

Department of Fisheries
Ministry of Agriculture, Livestock and Fisheries
Republic of Benin

**THE STUDY
ON
THE PROMOTION OF INLAND AQUACULTURE
FOR RURAL DEVELOPMENT
IN
THE REPUBLIC OF BENIN**

FINAL REPORT

MARCH 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

**OVERSEAS AGRO FISHERIES CONSULTANTS CO., LTD.
INTEM CONSULTING INC.**

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PREFACE

In response to a request from the Government of the Republic of Benin, the Government of Japan decided to conduct a development study on the promotion of inland aquaculture and entrusted the study to the Japan International Cooperation Agency (JICA).

From April 2007 to February 2009, JICA sent to Benin a study team led by Mr. Masashi SATO of Overseas Agro-Fisheries Consultants Co., Ltd.

The team held discussions with concerned officials from the Government of Benin, and conducted a field survey at the study area. After the team returned to Japan, further studies were made, and as a result, the present report was finalized.

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

I wish to express my sincere appreciation to the concerned officials of the Government of the Republic of Benin for their close cooperation extended to the team.

March 2009

Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

Dear Mr. Matsumoto

We are pleased to submit to you the Study Report on the promotion of inland aquaculture for rural development in the Republic of Benin.

This study report is a compilation of the study results conducted by the study team, with close relations with the Department of Fishery, Ministry of Agriculture, Livestock and Fishery and concerned organizations during the two-year period from April 2007 to March 2009. It consists of the orientation and concrete programs of the promotion of inland aquaculture for improvement of rural livelihood.

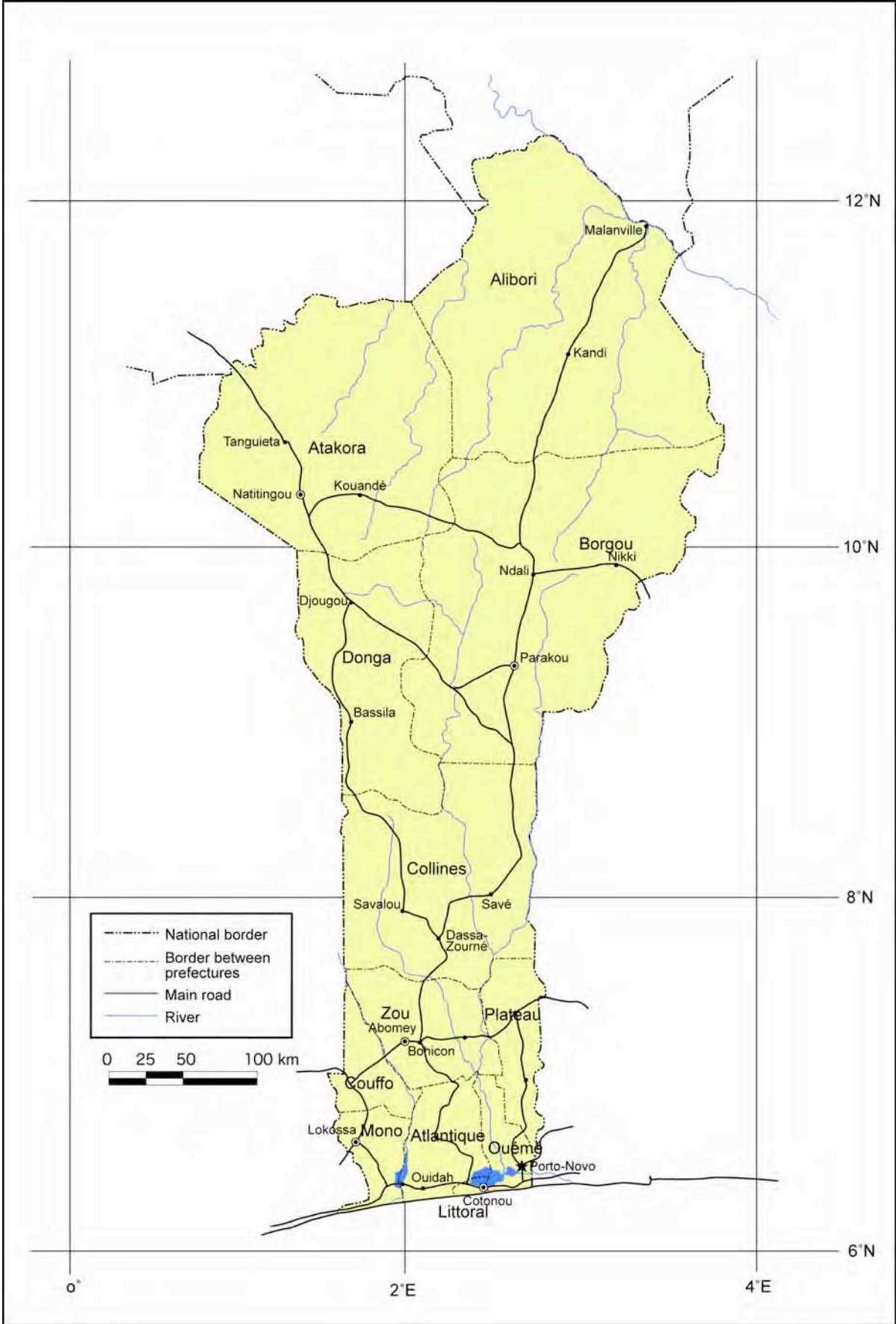
We would like to express our sincere appreciation for the great understanding and cooperation received from concerned officials from the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fishery as well as from your agency, during the study period. Additionally, as for the Government of the Republic of Benin, we would like to note the respectful cooperation that we received from the Department of Fisheries and other concerned officials of the Government. Moreover, we would like to express our gratitude to the personnel of Benin office of your agency for their valuable advice and support.

