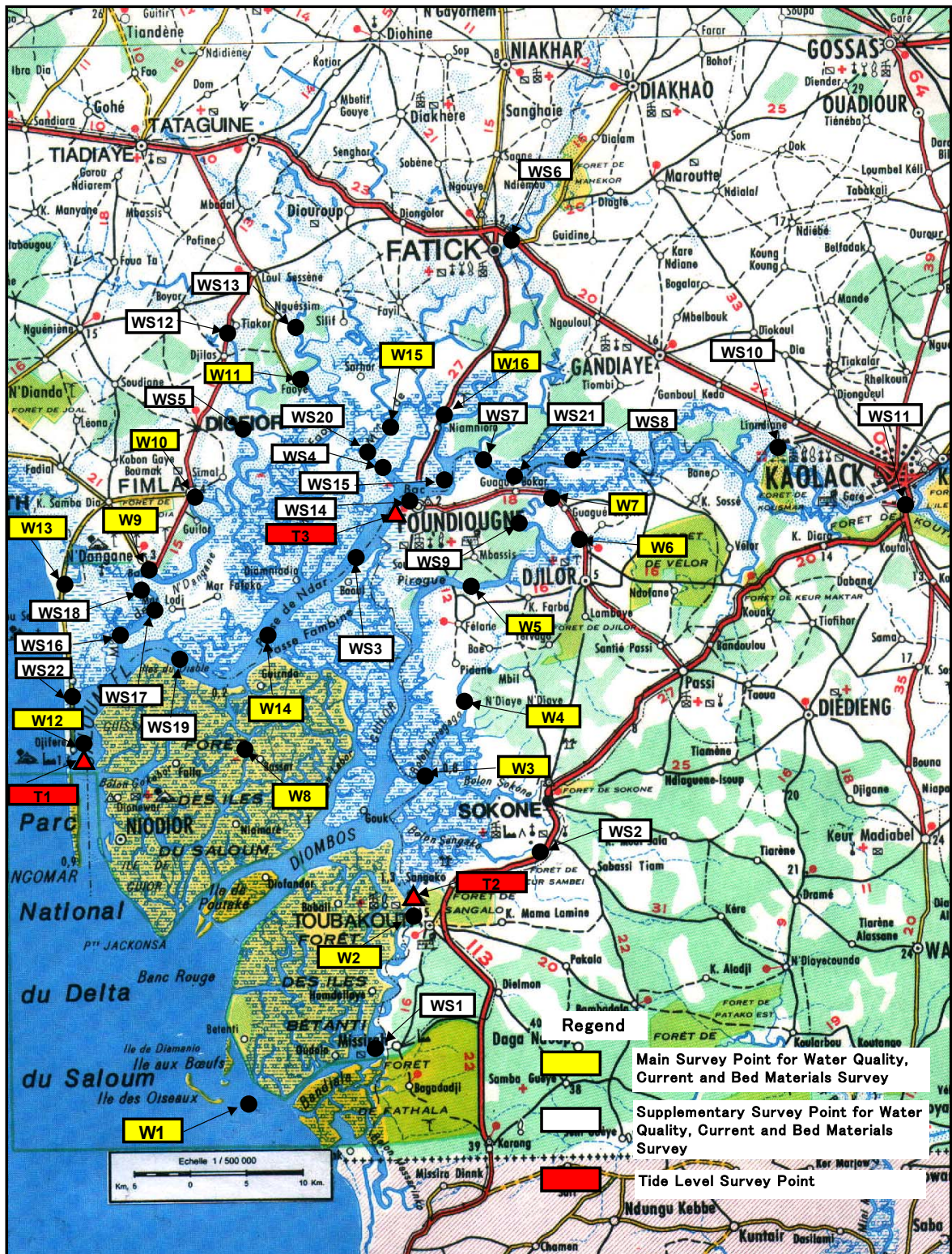
Niodior County, Foudiougne Prefecture (Population data as of 1999)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Diossong	15	Bambougar Mlc.	491	<ul style="list-style-type: none"> Village chief is highly experienced and skillful. No info on woman leader. 	<ul style="list-style-type: none"> 1 GPF (all women taking part in it). There are also a CARITAS-backed organization as well as a literacy promotion organization. 	
Dionewar	16	Niodior	5517	<ul style="list-style-type: none"> There are three competent women leaders, but women as a whole are not united due to conflict among age groups. Villagers have been split in two over the issue of a mosque. 	<ul style="list-style-type: none"> 12 women processors GIE (they are at odds, split in 7 to 5) Vegetable cultivating women's group, beach committee There is an ASC in each residential district but no common event among ASCs. 	<ul style="list-style-type: none"> It is hard to unite the vilage as a whole as the population is large and there is a conflict among residents. GIE was organized as recipient of assistance and MC.
	17	Dionewar	3953	<ul style="list-style-type: none"> The women's GIE federation head is very dynamic and has leadership skills. 	<ul style="list-style-type: none"> 11 women processors GIE and a federation that oversees it. There is also a vegetable cultivating women's group. 	
	18	Falia	586	<ul style="list-style-type: none"> CP head is competent. 	<ul style="list-style-type: none"> 2 women processors GIE, 2 unofficial groups, and beach committee. 	<ul style="list-style-type: none"> Shellfish gathering and processing are done by family units.
Bassoul	19	Bassoul	3723	<ul style="list-style-type: none"> 3 women leaders who are CR legislators are active, but women as a whole are not united./Village chief is a good leader. 	<ul style="list-style-type: none"> 7 women's GIE, 1 GFP and 1 fisher folk GIE. 1 ASC (made up of sub-groups by age), beach committee. 	<ul style="list-style-type: none"> Women's groups who receive aid from different organizations are at odds with one another over succession of leaders.
	20	Bassar	1536	<ul style="list-style-type: none"> No information is available as both village chief and village representative (man and woman) are absent. A woman leader understand French and is active. 	<ul style="list-style-type: none"> 7 women processors GIE, 1 fisher folk GIE, and 1 ASE. 	
	21	Diogane	780	<ul style="list-style-type: none"> A person with leadership skills has not been found. Village chief is old and retired from duties. 	<ul style="list-style-type: none"> 2 women processors GIE, 1 unofficial group. 	<ul style="list-style-type: none"> GIE was organized as recipient of MC. There is a traditional unit of oyster gathering and processing by 2 to 3 people.

Niodior County, Foudiougne Prefecture (Population data as of 1999)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Djirnda	22	Djirnda	1252	<ul style="list-style-type: none"> Village chief is competent and there is also a person suitable to be assistant. Women leaders (UGIS animators, etc.) are active. 	<ul style="list-style-type: none"> 9 women processors GIE, 1 brokers GIE, and 1 fisher folk GIE. 1 ASC (made up of sub-groups by age), beach committee. 	<ul style="list-style-type: none"> Unified work among age groups of women is difficult. There are 3 theater companies of women by age groups.
	23	Mounde	1291	<ul style="list-style-type: none"> Village chief and women leader are capable and village is united. Assistant is also enthusiastic about village development. 	<ul style="list-style-type: none"> 8 women processors GIE and a federation that oversees it. 1 ASC (made up of sub-groups by age), beach committee. 	<ul style="list-style-type: none"> Women implement shellfish gathering, processing, and sales in an organized fashion. 6 women GIE in Tialane are part of the federation.
	24	Diameniadio	684	<ul style="list-style-type: none"> Village chief is old and retired from duties./Deputy and women leader are competent. There is a youth who is a candidate for assistant. 	<ul style="list-style-type: none"> 5 women GIE 	<ul style="list-style-type: none"> Funds are collected from female GIE members on a regular basis, and repair of milling machine and setting of smoking platform are done jointly with the funds.
	25	Rofangue	146	<ul style="list-style-type: none"> The interpreter is a candidate for assistant. No woman who can be leader has been found. No info. 	<ul style="list-style-type: none"> 3 women processors GIE, 1 fisher folk GIE, and 1 ASE. All women belong to a GPF. 	<ul style="list-style-type: none"> Women GIE received a drying platform but sold it to an individual.
Toubacouta County, Foudiougne Prefecture (Population data as of 1998)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Toubacouta	26	Soucouta	342	<ul style="list-style-type: none"> 3 male leaders and 1 female leader are vigorously proceeding with activities and receive much outside support. 	<ul style="list-style-type: none"> 1. 1 women processors GIE; 2. 1 fresh oyster GIE. 3. 1 beekeepers GIE; 4. beach committee and 1 ASC. 	<ul style="list-style-type: none"> 1 and 4 were set up with support of UICN, 2 with JOCV, and 3 with MDS. 4 was set up with neighboring villages. There is a youth theater company.
	27	Sandi Coly	380	<ul style="list-style-type: none"> Village chief is a good leader and the village is united. Women leader and assistant are also backed by many people. 	<ul style="list-style-type: none"> 1 men's fresh oyster GIE, 2 women GIE, 1 beekeepers GIE, 1 ASC. There is GIE with all women in the village. 	<ul style="list-style-type: none"> Mainly Serer but Soce and Pular as well.
	28	Medina Sangako	852	<ul style="list-style-type: none"> Wealthy fisherman leader is in charge. Women leader is competent but women as a whole are not united. 	<ul style="list-style-type: none"> 1 men and women fresh oyster GIE, and 6 women shellfish processors Gs (2 of which are GIE). 1 fisheries GIE, 2 men farmers GIE, and 1 ASC. 	<ul style="list-style-type: none"> Women group is formed in each residential district.
	29	Sangako	118	<ul style="list-style-type: none"> Young men and women with a good command of French are candidates for assistant. Youths are united around ASC. 	<ul style="list-style-type: none"> Farm GIE (all the men), JOCV-backed GIE (all the women), and 1 ASC. 	<ul style="list-style-type: none"> A famous religious activist set up an Islamic and technical educational facility in the village. A traditional wrestling tournament organized by youth 2 years ago is well known.

Toubacouta County, Foudiougne Prefecture (Population data as of 1998)						
CR	No.	Village	Population	Leadership/Unity of residents	Organization	Remarks
Toubacouta	30	Nema Ba	951	<ul style="list-style-type: none"> Village chief is a patriarch type but there is also an assistant. Women are united well. 	<ul style="list-style-type: none"> 1. GIE with all the villagers; 2. 1 women GIE; and 3. 1 ASC. 2 engages collectively in labor and saves wages its members receive. 	<ul style="list-style-type: none"> 2 was organized as recipient of MC.
Toubacouta	31	Bettenty	3644	<ul style="list-style-type: none"> Village chief has good leadership skills. / CP secretary is also suitable for assistant. Women leader is unknown. 	<ul style="list-style-type: none"> 14 women processors GIE, 9 fisher folk GIE, and 2 brokers GIE. The oldest CP actively engages in natural resource management activities. 	<ul style="list-style-type: none"> Before UICN support, there was an organization that formed the core of CP. It has a regional federation with 32.
	32	Bossikang	766	<ul style="list-style-type: none"> Village chief has good leadership skills. Women leader is unknown. Young man who is CP deputy director is a candidate for assistant. 	<ul style="list-style-type: none"> 3 women processors GIE, 4 fisher folk GIE, and 1 shipbuilders GIE. There are 3 ASC and their union. CP is being set up. 	<ul style="list-style-type: none"> There is a village broadcast./Shipbuilders GIE is formed jointly with 31.
	33	Djinack Baro	467	<ul style="list-style-type: none"> Village chief of 32 is old and sick. /No meeting has been held with village chief of 33. 	<ul style="list-style-type: none"> Each village has age groups. Each age group has mutual aid fund. 	<ul style="list-style-type: none"> Both are Soce villages. Residents are united within each village, but the two villages do not get along.
	34	Djinack Diattaco	144	<ul style="list-style-type: none"> There is no information on women leader in either village. 	<ul style="list-style-type: none"> 3 fisher folk GIE./CP is being set up jointly among 2 villages. 	

Island

Source: Study mission's field survey (all population data were from county CERP)



A-2-7-1 Survey Points of Water Quality, Current and Bed Materials Survey

A-2-7-2 Results of the 1st Field Survey for Water Quality, Current and Bed Material