Finally, we hope that this report will contribute to your further promotion of the project.

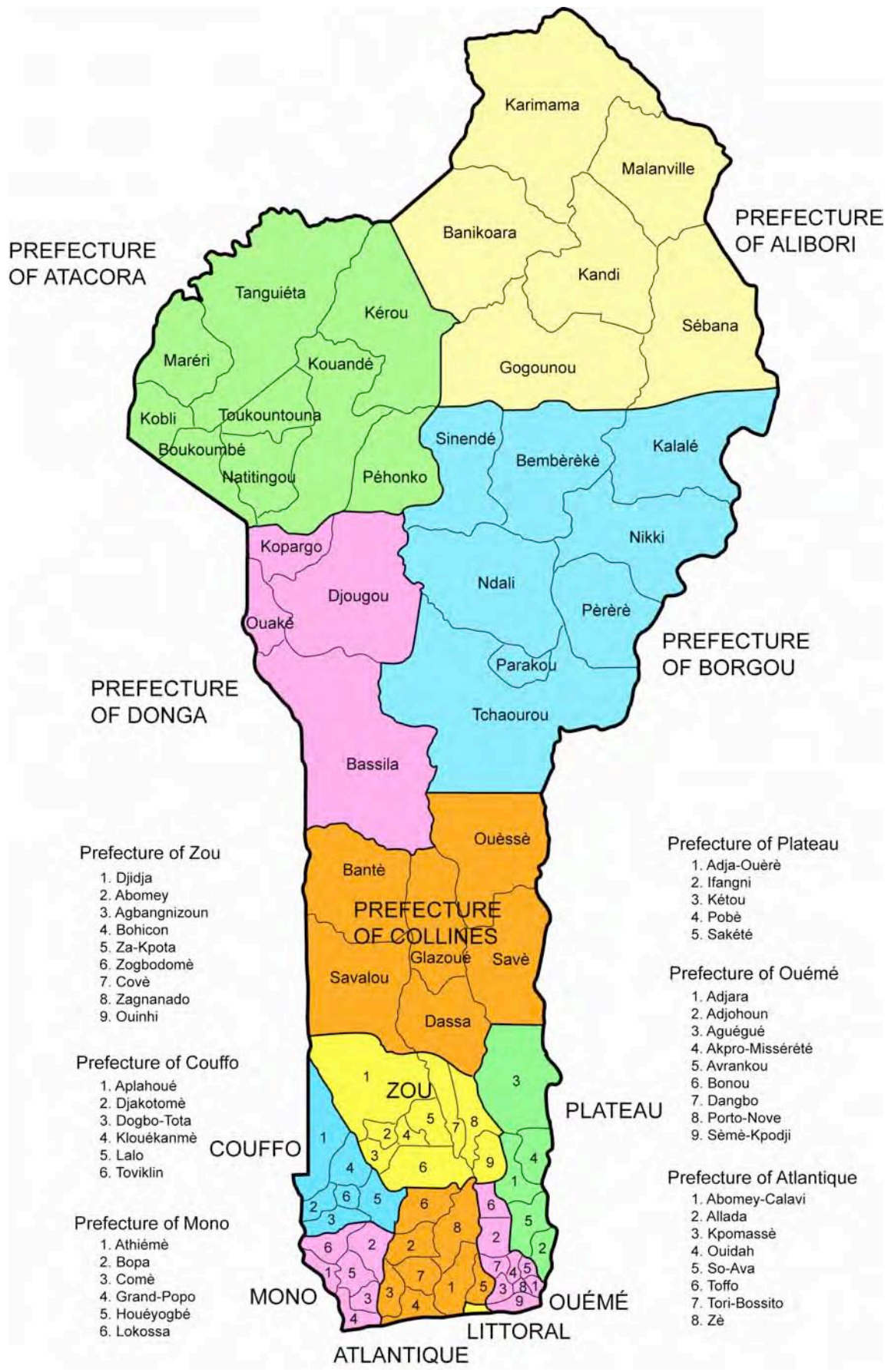
Very truly yours,

Masashi SATO
Project Manager
Study team of inland aquaculture development for rural development
in the Republic of Benin