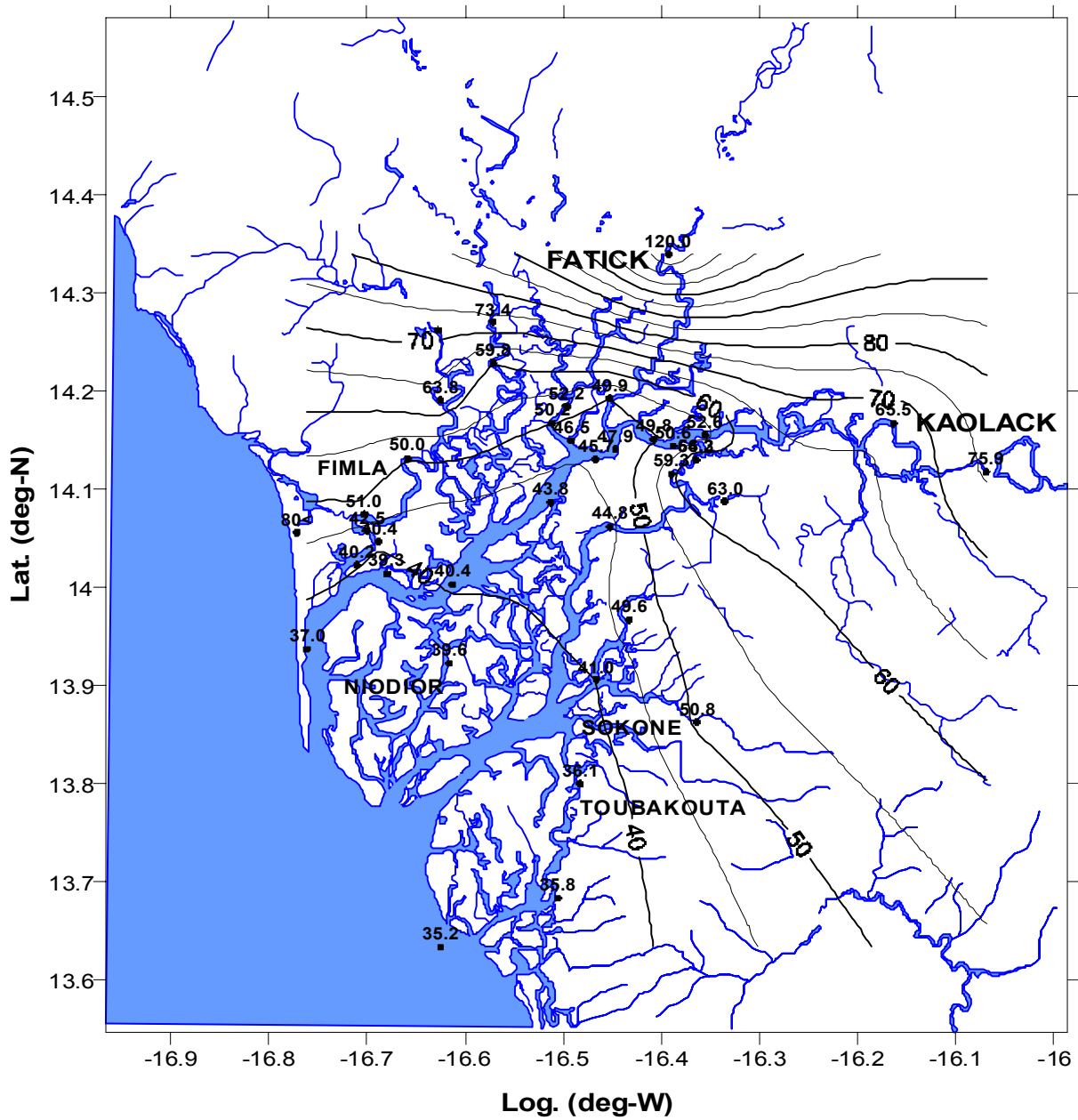
Location	Lat	Lon	Distance from Inlet	Survey Date	Survey Time	Tide Condition	Water. Depth	Water. Temp	DO	DO	EC	Salinity	Current Velocity	Current Direct.	Bed Material	Odor	Remarks
UNIT	°N	°W	Km				m	°C	%	mg/l	ms/m	ppt	m/s	up/down			
W1	13.6333	16.6250	0.0	18-Feb-02	8:52	Low	1.5	23.0	76.7	5.2	52.3	35.2			sand		Open Sea
W2	13.7997	16.4831	26.5	19-Feb-02	8:10	Low	0.5	22.9	65.9	4.6	52.3	36.1	0.2	down	mud	sulfer smell	Toubakouta
W2	13.7997	16.4831	26.5	19-Feb-02	14:28	High	2.3	24.2	68.6	4.7	54.0	35.9	0.2	up			
W3	13.9058	16.4664	22.0	20-Feb-02	8:56	Low	3.5	23.2	63.3	4.6	61.0	41.0	0.1	down	sand+mud	No smell	
W3	13.9058	16.4664	22.0	20-Feb-02	14:38	High	4.0	23.7	86.4	5.6	58.2	38.9	0.05	up			
W4	13.9667	16.4333	31.3	20-Feb-02	9:30	Low	3.5	23.4	76.1	5.0	71.5	49.6	0.1	down	sand+mud	sulfer smell	Bangaler
W4	13.9667	16.4333	31.3	20-Feb-02	15:00	High	4.0	23.8	81.6	5.2	65.4	44.4	0.02	up			
W5	14.0614	16.4525	42.0	19-Feb-02	8:42	Low	2.4	22.1	82.2	5.8	62.3	44.8	0.2	down	sand+mud	sulfer smell	Mbelane
W5	14.0614	16.4525	42.0	19-Feb-02	14:00	High	2.9	22.7	110.6	7.0	60.4	42.8	0.1	up			
W6-in	14.0874	16.3355	56.3	28-Feb-02	16:13		0.3	25.5	74.7	4.3	89.5	63.0			sand+mud	sulfer smell	
W6-out	14.0874	16.3355	56.3	18-Feb-02	9:42		0.7	20.6	55.9		140.3	80<			sand+mud	sulfer smell	Djilor
W6-out	14.0874	16.3355	56.3	28-Feb-02	16:13		0.5	31.4	27.0		197.5	80<					
W7-in	14.1298	16.3649	56.3	28-Feb-02	15:25		0.3	23.4	80.6	4.7	87.4	64.3			sand+mud	sulfer smell	
W7-out	14.1298	16.3649	56.3	18-Feb-02	8:00		0.4	20.0	57.9	3.8	72.6	56.2			sand+mud	sulfer smell	Gague Bokar
W7-out	14.1298	16.3649	56.3	28-Feb-02	15:25		0.4	24.7	50.8	2.9	80.3	56.3					
W8	13.9296	16.6112	20.0	20-Feb-02	11:00	Low	1.9	22.6	61.9	4.3	56.4	39.6	0.3	down	mud	No smell	Bassar
W8	13.9296	16.6112	20.0	20-Feb-02	14:55	High	1.8	23.9	72.8	4.9	57.7	36.9	0.15	up			
W9	14.0744	16.7028	17.5	18-Feb-02	8:40	Low	3.1	21.8	66.2	4.4	69.5	51.0	0.2	down	sand+mud	No smell	
W9	14.0744	16.7028	17.5	18-Feb-02	13:20	High	3.4	22.4	74.1	4.8	70.5	51.4	0.2	up			
W9	14.0744	16.7028	17.5	27-Feb-02	13:30	High		22.2	72.7	4.9	62.7	45.0					
W10	14.1311	16.6583	30.0	18-Feb-02	9:40	Low	6.5	21.2	70.2	4.6	67.0	50.0	0.3	down	mud	sulfer smell	
W10	14.1311	16.6583	30.0	18-Feb-02	14:00	High	6.7	22.3	79.5	5.1	68.8	50.1	0.15	up			
W11	14.2283	16.5714	58.8	19-Feb-02	9:40	Low	6.3	20.1	66.8	4.3	76.7	59.8	0.2	down	sand+mud	sulfer smell	Faoye
W11	14.2283	16.5714	58.8	19-Feb-02	14:00	High	5.9	21.1	71.9	4.7	78.2	59.9	0.5	up			
W12	13.9367	16.7614	2.0	26-Feb-02	13:55		0.5	23.9	84.3	5.7	54.6	37.0			sand		Djifere
W13	14.0555	16.7714	-	26-Feb-02	14:50		0.2	24.7	65.0		125.9	80<					
W14	14.0028	16.6133	24.8	27-Feb-02	11:00	High	10.0	23.3	69.6	4.7	58.1	40.4	0.4	up			
W15	14.1836	16.4964	51.3	1-Mar-02	9:55	Low	6.0	21.8	68.3	4.4	70.7	52.2	0.0		mud		
W16	14.1925	16.4528	54.3	28-Feb-02	11:00		0.2	22.7	70.4	4.5	69.0	49.9			mud		Niamdiarokh

Location	Lat	Lon	Distance from Inlet	Survey Date	Survey Time	Tide Condition	Water. Depth	Water. Temp	DO	DO	EC	Salinity	Current Velocity	Current Direct.	Bed Material	Odor	Remarks
UNIT	°N	°W	Km				m	°C	%	mg/l	ms/m	ppt	m/s	up/down			
WS1	13.6833	16.5056	10.5	18-Feb-02	7:38	Low	0.8	20.5	56.1	4.0	51.8	35.8	0.3	down	sand+mud	sulfer smell	Missira
WS1	13.6833	16.5056	10.5	18-Feb-02	13:15	High	2.0	23.0	74.9	5.7	52.7	35.7	2.0	up			
WS2	13.8625	16.3642	32.5	19-Feb-02	9:45	Low	0.8	17.8	19.9	1.4	63.2	50.8	0.1	down	sand+mud	No smell	Senghor
WS2	13.8625	16.3642	32.5	19-Feb-02	15:33	High	1.0	29.2	82.1	4.7	73.6	50.6	0.2	up			
WS3	14.0864	16.5131	37.3	20-Feb-02	10:45	Low	7.0	22.4	71.4	4.8	61.4	43.8	0.2	down	mud	No smell	
WS3	14.0864	16.5131	37.3	20-Feb-02	15:50	High	9.5	23.0	73.2	4.9	60.4	42.4	0.3	up			
WS4	14.1492	16.4922	45.8	20-Feb-02	9:45	Low	5.3	22.2	73.4	4.8	64.5	46.5	0.1	down	mud	No smell	
WS4	14.1492	16.4922	45.8	20-Feb-02	14:40	High	8.3	22.5	74.2	4.8	64.8	46.5	0.1	up			
WS5	14.1906	16.6253	44.8	18-Feb-02	14:32			25.2	81.6	4.8	89.0	63.8			sand+mud	No smell	
WS6	14.3394	16.3928	83.3	28-Feb-02	10:10		1.3	20.3	70.5		107.3	80<(120)	0.3	down			Fatick
WS7	14.1506	16.4083	53.8	1-Mar-02	11:00		7.5	22.8	67.1	4.3	69.1	49.8					
WS8	14.1553	16.3558	61.8	1-Mar-02	12:00		6.8	22.7	70.2	4.5	72.4	52.6					
WS9	14.1150	16.3897	53.8	28-Feb-02	16:35		0.2	29.3	79.7	4.2	90.7	59.3			mud	No smell	
WS10	14.1667	16.1636	90.0	2-Mar-02	11:20			22.8	53.2	3.1	87.9	65.5					
WS11	14.1175	16.0692	108.0	2-Mar-02	10:50			22.8	66.2	3.7	99.1	75.9					Kaolack
WS12	14.2617	16.6275	-	19-Feb-02	8:32		0.5	20.2	42.2	3.6	7.8	4.8	0.0		sand	No smell	Djilos
WS13	14.2700	16.5719	65.0	19-Feb-02	10:20			19.9	9.7	0.6	91.2	73.4			sand+mud	No smell	Sing
WS14	14.1303	16.4672	44.8	17-Feb-02	16:20		0.2	26.9	69.2	4.3	67.2	45.7					Foundiougne
WS15	14.1408	16.4469	47.8	20-Feb-02	11:45		7.1	22.4	66.3	4.4	69.9	47.9			mud		
WS16	14.0228	16.7103	8.0	27-Feb-02	9:15	High	5.2	22.6	70.5	4.8	57.3	40.2	0.3	up			
WS17	14.0467	16.6881	12.0	27-Feb-02	12:45		3.1	23.0	69.3	4.7	57.8	40.4					
WS18	14.0575	16.0700	16.0	27-Feb-02	13:00			22.5	72.2	4.9	59.9	42.5					
WS19	14.0136	16.6797	14.8	27-Feb-02	10:00	High		22.3	72.9	5.1	55.7	39.3	0.4	up			
WS20	14.1667	16.5117	48.3	1-Mar-02	10:30	High	12.7	22.0	68.3	4.5	68.6	50.2	0.10	up	mud		
WS21	14.1437	16.3877	56.8	18-Feb-02	10:00		1.9	23.0	126.6	6.7	70.4	50.6					

A-2-7-3 Results of the 2nd Field Survey for Water Quality and Current

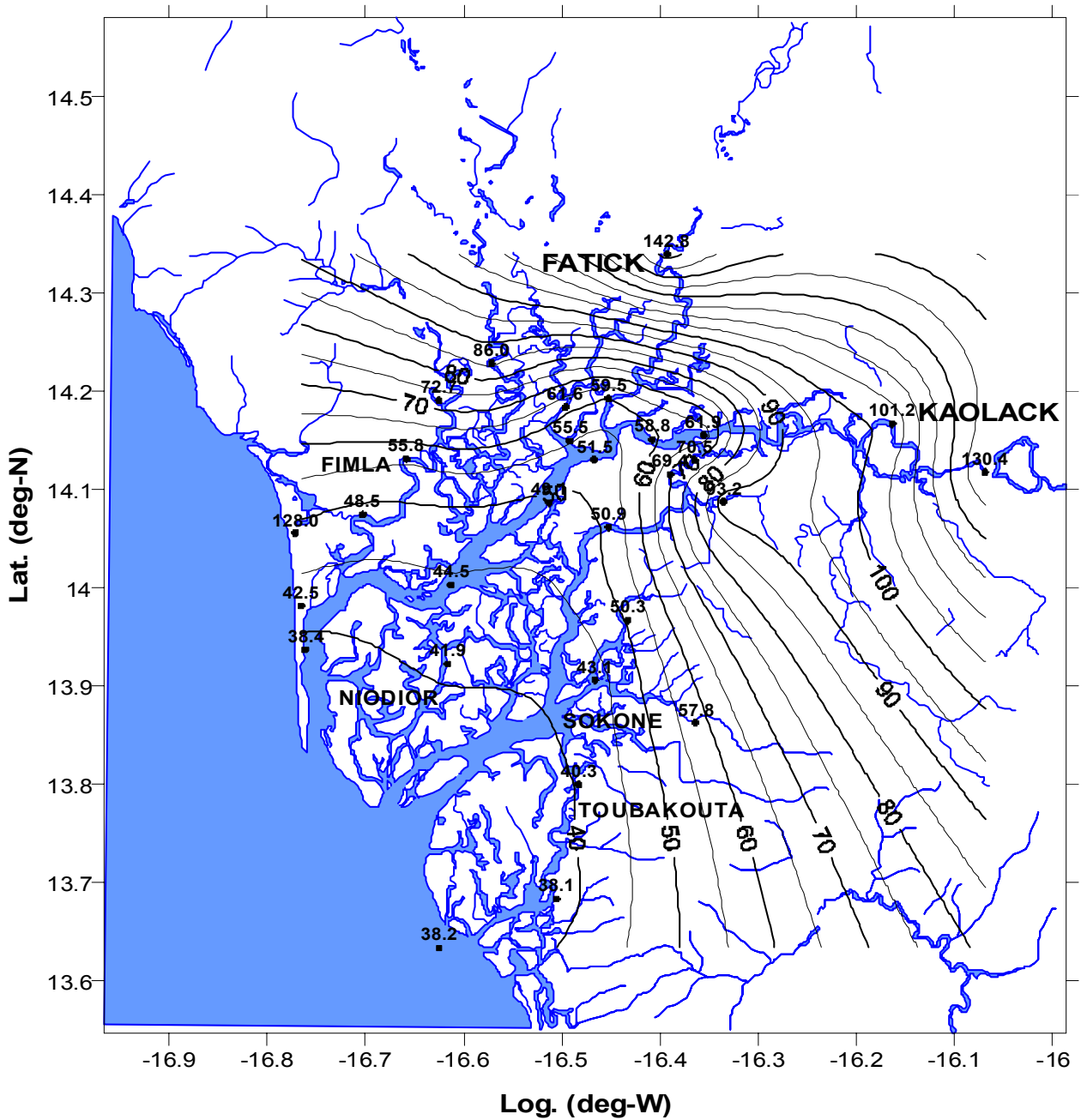
Location	Lat	Lon	Distance from Inlet	Survey Date	Survey Time	Tide Condition	Water. Depth	Water. Temp	DO	DO	EC	Salinity	Current Velocity	Current Direct.	Remarks
UNIT	°N	°W	Km				m	°C	%	mg/l	ms/m	ppt	m/s	up/down	
W1	13.6333	16.6250	0.0	13-Jun-02	9:12	Low	2.9	28.2	73.6	4.6	59.9	38.2	0.5		Open Sea
W2	13.7997	16.4831	26.5	14-Jun-02	7:01	Low	1.8	28.7	50.8	3.2	64.8	40.5	0.2	up	Toubakouta
W2	13.7997	16.4831	26.5	14-Jun-02	14:44	High	2.4	29.5	71.8	4.3	65.5	40.0	0.3	down	
W3	13.9058	16.4664	22.0	15-Jun-02	7:47	Low	7.6	28.7	59.4	3.4	71.7	45.4	0.1	up	
W3	13.9058	16.4664	22.0	15-Jun-02	14:34	High	3.2	29.2	83.1	5.1	65.7	40.8	0.3	down	
W4	13.9667	16.4333	31.3	15-Jun-02	8:44	Low	4.3	28.3	63.8	3.7	81.6	53.1	0.4	up	Bangaler
W4	13.9667	16.4333	31.3	15-Jun-02	13:30	High	4.3	29.8	73.1	4.3	75.8	47.4	0.4	down	
W5	14.0614	16.4525	42.0	14-Jun-02	10:35	Low	3.0	28.8	76.2	4.4	78.4	50.4	0.6	up	Mbelane
W5	14.0614	16.4525	42.0	14-Jun-02	16:00	High		32.7	86.3	4.7	85.4	51.3			
W6-in	14.0874	16.3355	56.3	26-Jun-02	9:50	Low	0.2	28.3	55.5		141.0	117.0			Djilor
W6-in	14.0874	16.3355	56.3	26-Jun-02	15:38	High	0.2	31.7	79.1	4.1	108.7	69.4			
W6-out	14.0874	16.3355	56.3	26-Jun-02	9:34	Low	0.2	29.5	30.3		167.1	159.0			Djilor
W6-out	14.0874	16.3355	56.3	26-Jun-02	15:32	High	0.2	31.3	72.0		167.9	91.2			
W7-in	14.1298	16.3649	56.3	26-Jun-02	10:15	Low	0.2	27.2	65.6	3.5	101.9	70.7			Gague Bokar
W7-in	14.1298	16.3649	56.3	26-Jun-02	16:00	High	0.2	29.9	84.2	4.3	106.8	70.4			
W7-out	14.1298	16.3649	56.3	26-Jun-02	10:07	Low	0.2	27.0	55.6	3.0	94.7	65.1			Gague Bokar
W7-out	14.1298	16.3649	56.3	26-Jun-02	15:52	High	0.2	30.8	96.0	4.8	104.0	67.6			
W8	13.9296	16.6112	20.0	16-Jun-02	12:15	Low	1.5	29.5	53.7	3.3	68.0	42.1	0.2	up	Bassar
W8	13.9296	16.6112	20.0	16-Jun-02	14:40	High	2.2	29.3	53.9	3.2	67.1	41.6	0.3	up	
W9	14.0744	16.7028	17.5	13-Jun-02	9:07	Low	2.5	27.8	78.9	4.6	78.3	51.2	0.2	up	
W9	14.0744	16.7028	17.5	13-Jun-02	15:10	High		29.3	80.4	4.8	72.7	45.8			
W10	14.1311	16.6583	30.0	13-Jun-02	10:00	Low	0.3	28.2	62.0	3.6	86.8	57.3	0.3	up	
W10	14.1311	16.6583	30.0	13-Jun-02	15:40	High	0.3	29.2	78.6	4.4	84.2	54.2	0.1	down	
W11	14.2283	16.5714	58.8	13-Jun-02	10:45	Low	0.2	27.5	70.1	2.8	113.6	97.8	0.2	up	Faoye
W11	14.2283	16.5714	58.8	13-Jun-02	16:20	High	0.2	30.9	76.2	3.6	113.6	74.3			
W12	13.9367	16.7614	2.0	14-Jun-02	10:20	Low	2.5	27.9	72.0	4.6	60.4	38.1			Djifere
W12	13.9367	16.7614	2.0	14-Jun-02	16:37	High	1.0	30.2	92.0	5.6	63.8	38.6	0.4	down	Djifere
W13	14.0555	16.7714	-	14-Jun-02	10:00		0.2	27.9	84.8		139.3	128.0			
W14	14.0028	16.6133	24.8	16-Jun-02	10:45	Low	9.2	28.6	72.6	4.3	72.4	46.1	0.5	up	
W14	14.0028	16.6133	24.8	16-Jun-02	15:22	High	10.5	28.9	85.0	5.2	68.3	42.9	1.0	down	