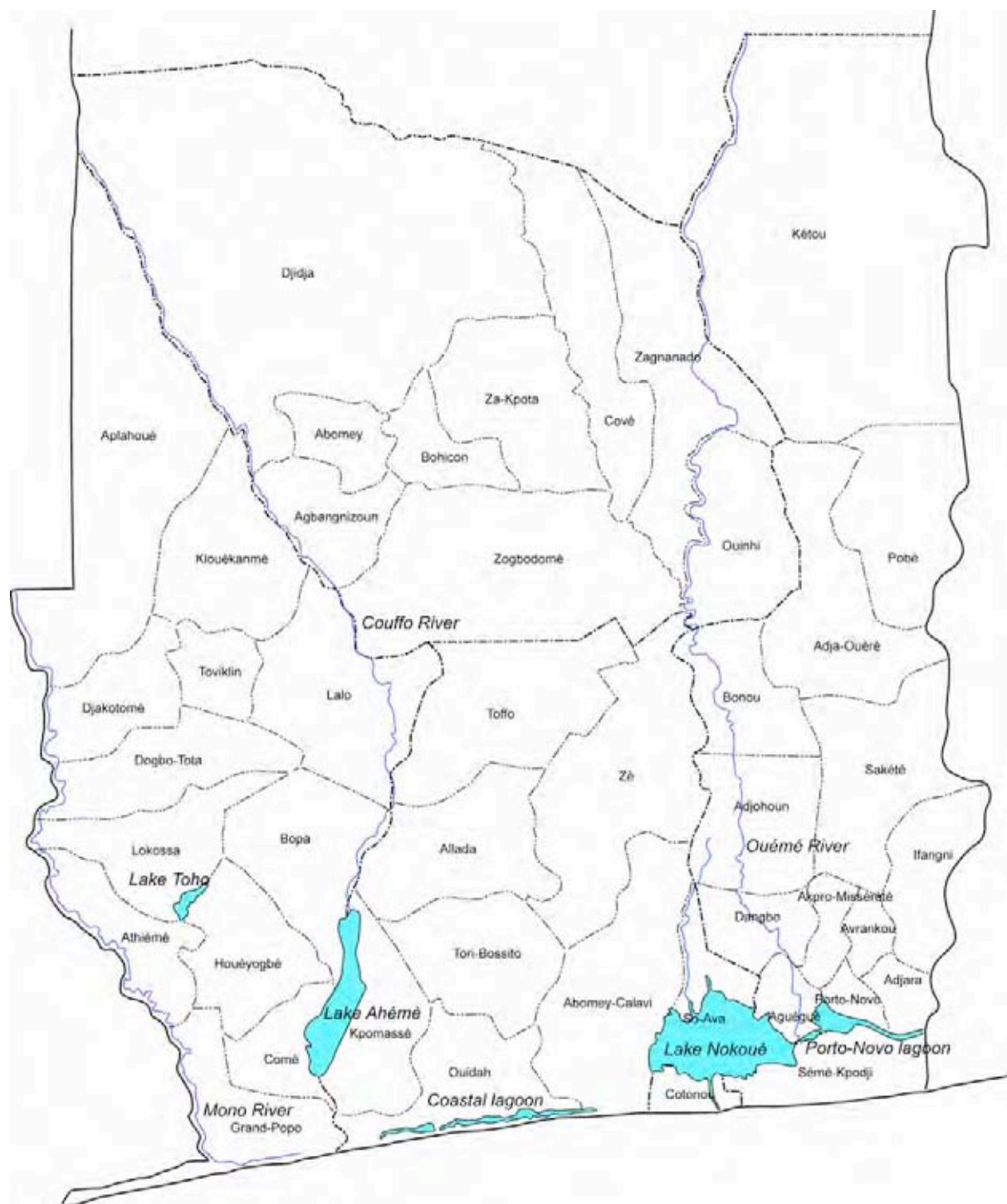
Consortium of
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and
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Map of Benin



Map of communes



Map of southern part of Benin

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Exchange rate

1 FCFA = 0.20yen (Exchange rate of JICA in Novembre 2008)

Abbreviation

ABE	Agence Béninoise pour l'Environnement
ANM	Association Nationale des Mareyeurs, Mareyeuses et assimilés au Bénin
A/P	Action plan
BAD	Banque Africaine de Développement
BHN	Basic Human Needs
BOD	Biological Oxygen Demand
CARDER	Centre d'Action Régionale pour le Développement Rural
CC	Comité de Concertation
COD	Chemical Oxygen Demand
CPA	Conseiller en Production Animale
CPH	Conseiller en Production Halieutique
CPV	Conseiller en Production Végétale
CeCPA	Centre Communal pour la Promotion Agricole
CeRPA	Centre Régional pour la Promotion Agricole
COGES	Comité de Gestion pour la Santé
CVD	Comité Villageoise pour le Développement
CTB	Coopération Technique Belge
CV	Comité Villageoise
DEPOLIPO	Déclaration de politique de population
DOF	Department of Fisheries
DPDR	Déclaration de Politique de Développement Rural
DPLR	Direction de la Promotion de la Législation Rurale
DPP	Direction de la Programmation et de la Prospective
DSCR	Document de Stratégie de Croissance et de Réduction de la Pauvreté
DSRP	Document de Stratégie de Réduction de la Pauvreté
FAO	Food and Agriculture Organization
FCFA	Franc de la Communauté Financière d'Afrique
FCR	Food Conversion Rate
FED	Fonds Européen de Développement
FIDA	Fonds International de Développement Agricole
GDP	Gross Domestic Products
INRAB	Institut National des Recherches Agricoles du Bénin
IRD	Institut de Recherche pour le Développement
JICA	Japan International Cooperation Agency
MAEP	Ministère de l'Agriculture, de l'Elevage et de la Pêche
M/M	Minutes of discussion
M/P	Master plan
NPK	Nitrogen, Phosphorus, Potassium
NGO	Non-Governmental Organization
PACODER	Promotion de l'Aquaculture Continentale pour le Développement Rural (Abbreviation of this development study)
PADFA	Projet d'Appui au Développement des Filières Agricoles
PADPC	Projet d'Appui au Développement de la Pisciculture Communautaire
PADPPA	Programme d'appui au développement participatif de la pêche artisanale
PAMR	Projet d'Appui au Monde Rural dans le Mono
PCM	Project Cycle Management
PDP	Projet de Développement de la Pisciculture