Location	Lat	Lon	Distance from Inlet	Survey Date	Survey Time	Tide Condition	Water. Depth	Water. Temp	DO	DO	EC	Salinity	Current Velocity	Current Direct.	Remarks
UNIT	°N	°W	Km				m	°C	%	mg/l	ms/m	ppt	m/s	up/down	
W15	14.1836	16.4964	51.3	16-Jun-02	11:00	Low	6.5	27.8	65.8	3.4	98.0	66.8	0.0	up	
W15	14.1836	16.4964	51.3	16-Jun-02	16:00	High	7.0	28.9	77.5	4.4	86.8	56.4	0.5	up	
W16	14.1925	16.4528	54.3	15-Jun-02	10:15	Low	0.5	25.2	56.8	3.2	86.6	61.1	0		Niamdiarokh
W16	14.1925	16.4528	54.3	15-Jun-02	15:00	High	0.9	29.9	87.1	4.8	90.1	57.9	0.2	down	Niamdiarokh
WS1	13.6833	16.5056	10.5	13-Jun-02	7:29	Low	1.5	26.2	60.0	3.9	58.3	37.8	0.3	up	Missira
WS1	13.6833	16.5056	10.5	13-Jun-02	13:53	High	2.6	29.2	69.5	4.5	61.5	38.4	0.2	down	
WS2	13.8625	16.3642	32.5	14-Jun-02	7:47	Low	1.2	24.7	50.0	3.0	82.1	58.0	0.4	up	Senghor
WS2	13.8625	16.3642	32.5	14-Jun-02	13:45	High	1.3	31.9	87.3	4.7	93.3	57.5	0.4	down	
WS3	14.0864	16.5131	37.3	16-Jun-02	12:35	Low	8.2	29.1	73.3	4.2	79.9	51.2	0.4	up	
WS3	14.0864	16.5131	37.3	16-Jun-02	15:50	High		29.3	78.3	4.6	74.7	47.0	0.3	down	
WS4	14.1492	16.4922	45.8	16-Jun-02	11:50	Low	6.1	28.4	69.4	3.9	89.2	58.9	0.4	up	
WS4	14.1492	16.4922	45.8	16-Jun-02	16:40	Low		29.1	78.6	4.6	81.4	52.1	0.1	up	
WS5	14.1906	16.6253	44.8	13-Jun-02	14:32	High	0.2	31.4	81.9	4.0	112.6	72.7	0.2	down	
WS6	14.3394	16.3928	83.3	15-Jun-02	10:10		0.2	27.3	68.3		155.0	142.8	0.5	down	Fatick
WS7	14.1506	16.4083	53.8	16-Jun-02	9:00	Low	1.6	26.6	66.0	3.6	86.9	59.3	0		
WS7	14.1506	16.4083	53.8	16-Jun-02	15:40	High	1.7	30.0	80.6	4.5	91.1	58.3	0.4	down	
WS8	14.1553	16.3558	61.8	16-Jun-02	8:10	Low	1.8	27.3	69.9	3.9	90.6	61.4	0		
WS8	14.1553	16.3558	61.8	16-Jun-02	15:10	High	5.1	29.9	89.2	4.8	96.3	62.4	0.4	down	
WS9	14.1150	16.3897	53.8	26-Jun-02	10:30	Low	0.2	28.6	44.0	2.0	101.5	68.2			Gague Modi
WS9	14.1150	16.3897	53.8	26-Jun-02	16:15	High	0.2	35.7	50.3	2.3	118.5	70.6			
WS10	14.1667	16.1636	90.0	15-Jun-02	11:20		0.2	27.9	56.3		115.9	101.2			
WS11	14.1175	16.0692	108.0	15-Jun-02	10:50		0.2	28.9	82.3		136.8	130.4	0.5	down	Kaolack
WS14	14.1303	16.4672	44.8	26-Jun-02	11:00	Low	0.2	28.3	67.3	4.0	80.5	52.4			Foundiougne
WS14	14.1303	16.4672	44.8	26-Jun-02	16:35	High	0.2	29.9	68.1	3.9	80.5	50.7			
WS22	13.9814	16.7653	10.0	14-Jun-02	10:40	Low		26.9	61.4	3.8	65.8	42.9			
WS22	13.9814	16.7653	10.0	14-Jun-02	17:06	High		30.6	68.6	4.0	69.5	42.2			