PMEDP	Programme pour des Moyens Existence Durables dans la Pêche en Afrique de l'Ouest
PNPF	Programme National de Promotion de la Femme
PSO	Plan Stratégique Opérationnel
RCPA	Responsable Communal pour la Promotion Agricole
RGPH3	Troisième Recensement général de la population et de l'habitation
SDDAR	Schéma Directeur du Développement Agricole et Rural
SOP	Spécialiste en Organisation Paysanne
SPA	Spécialiste en Production Animale
SPH	Spécialiste en Production Halieutique
S/W	Scope of work
TSIEC	Technicien Spécialisé en Inspection et Education Coopérative
TSPA	Technicien Spécialisé en Production Animale
TSPH	Technicien Spécialisé en Production Halieutique
TSPV	Technicien Spécialisé en Production Végétale
UNAPECAB	Union Nationale des Pêcheurs Continentaux et Assimilés du Bénin
UNAPEMAB	Union Nationale des Pêcheurs Marins Artisans et Assimilés du Bénin
UNDP	United Nations Development Programme
USAID	United States Agency for International Development

Summary

1. Background

Republic of Benin (hereinafter called as “Benin ”) is a country with an area of 114,763km² (1/3 of Japan), located in the Gulf of Guinea in West Africa. The national territory is extended on a narrow strip from north to south, the coastal line facing the Gulf of Guinea being only of 120km whereas the interior stretch is extended over approximately 700km (map at the opening). The climate varies between the north and the south: the southern region enjoys a hot and humid subtropical climate and the northern region a savannah one. Because of its limited coastline, Benin only has a small Exclusive Economic Zone (EEZ) of 200 miles and narrow continental shelf (depth less than 200m) of 3,100km². Besides, its coastal area is covered with lagoons, lakes and marshes of a total area of 330km², and is crossed, from north to south, by several rivers of total length of 7,000km. Thanks to these natural conditions, a total of about 30,000 tons of fish were produced annually by inland fishery, whereas marine fish production is limited about 8,000-10,000 ton.

The population, which was estimated at 6,8 million in 2002, increases annually by 3.25%, and is likely to exceed 10 million in 2014 according to the demographic forecasting. The marine fishery, which is characterized by an adverse oceanographic environment, won't be sufficient to meet the increasing food requirement, and accordingly it is eagerly expected to increase the fish production through appropriate utilization of fresh and brackish water environments.

Apart from some urban areas in the south, the interior regions are underdeveloped and poverty rate is high. The importance of rural development through incorporation of inland aquaculture and conventional agriculture - livestock is emphasized from multiple views not only on the necessity for increasing food production but also on the improvement of livelihood in interior regions.

2. Outline of the study

Objective: Preparation of the Master Plan (M/P) and the Action Plan (A/P) for the promotion of inland aquaculture for rural development

Target area: Entire potential zones for inland aquaculture development in the country

Study period: 24 months from April 2007 to March 2009

The period from April to September 2007 is called “First phase” and was sacrificed to the study on current situation, analysis, preparation of draft Master Plan and Action Plan and formulation of pilot project. The period from October 2007 to the end of the study period is called “Second phase”, during which pilot projects were implemented for a period of 12 months from October 2007 to November 2008, and based on the result, the final report was prepared.

Implementing agency:

The Department of Fisheries (DOF) of the Ministry of Agriculture, Livestock and Fishery (MAEP) is the main counterpart agency for this study. The counterpart persons are from the DOF, the Department of Agriculture, the Department of Livestock and the Unit for women in agriculture and rural development. Besides, the steering committee was organized for smooth implementation of the study. The committee was consisted of the DOF, the Department of Agriculture, the Department of Livestock, the Department of Rural Engineering, the Unit for women in agriculture and rural development, 6 CeRPAs, INRAB, the Ministry of Economy and Finance, the Ministry of Mining, Energy and Water, the Ministry of Environment and Nature Conservation and the Ministry of Interior, Public Security and Local Governance.

3. General aspects of Benin

Benin is a country of agriculture where the basic industries are crop cultivation, primary processing and export of cotton. Maize, cassava, yam and cowpea are cultivated everywhere as a food crop. Having the rainy season of 2 times a year in the south, while once a year in the north, the culture pattern of food crop is different due to the localities corresponding to the rainy pattern. People of Benin grind these grains, root crops and beans, and knead them to eat as a principal food.

The pasturage of cow is active in the spacious land of the north, while pig, chicken and goat are grown in the garden in the south. Since the area of crop field per family is small, agriculture using draft cattle is hardly seen. Fish is preferred animal protein even in inland area. Per capita fish consumption is 8.9kg per year.

Literary rate is 45% for men and 21% for women. The nation consists of plural ethnic groups using different languages. Accordingly, the extension works of CeRPA (Regional Center for Agriculture Promotion) is insufficient.