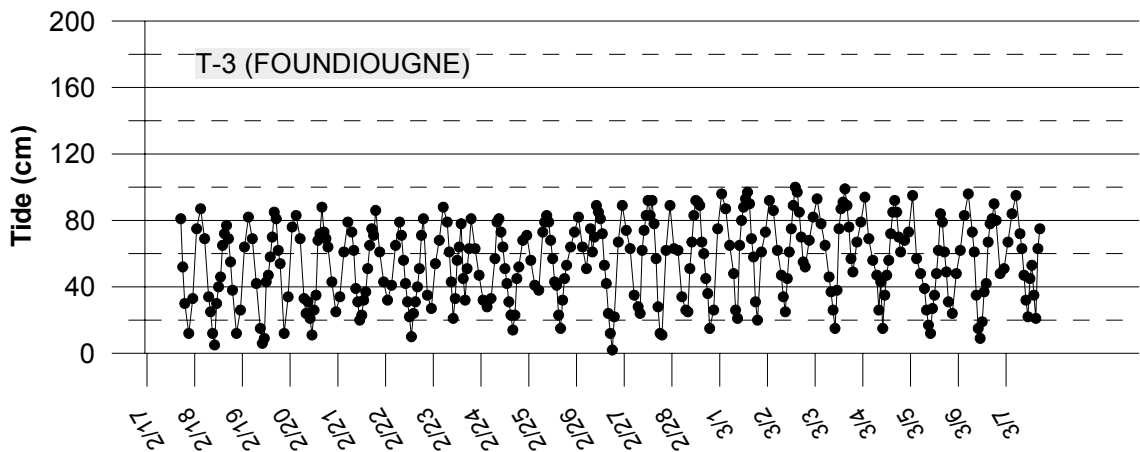
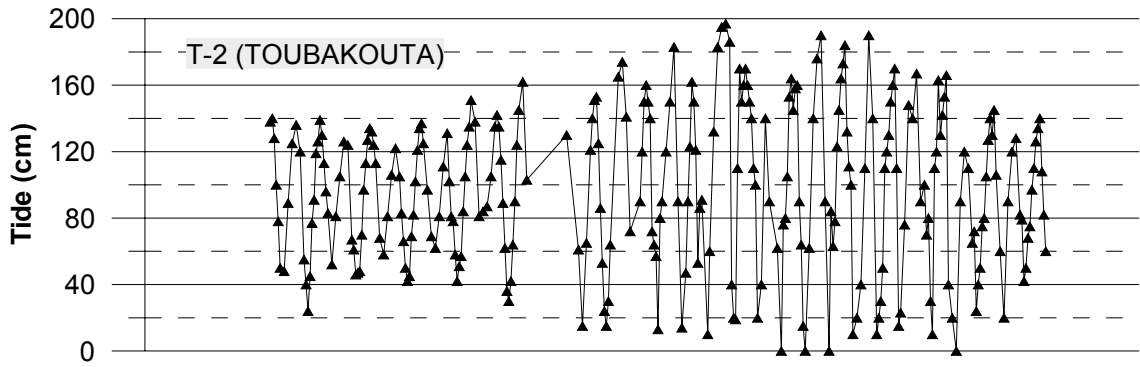
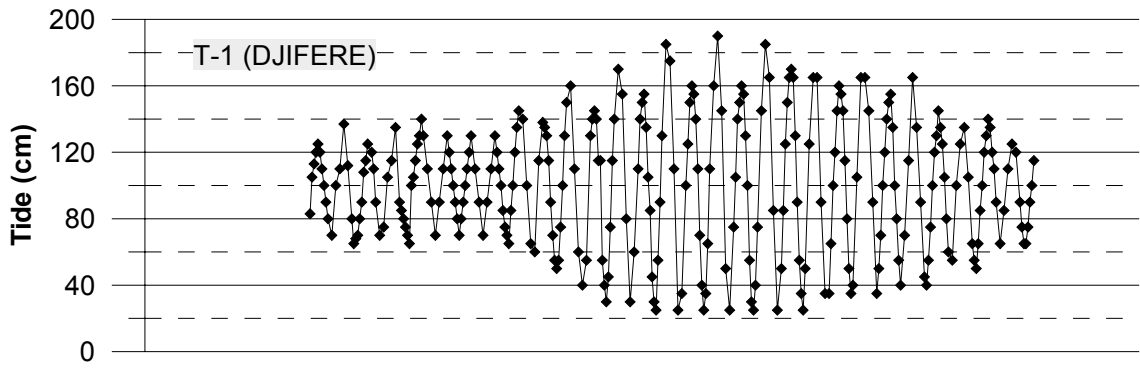
Salinity Unit: ppt

A-2-7-4 Distribution of Salinity in the Saloum Delta (February, 2002)



Salinity Unit: ppt

A-2-7-5 Distribution of Salinity in the Saloum Delta (June, 2002)



A-2-7-6 Changes of Tide Level in the Saloum Delta (February to March, 2002)

A-2-8-1 Estimation of CO₂ Absorption Volume

The IPCC Guidelines suggest the use of the following expression to estimate the CO₂ absorption volume.

$$\text{Annual CO}_2 \text{ absorption volume} = \text{annual growth (m}^3\text{)} \times \text{enlargement coefficient} \times \text{specific density} \times \text{carbon content} \times \text{carbon conversion factor}$$

The CO₂ absorption volume in the Study Area is estimated below using the above expression.

[CO₂ absorption volume of existing mangrove forests]

The values required for this estimation are given below.

Item	Value	Basis
Area	64,286 ha	Total area of mangrove forests in the Study Area
Mean Annual Growth	1.1 m ³	Volume per ha [3m^3 (increment)/ 81m^3 (volume of high forest) x $31\text{m}^3 = 1.1\text{m}^3$]
Enlargement Factor	2.15	Biomass proportion in leaves and buds: 15% (based on the existing report); biomass proportion in roots: 100% (The biomass proportion in underground parts of mangrove is high and double that of ordinary trees is assumed).
Specific Gravity	1.0	The specific gravity of raw mangrove wood is 1.4 while that of dried wood is 1.0 (meaning $1\text{ m}^3 = 1\text{ ton}$).
Carbon Content	0.5	The common carbon content of wood is 50%.
Carbon Conversion Factor to CO ₂	3.667	Molecular weight of C: 12 Molecular weight of CO ₂ : 44 $44/12 = 3.667$

Using these values, the annual CO₂ absorption volume per ha is 4.3362275 tons ($1.1 \times 2.15 \times 1.0 \times 0.5 \times 3.667$). The total annual CO₂ absorption volume in the Study Area is estimated to be 278,759 tons ($4.3362275\text{ tons/ha} \times 64,286\text{ ha}$).

A-3-1-1 List of Target Villages of the Project

RC. Diossong			RC. Toubacouta		RC. Djiirnda		RC. Bassoul		RC. Dionouar		RC. Fimla				
	Village	Population		Village	Population		Village	Population		Village	Population		Village	Population	
1	Ndiaye Ndiaye Serere	179	1	Sipo	42	1	Velingara	63	1	Siwo	483	1	Falia	586	
2	Bambougar Massamba	237	2	Bakadadji	88	2	Rofangué	146	2	Diogane	780	2	Dionouar	3953	
3	Bouli	256	3	Daga Bera	106	3	Maya*	274	3	Tialane	834	3	Niodior	5517	
4	Ndienghene Madi	263	4	Sangako	118	4	Fambine	315	4	Bassar	1536	3 villages 10056 1006 househols	4	Mar Soulou	343
5	Bangalere	431	5	Keur Sambel	130	5	Babout	612	5	Bassoul	3723		4	Mbissel	458
6	Bambougar Malick	491	6	Djinack Diatako	144	6	Diamniadio	684	5 villages 7356 736 househols		5		Djilor	589	
7	Lerane Koly	609	7	Sourou	168	7	Ngador	690			6		Ndangane	795	
7 villages 2466 247 househols			8	Ndiambang	308	8	Djiirnda	1252			7		Mar Lodj	1316	
			9	Soukouta	342	9	Moundé	1291			8	Fimla	1668		
			10	Dassilame Sérère	346	9 villages 5327 533 househols		9			Simal	1749			
			11	Ndofane	364			10	Mar Fafaco	2022					
			12	Sandikoli	380			10 villages Mainland 5640 parsons Island 3681 parsons							
13	Djinack Bara	467													
14	Badoudou	513													
15	Bani	627													
16	Bossinkang	766													
17	Médina Sangako	852	18	Nema Bah	951	19	Toubakouta	1142							
10	9321	21 villages Mainland 8285 parsons Island 4452 parsons	20	Missira	1239	21	Bettenti	3644							
2	1010	12737	829househols	445househols											
5	3364	12737													
28	16977														
2	5264														
3	1261														
95	Sub-total														
3Com	75139														
	30909														
	106048														