4. Current situation of inland aquaculture

At present, pond culture is most popular in rural aquaculture. There are two types of ponds, one is the drainable pond in which pond water is supplied from various surface water sources, and the other is non-drainable pond in which pond water is derived from shallow underground water and cannot be drained by gravity. The latter type is dominant in number in Benin. Major target species are Tilapia (*Oreochromis niloticus*) and Clarias (*Clarias gariepinus*).

According to the nationwide aquaculture census carried out in this study in 2008, a total of 931 fish farms were confirmed, of which more than 93% concentrated in the southern region, the south of Zou prefecture. Most of fish farms are managed by individual farmers in the south, while relatively large number of farms are managed by farmers group in the north. The farms culturing fish for the purpose of sale and generating cash income accounted for 67%, and those mainly for self consumption 33%. Some 66% of fish farms incorporated with agriculture and 57% with livestock. Some of them also work as paid workers particularly in the south, the percentage accounted 14%.

The total surface area of fish pond consist 90.92ha, of which 67.57ha is non-drainable pond and the rest 23.35ha is drainable pond. Percentage of operational ponds is estimated as low as 67.0% and 58.4% in non-drainable and drainable pond, respectively. Total aquaculture production was calculated to be 159 tons in 2008 with the pond productivity of 2.87 tons/ha/year.

Public facility functioning for seeds and feed supply is only one in the country. Therefore, fish farmers used to encounter the problems on timely procurement of these farm inputs. Some private feed manufacturers are interested in making and selling of feeds for aquaculture but it is seldom achieved. There are also problems about availability of aquaculture equipments such as fishing net for harvesting fish, fish meal as an ingredient of feeds, etc. They are mostly imported and costly.

5. Master Plan and Action Plan for promotion of inland aquaculture

5.1 Basic idea

Target year:	Year 2020
Purpose:	1) Increase of income and diversification of its source for rural residents 2) Increase of fish production through aquaculture
Target area:	Entire potential zones for inland aquaculture development in the country
Target group:	Farmers who practice agriculture as well as agriculture and livestock

5.2 Master Plan

The orientation and activities for promotion of inland aquaculture is proposed as follows.

Orientation	Activities
(1) Capacity development of villagers	1) Support to the capacity development of villagers' organizational skill
(2) Cost down of aquaculture business	1) Improvement of productivity of fish ponds through fertilization 2) Extension of small-scale net cage culture 3) Promotion of catfish culture by using plastic sheet tank
(3) Improvement of productivity of aquaculture	1) Improvement of the broodstock of Tilapia 2) Improvement of pond culture technology 3) Improvement of feeds and their extension 4) Improvement of seed production technology of catfish
(4) Strengthening of technology extension system	1) Extension through "farmer-to farmer" training 2) Development of training materials 3) Training for extension officer of CeRPA 4) Establishment of a data collection system for aquaculture statistics
(5) Collaboration with agriculture and livestock activities	1) Establishment of a distribution system of high yield seeds and fertilizers 2) Introduction of rabbit farming to improve the cash flow

5.3 Proposed projects in the Action Plan

In order to realize above-mentioned orientation and activities, following projects are proposed as the Action Plan.

(1) Project for improvement of pond productivity through fertilization

Outline: Tilapia culture with fertilization using manure pit is extended among existing pig farmers. Financial assistance for excavation of fish pond and procurement of seeds is provided. Accordingly low cost tilapia culture is promoted.

Purpose: Non-feeding Tilapia culture through fertilization is promoted in association with pig farming.

Target group: 173 fish farmers who practice pig farming and 100 pig farmers who are interested in aquaculture in the southern 6 prefectures

Period: 3 years

Project cost: 49,504,000 FCFA

(2) Project for development of small-scale net cage culture

Outline: Small-scale net cage culture of Tilapia, which requires lesser initial cost, is promoted in the lakes and lagoons of southern Benin.

Purpose: Aquaculture production from net cage culture increases.

Target group: 100 fishermen having canoes in 5 communes along the Nokoue Lake and Porto-Novo Lagoon.

Period: 4 years

Project cost: 31,500,000 FCFA

(3) Project for development of catfish culture using plastic sheet tank

Outline: Catfish culture in plastic sheet tanks, which is not costly, is promoted. Participation of farmers who don't have land for constructing pond and women is expected.

Purpose: Catfish production increases.

Target group: 1,000 farmers in the prefectures of Ouémé and Plateau

Period: 3 years

Project cost: 72,700,000 FCFA

(4) Project for development of quality Tilapia broodstock by selective breeding

Outline: Tilapia broodstock with high growth performance is developed through selective breeding of existing strains. Relevant facilities for distribution of the broodstock are strengthened in the whole country.

Purpose: Quality of Tilapia seeds is improved.

Target group: Tohonou aquaculture center and Tilapia farmers in the whole country

Period: 5 years

Project cost: 20,470,000 FCFA

(5) Project for improvement of pond aquaculture technologies

Outline: Useful equipments for pond culture such as hapa net, scoop net, seine net, engine pump and so forth are provided to fish farmers with pay partly.

Purpose: Production efficiency and then productivity of fish pond improves

Target group: Fish farmers in the whole country

Period: 2 years

Project cost: 254,300,000 FCFA

(6) Project for feed improvement and extension

Outline: The optimum local aquaculture feed is developed through the chemical analysis of ingredients and feeding experiments including the feeding methodology. Technical training is carried out to extend the developed feed to fish farmers.

Purpose: Productivity of feeding aquaculture improves.

Target group: Fish farmers in the whole country

Period: 4 years

Project cost: 35,430,000 FCFA

(7) Project for training of catfish seed producing farmers

Outline: Catfish seed producing farmers are fostered through financial and technical assistance on seed production facility and technical training.

Purpose: Catfish seeds are assured to be supplied for catfish farmers.

Target group: 100 middle-scale fish farmers in the whole country but mainly in the southern 6 prefectures

Period: 3 years

Project cost: 107,750,000 FCFA

(8) Project for aquaculture extension through farmer-to-farmer training

Outline: Using facilities and techniques of core fish farmers who have achieved good practice, the aquaculture know-how is trained on-site to other farmers. The participated farmers are supported partly about pond construction and procurement of initial seeds and feeds

Purpose: Population in aquaculture sector increases.

Target group: 6 prefectures in the south for Tilapia culture
2 prefectures, Ouémé and Plateau for Clarias culture

Period: 5 years

Project cost: 1,091,542,800 FCFA

(9) Project for development of training materials on aquaculture

Outline: Practical manuals on aquaculture technique used for training in rural area are prepared.

Purpose: Aquaculture technique improves and productivity increases.

Target group: Existing and new fish farmers nationwide

Period: 2 years

Project cost: 9,515,000 FCFA

(10) Project for capacity building of fishery extension officer

Outline: Technical trainings in terms of lecture and practice are carried out to fishery extension officer of CeCPA

Purpose: Capacity of fishery extension officer improves

Target group: 220 fishery extension officer deployed at CeCPA/CeRPA nationwide

Period: 1 year

Project cost: 78,300,000 FCFA

(11) Project for establishment of aquaculture statistics system

Outline: In order to make possible statistical data monitoring on aquaculture, relevant trainings are conducted for fishery extension officers and the DOF officers.

Purpose: Aquaculture statistics can be managed properly at respective level of the DOF and CeRPA.

Target group: Officers of the Division of Inland Fishery and Aquaculture, DOF and fishery extension officers of CeRPA in the whole country

Period: 6 months

Project cost: 6,295,000 FCFA

(12) Project for aquaculture development in northern Benin

Outline: Technical training in combination with input support of seeds and feeds is carried out for existing fish farmers and those who want to start aquaculture.

Purpose: Number of fish farmers in northern Benin increases.

Target group: 66 existing fish farmers and 500 potential new fish farmers in 5 prefectures in the north.

Period: 3 years

Project cost: 69,134,000 FCFA

(13) Project for development of fishery in artificial reservoir dams in northern Benin

Outline: Basket trap fishing that is less expensive to fabricate, easy to maintain and simple to operate, is introduced to exploit artificial reservoir dams.

Purpose: Farmers living around the artificial reservoir dams practice fishing.

Target group: Management committee and farmers living nearby at 33 artificial reservoir dams in 5 prefectures of north

Period: 3 years

Project cost: 15,444,000 FCFA

(14) Project for strengthening of fish farmers' group through capacity improvement of extension officer

Outline: TSIEC (extension officer for capacity building of farmers group) of CeCPA are trained to improve their capacity. And then TSIEC conduct capacity development training for farmers group. Literacy training is also accompanied to farmers group.

Purpose: Management capacity of farmer group activity improves.

Target group: 77 TSIEC of all over the country and farmers supported by them

Period: 3 years

Project cost: 37,526,000 FCFA

(15) Project for development of rabbit farming

Outline: Rabbit farming that farming cost is small and money circuit is rapid, is promoted as a source of secondary income.

Purpose: Rabbit farmers increase and cash flow improves.

Target group: 200 fish farmers all over the country

Period: 2 years

Project cost: 9,900,000 FCFA

5.4 Implementation structure

Proposed projects in the Action Plan are, in principle, implemented with own finance of the Government of Benin. But, the collaboration with Japan or FAO, and other donors is also examined. The implementation schedule of each project is shown below.

List of projects and its cost

No.	Project	Project cost (FCFA)
1)	Project for improvement of pond productivity through fertilization	49,504,999
2)	Project for development of small-scale net cage culture	31,500,000
3)	Project for development of catfish culture using plastic sheet tank	72,700,000
4)	Project for development of quality Tilapia bloodstock by selective breeding	20,470,000
5)	Project for improvement of pond aquaculture technologies	254,300,000
6)	Project for feed improvement and extension	35,430,000
7)	Project for training of catfish seed producing farmers	107,750,000
8)	Project for aquaculture extension through farmer-to-farmer training	1,091,542,800
9)	Project for development of training materials on aquaculture	9,515,000
10)	Project for capacity building of fishery extension officer	78,300,000
11)	Project for establishment of aquaculture statistics system	6,295,000
12)	Project for aquaculture development in northern Benin	69,134,000
13)	Project for development of fishery in artificial reservoir dams in northern Benin	15,444,000
14)	Project for strengthening of fish farmers' group through capacity improvement of extension officer	37,526,000
15)	Project for development of rabbit farming	9,900,000
		1,889,310,800



Implementation schedule

5.5 Project evaluation

After the implementation of all the projects proposed in the Action Plan, aquaculture production will increase to 1,137.6 tons in 2020, which correspond to 7.1 times as much as current production of 159 tons. Though it is challenging plan, this production level is far below to replace the volume of imported frozen fish of 46,466 tons in 2006. And fish farming household will increase from 2,193 household of today to 10,749. In a view point of rural development and poverty reduction, the Action Plan is expected to contribute in following aspects such as, 1) benefit to labors, 2) encouragement of flexible business finance in a household, 3) improvement of business management capability, 4) improvement of fish consumption, 5) rise of business chance for women and consistency between aquaculture and housework, 6) organization of fish farmers network.