RC. Djilass			RC. Palmarin Fakao			RC. Djilor			RC. Nguekokh			RC. Malicounda I			Commune		
	Village	Population		Village	Population		Village	Population		Village	Population		Village	Population		Commune	Population
1	Roh	176	1	Palmarin Diakhanor	353	1	Keur Pate	57	1	Somone	1493	1	Keur Mbat		1	Sokone*	8552
2	Faoye	834	2	Palmarin Nguethie	412	2	Keur Nghary	92	2	Guéréw	3771	2	Diagle		2	Foundiougne*	3354
		1010	3	Palmarin Ngallou	777	3	Bambou*	99			5264	3	PointeSarene*	1261	3	Joal Fadiout*	19003
	2 villages	101 househols	4	Palmarin Fakao	810	4	Keur Djindak	105		2 villages	526 househols			1261			30909
			5	Palmarin Sessène	1012	5	Ngamsa	125					3 villages	126 househols		3 Communes	855 househols
					3364	6	Bayi	150									335 househols
					336 househols	7	Sap	154									1900 househols
						8	Kamatane Bambara	212									
						9	Keur Yoro	234									
						10	Mbelane	250									
						11	Keur Cheïkhou	259									
						12	Felir	274									
						13	Gagué Chérif	286									
						14	Pethie	289									
						15	Fayako	315									
						16	Keur Omar	366									
						17	Keur Dabo	432									
						18	Gagué Bokar	484									
						19	Goudeme Sidi	516									
						20	Ndorong Log	618									
						21	Sadioga	713									
						22	Gagué Modi	736									
						23	Félane	748									
						24	Tiaré	944									
						25	Mbassis	1277									
						26	Mbam	1793									
						27	Djilor	1865									
						28	Soum 1, 2	3584									
								16977									
							28 villages	1698 househols									

A-3-2-1 Suitable Sites for Planting Based on Salinity

Zone	Salinity	Suitability	RC or Village	Village	Class	Salinity	Suitability	RC or Village	Village
I	~4.5%	Rhizophora: Suitable Avicennia: Suitable	Bassoul	Bassar	II	4.5%~6.0%	Rhizophora: Medium Avicennia: Medium	Sokone	
				Bassoul				Foundiougne	
				Diogane				Diossong	Bambougar Malick
				Siwo					Bambougar Massamba
				Tialiane					Bangaler
			Joal					Djilor	Félane
			Dionouar	Dionouar					Felir
				Falia					Keur Dabo
				Niodior				Mbam	
			Djirnda	Djirnda				Mbelane	
				Fambine				Ndorong Log	
				Maya				Sap	
				Moundé				Soum 1	
				Ngadior				Soum 2	
			Malikounda	Diagle				Thiaré	
				Keur Mbat				Djirnda	Bout
				Pointe Sarene					Diamniadio
			Guéréw	Rofangué					
			Nguekokh	Somone				Velingara	
				Palmarin Fakao				Djilor	Djilor
			Fimela						
			Mar Fafako						
			Mar Lodj						
			Mar Soulou						
			Toubacouta	Bakadadji				Mbissel	
				Bani				Ndangane	
				Betanti				Ndangane campement	
				Bossikang				Toubacouta	Badoudou
				Dassilame Sérère					Daga Bera
				Djinack Diattako					Keur Sambel
				Djinakh Bara					Ndiambang
				Médina Sangako					Ndofane
				Missira					Sandikoli
				Nema Ba					Djilass
				Sangako				Bambou	
				Sipo				Bayi	
				Soukouta				Fayako	
				Sourou				Gagué Bokar	
				Toubakouta				Gagué Chérif	
				Gagué Modi					
				Keur Cheikhou					
				Keur N'ghari					
	Mbassis								
	Pethie								
	Sadioga								
	Fimela	Kobongoye 2							
		Simal							
III	6.0%~8.0%	Rhizophora: Unsuitable Avicennia: Growth Possible	Djilor						
IV	8%~	Rhizophora: Unsuitable Avicennia: Unsuitable	Djilor	Djilass	Faoye				
					Kamatane Bambara				
					Keur Djindak				
					Keur Omar				
					Keur Pate				
					Keur Yoro				
					Ngamsa				

A-3-2-2 Possible Area for Planting and Planned Area for Planting

Zone	RC or Village	Village	Plantable Coastal Length (Km)	Plantable Area (ha)	Planned Planting Area			Exisating Plantations		Population		
					Rhizophora	Avicennia	Total	Planted Area (ha)	Supporting NGO			
Conservation	I	Toubacouta	Bakadadji					-	UICN	88		
			Djinakh Bara							467		
			Djinack Diattako								144	
			Sub-total								699	
	II	Toubacouta	Betanti	5	25	2.5		2.5	-	UICN	3644	
			Bossikang	2	20	2.5		2.5			766	
			Sipo	1	5	2.5		2.5			42	
			Sub-total	8	50	7.5	0	7.5			4452	
	III	Commune	Sokone								8552	
		Diossong	Bambougar Malick	3	10	2.5		2.5			491	
			Bambougar Massamba	3	10	2.5		2.5			237	
			Bangaler	3	10	2.5		2.5			431	
			Bouli								256	
			Lerane Koli								609	
			Ndiaye Ndiaye Serere								179	
			Ndienghene Madi								263	
			Sub-total	9	30	7.5	0	7.5			2466	
		Toubacouta	Badoudou	5	15	2.5		2.5			513	
			Bani	1	5	2.5		2.5	1	WAAME	627	
			Daga Bera								106	
			Dassilame Sérère	1	5		1	1			346	
			Keur Sambel	1	5	2.5		2.5			130	
			Médina Sangako	4	20	2.5		2.5	-	UICN	852	
			Missira	1	5	2.5		2.5	-	UICN	1239	
			Ndiambang	2	10	2.5		2.5			308	
			Ndofane								364	
			Nema Ba	1	5	2.5		2.5	-	UICN	951	
			Sandikoli	5	20	2.5		2.5			380	
			Sangako	4	20	2.5		2.5	-	UICN	118	
			Soukouta	3	15	2.5		2.5	-	UICN	342	
			Sourou	1	5	2.5		2.5			168	
			Toubakouta	2	10	2.5		2.5			1142	
			Sub-total	31	140	30	1	31			7586	
			Bassoul	Bassar	3	15	2.5		2.5	9	UICN	1536
				Bassoul	3	15	2.5		2.5	8	UICN	3723
		Diogane		7	35	2.5		2.5	4	UICN	780	
		Siwo		1	10	2.5		2.5	3	UICN	483	
		Tialiane		3	15	2.5		2.5	3	UICN	834	
		Sub-total		17	90	12.5	0	12.5			7356	
		Dionouar	Dionouar	4	20	2.5		2.5	1	UICN	3953	
			Falia	3	20	2.5		2.5	5	UICN	586	
			Niodior	4	20	2.5		2.5	11	UICN	5517	
			Sub-total	11	60	7.5	0	7.5			10056	
		Djirnda	Djirnda	5	20	2.5		2.5	15	UICN	1252	
			Fambine	3	10	2.5		2.5	-	UICN	315	
			Maya	3	10	2.5		2.5	22	UICN	274	
			Moundé	5	10	2.5		2.5	-	UICN	1291	
			Ngadior	5	10	2.5		2.5	-	UICN	690	
			Sub-total	21	60	12.5	0	12.5			3822	
		Sub-total			89	380	70	1	71		39838	