Under the condition that growth volume of aquaculture production times current market price is defined as “benefit” and that project cost as “cost”, the internal rate of return is calculated for the period of 12 years. The result of calculation is of 33%. That means the entire projects of the Action

Plan is justified in an economic point of view.

5.6 Environmental and social considerations

Based on the guideline for environmental and social considerations of JICA (April 2004), the considerable impacts were examined preliminary for all the 15 proposed projects. Since all these projects are small-scale economic activities in rural area, serious impacts on the natural and social environment are not projected in general.

Project	Expected negative impacts	Rating	Counter measures
Project for improvement of pond productivity through fertilization	Bad smell	C	Monitoring
Project for development of small-scale net cage culture	Deterioration of water quality Trouble in public water usage	B	Guidance on feeding Administrative coordination
Project for development of catfish culture using plastic sheet tank	Discharged water Disused plastic sheet	C	Monitoring Study on alternative use
Project for development of quality Tilapia bloodstock by selective breeding	Almost no negative impact	C	-
Project for improvement of pond aquaculture technologies	Social conflict among beneficiaries	C	Consideration on equal treatment
Project for feed improvement and extension	Almost no negative impact	C	
Project for training of catfish seed producing farmers	Social conflict among beneficiaries	C	Consideration on equal treatment
Project for aquaculture extension through farmer-to-farmer training	Deterioration of water quality	B	Monitoring on water quality
Project for development of training materials on aquaculture	Almost no negative impact	C	-
Project for capacity building of fishery extension officer	Almost no negative impact	C	-
Project for establishment of aquaculture statistics system	Almost no negative impact	C	-
Project for aquaculture development in northern Benin	Social conflict among beneficiaries	C	Consideration on equal treatment
Project for development of fishery in artificial reservoir dams in northern Benin	Over fishing Social conflict among beneficiaries	C	Establishment of fishing rule Consideration on equal treatment
Project for strengthening of fish farmers' group through capacity improvement of extension officer	Almost no negative impact	C	-
Project for development of rabbit farming	Treatment of waste (Dejection of rabbit)	C	Use as a fertilization material

Rating:

A: Projects that are likely to have adverse impacts

B: Projects that are likely to have less adverse impacts than those of Rating A

C: Projects that are likely to have minimal or no adverse impacts

6. Pilot project

The pilot project was carried out at the 10 sites in order to verify the effectiveness and validity of draft version of Master Plan and Action plan. Started from November 2007, through 3 mid-term evaluations, the final evaluation was conducted in November 2008. The result of evaluation was reflected on Master Plan and Action Plan.

6.1 Outline of pilot project

(1) Aquaculture in association with agriculture and livestock

Aquaculture using animal excreta as fertilizer was examined. In order to obtain the excreta and also to be alternative livelihood, pig farming, poultry and mouton fattening were carried out at the 5 sites. Cultivation of feeding crops (kang kung and Taro) was also attempted.

(2) Farmer-to-farmer type extension

As an extension model of inland aquaculture, farmer-to-farmer type extension was introduced. A series of technical training courses were held at the 2 fish farms (Tilapia and Clarias).

(3) Effective use of artificial dam reservoirs

Alternative utilization of artificial dam reservoirs was verified from the view of not only aquaculture but also fishing, livestock and agriculture.

(4) Brackishwater aquaculture

Experimental culture of *Chrysichthys* (a kind of catfish) and *Sarotherodon* (a kind of tilapia), which are expected as potential species for aquaculture, was carried out.

(5) Aquaculture in whédo

Aquaculture of Clarias in whédos was carried out experimentally in dry season.

(6) Strengthening of farmers group

A method for strengthening farmer's group was verified in collaboration with extension officer of CeCPA responsible for capacity building of farmers.

(7) Reduction of women's work load

Cassava processing is one of the income generating activities of women in rural area with high work load, which was tried to be reduced by introduction of machines.

6.2 Result and lessons learnt from pilot project

(1) Aquaculture in association with agriculture and livestock

- Aquaculture through fertilization with pig manure was successful at one site. This aquaculture model could be applied among existing pig farmers. But the success of this model depends on the natural conditions (quality of water and soil in pond) and stable management of pig farming.
- Cow dump and small droppings of mouton and goat are not suitable for the material of fertilization in terms of quality and available quantity.
- Rice-cum-fish culture is difficult in a financial point of view.
- Goat farming contributes to the improvement of income and the diversification of income source in rural area.
- Pig farming is difficult for farmers who don't have sufficient funds.