Zone	RC or Village	Village	Plantable Coastal Length (Km)	Plantable Area (ha)	Planned Planting Area			Exisating Plantations		Population	
					Rhizophora	Avicennia	Total	Planted Area (ha)	Supporting NGO		
Rehabilitation	Comune	Joal								19003	
	Comune	Foundiougne								3354	
	Malikounda	Pointe Sarene	3	20	2.5		2.5			1261	
		Diagle									
		Keur Mbat									
		Sub-total		20	2.5	0	2.5			1261	
	Nguekokh	Guéréw								3771	
		Somone	5	10		1	1	-		1493	
		Sub-total	5	10		1	1			5264	
	Djilor	Bambou								99	
		Bayi								150	
		Djilor	2	5			0			1865	
		Fayako	9	45		1	1	7	WAAME	315	
		Félane	2	10	2.5		2.5			748	
		Felir	2	5	2.5		2.5	-	UICN	274	
		Gagué Bokar	4	15		1	1	3	WAAME	484	
		Gagué Chérif	8	40		1	1	5	WAAME	286	
		Gagué Modi	2	5		1	1	1	WAAME	736	
		Goudeme Sidi								516	
		Kamatane Bambara	3	15			0	1	WAAME	212	
		Keur Cheikhou	3	10		1	1	2	WAAME	259	
		Keur Dabo								432	
		Keur Djindak	1	5			0	1	WAAME	105	
		Keur N'ghari	2	10		1	1	-	WAAME	92	
		Keur Omar						-	WAAME	366	
		Keur Pate	2	10			0	-	WAAME	57	
		Keur Yoro	2	10			0	3	WAAME	234	
		Mbam	4	20		1	1	17	WAAME	1793	
		Mbassis	5	15		1	1	3	WAAME	1277	
		Mbelane	4	10	2.5		2.5	2	WAAME	250	
		Ndorong Log	3	10	2.5		2.5	2	WAAME	618	
		Ngamsa	1	5			0	1	WAAME	125	
		Pethie	3	15			1	1	-	WAAME	289
		Sadioga	2	10			1	1	3	WAAME	713
		Sap						2	WAAME	154	
		Soum 1	5	20			1	1	-	WAAME	1124
		Soum 2							-	WAAME	2460
		Thiaré	3	10			1	1	2	WAAME	944
		Sub-total		72	300	10	12	22			16977
	Djilass	Faoye						-	UICN	834	
		Roh	10	30		1	1	6	FIOD	176	
		Sub-total	10	30	0	1	1			1010	
	Djirnda	Bout	3	10	2.5		2.5	1	UICN	612	
		Rofangué	5	15	2.5		2.5	3	UICN	146	
		Velingara	1	5	2.5		2.5	3	UICN	63	
		Sub-total	9	30	7.5	0	7.5			821	
	Sub-total		96	390	20	14	34			47690	

Zone	RC or Village	Village	Plantable Coastal Length (Km)	Plantable Area (ha)	Planned Planting Area			Exisating Plantations		Population		
					Rhizophora	Avicennia	Total	Planted Area (ha)	Supporting NGO			
Rehabilitation	II	Fimela	Djilor	10	60	2.5		2.5	-	CAREM	589	
			Fimela	7	30	2.5		2.5	-	CAREM	1668	
			Kobongoye 2									152
			Mar Fafako	10	50	2.5		2.5	-			2022
			Mar Lodj	2	10	2.5		2.5	-			1316
			Mar Soulou	4	10	2.5		2.5	-			343
			Mbissel									458
			Ndangane	5	20	2.5		2.5	-	Yungal		795
			Ndangane campement									229
			Simal	10	60	2.5		2.5	209	FIOD		1749
			Sub-total		48	240	17.5	0	17.5			9321
	Palmarin Fakao	Palmarin Diakhanor	5	20	2.5		2.5	4	UICN		353	
		Palmarin Facao	3	10	2.5		2.5	1	UICN		810	
		Palmarin Ngallou	3	10	2.5		2.5	1	UICN		777	
		Palmarin Nguethie	3	10	2.5		2.5				412	
		Palmarin Sessène									1012	
		Sub-total		14	50	10	0	10			3364	
	Djirnda	Diamniadio	7	30	2.5		2.5				684	
	Sub-total		69	320	30	0	30				13369	
	Total			262	1140	127.5	15	142.5			106048	

Firstly, the plantable coastal length was measured using aerial photographs (taken in 1989) and a topographical map (scale: 1 to 50,000). The possible planting width was then estimated based on the gradient of the land to estimate the plantable area.

A-3-2-3 Project Cost Regarding Planting of Mangrove by Year and RC

(Unit : 1000CFA)

Zone	RC	Status	Species	Year										
				1	2	3	4	5	6	7	8	9	10	
Conservation	II	Toubacouta	Planting	R	162	132	132	132	132	132	132	132	132	132
		Diossong	Planting	R	162	132	132	132	132	132	132	132	132	132
		Toubacouta	Planting	R	648	528	528	528	528	528	528	528	528	528
				A	266	84	84	84	84	84	84	84	84	84
			Sub-toal		914	612	612	612	612	612	612	612	612	612
		III	Bassoul	Planting	R	270	220	220	220	220	220	220	220	220
			Dionouar	Planting	R	162	132	132	132	132	132	132	132	132
			Djirnda	Planting	R	270	220	220	220	220	220	220	220	220
			Sub-toal	Planting	R	1,512	1,232	1,232	1,232	1,232	1,232	1,232	1,232	1,232
					A	266	84	84	84	84	84	84	84	84
			Sub-toal		1,778	1,316	1,316	1,316	1,316	1,316	1,316	1,316	1,316	
Rehabilitation	I	Malikounda	Planting	R	54	44	44	44	44	44	44	44	44	
				A	0	0	0	0	0	0	0	0	0	
				Sub-toal		54	44	44	44	44	44	44	44	44
		Ngueniene	Planting	R	0	0	0	0	0	0	0	0	0	
				A	0	0	0	0	0	0	0	0	0	
			Sub-toal		0	0	0	0	0	0	0	0	0	
		Nguekokh	Planting	R	0	0	0	0	0	0	0	0	0	
				A	266	84	84	84	84	84	84	84	84	
			Sub-toal		266	84	84	84	84	84	84	84	84	
		Djilor	Planting	R	216	176	176	176	176	176	176	176	176	
				A	3,192	1,008	1,008	1,008	1,008	1,008	1,008	1,008	1,008	
			Sub-toal		3,408	1,184	1,184	1,184	1,184	1,184	1,184	1,184	1,184	
		Djilass	Planting	R	0	0	0	0	0	0	0	0	0	
				A	266	84	84	84	84	84	84	84	84	
			Sub-toal		266	84	84	84	84	84	84	84	84	
		Djirnda	Planting	R	162	132	132	132	132	132	132	132	132	
				A	0	0	0	0	0	0	0	0	0	
			Sub-toal		162	132	132	132	132	132	132	132	132	
	Sub-toal	Planting	R	432	352	352	352	352	352	352	352	352		
			A	3,724	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176		
		Sub-toal		4,156	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528		
	II	Fimela	Planting	R	378	308	308	308	308	308	308	308		
				A	0	0	0	0	0	0	0	0	0	
			Sub-toal		378	308	308	308	308	308	308	308	308	
	Palmarin Fakao	Planting	R	216	176	176	176	176	176	176	176	176		
			A	0	0	0	0	0	0	0	0	0		
		Sub-toal		216	176	176	176	176	176	176	176	176		
	Djirnda	Planting	R	54	44	44	44	44	44	44	44	44		
			A	0	0	0	0	0	0	0	0	0		
		Sub-toal		54	44	44	44	44	44	44	44	44		
	Sub-toal	Planting	R	648	528	528	528	528	528	528	528	528		
			A	0	0	0	0	0	0	0	0	0		
		Sub-toal		648	528	528	528	528	528	528	528	528		
	Total	Planting	R	2,754	2,244	2,244	2,244	2,244	2,244	2,244	2,244	2,244		
			A	3,990	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260		
			Sub-toal		6,744	3,504	3,504	3,504	3,504	3,504	3,504	3,504	3,504	

R=Rhizophora, A=Avicennia