(2) Farmer-to-farmer type extension

- The technical training courses were properly managed in collaboration with CeCPA/CeRPA
- Appropriateness of free seed delivery for trainees at the first run should be examined.
- Fish farmers in suspension should be selected in priority as trainees for the time being.
- Clarias culture in small-scale plastic sheet tank is an adequate method for farmers who don't have experience or aquaculture facility

(3) Effective use of artificial dam reservoirs

- Basket trap fishing was applicable even for farmers who don't have fishing experiences.
- Strengthening of dam reservoir management committee is essential.

(4) Brackishwater aquaculture

- Abandoned brackishwater aquaculture ponds are better to utilize an extensive manner like whédo, rather than semi-intensive culture approach because of the difficulty in pond management.

(5) Aquaculture in whédo

- It is difficult to use whédo as a site of semi-intensive culture for the time being.

(6) Strengthening of farmers group and reduction of women's work load

- Newly organized farmers group for a body of receiving aid does not work properly.
- Literacy education is necessary.

(7) General lessons

- Technical level of CeCPA extension officer is insufficient. Training of extension officers is necessary.
- It was difficult to assure enough collaboration between the project office in Cotonou and extension officers at sites due to problems on communication measures as well as physical distance.
- It is desirable to have a chance to exchange information of each extension officer
- Capacity of NGO in aquaculture sector was limited.
- It is necessary to take a necessary measure to prevent robbery of fish at site.

Chapter 1

Foreword

Chapter 1 Foreword

1.1 Background of the study

Republic of Benin (hereinafter named as "Benin ") is a country with an area of 114,763km² (1/3 of Japan), located in the Gulf of Guinea in West Africa. The national territory is extended on a narrow strip from north to south, the coastal line facing the Gulf of Guinea being only of 120km whereas the interior regions are extended over approximately 700km (map at the beginning). The climate varies between the north and the south: the southern region enjoys a hot and humid subtropical climate and the northern region a savannah one. Because of its limited coastline, Benin only has a small Exclusive Economic Zone (EEZ) of 200 miles and limited continental shelf (depth of below 200m) of 3,100km². But its coastal region is covered with lagoons, lakes and marshes of a total area of 330km², and is crossed, from north to south, by several rivers of total length of 7,000km. As a result of this natural condition, the 38,415 tons (2001, FAO) of annual fishery production, of which 30,000 tons are provided by inland fishery.

The population estimated in 2002 at 6,8 million inhabitants increases annually by 3.25%, and is likely, according to demographic forecasting, to exceed 10 million of inhabitants in 2014. The marine fishery, characterized by an adverse oceanographic environment, won't be sufficient to meet the increasing food requirement, and hopes are focused on the rise of fishery production through the use of fresh and brackish water basins in the inland regions.

Compared to urban area in the south, the interior regions are underdeveloped and poverty is increasing among the population. The importance of rural development integrating inland aquaculture and agriculture - livestock is emphasized not only from the point of view of the increase of food production but also the improvement of inhabitants' standard of living in interior regions.

It is within this context that the Government of Benin submitted a request to the Government of Japan for the development study on the promotion of inland aquaculture. To meet this request Japan International Cooperation Agency "JICA" sent in January 2007 a team of the preliminary study (discussion on the scope of works). This team consulted with Benin side about the content of the development study and both signed the scope of works (S/W) as well as the Minutes of the Meeting (M/M).

1.2 Objective of the study

The objective of this study is the preparation of the Master Plan (M/P) for the promotion of inland aquaculture in Republic of Benin as well as the Action Plan (A/P) regarding the implementation of the latter. Moreover it carries out a technological transfer to the counterparts and to the target population through survey, analysis and projects formulation as well as the implementation of the pilot project.

1.3 The target regions of the study

The target area of this study is the entire potential zone in inland aquaculture development. But after selection of these potential areas, priority of study is given to those areas and the pilot projects mentioned above implemented.

1.4 Organization of the study

The study lasts total of 24 months (2 years). The first 6 months (from April to September 2007) represent the Phase 1, and the remaining year and half (from October 2007 to March 2009) is Phase 2. During Phase 1, the survey and the analysis of the situation were carried out, and the draft version of the Master Plan and the Action Plan was prepared. In addition, the implementation plan of pilot project that is implemented in phase 2 to verify the feasibility of the proposed Action Plan was prepared. During phase 2 the pilot project was implemented and the Master Plan and the Action Plan was finalized by integrating the lessons learnt from it.

1.5 Conduct of the implementation of the study

Taking into account the development of rural communities for whom the development of inland

aquaculture serves as a point of entry, the study team consists of five experts, not only in the field of inland aquaculture but also agriculture, livestock, improvement of standard of living and gender. The main counterpart body is the Department of Fisheries of the Ministry of Agriculture, Livestock and Fisheries (MAEP). And the other counterparts of other fields were appointed by the Department of Agriculture, that of Livestock and the Unit of women in agriculture and rural development, to cover the fields of Japanese experts.

In addition to the counterpart body, a steering committee, an advisory body for the evolution and the results of the study was organized by the ministerial ordinance No. 0146-2007/MAEP dated May 4, 2007. Its members are the Department of Fisheries, the Department of Agriculture, the Department of Livestock, the Department of Rural Engineering, the Unit of woman in agriculture and rural development of the MAEP, bodies under the authority of the MAEP such as the Regional Center for Agricultural Promotion (CeRPA), the Benin National Institute for Agricultural Research (INRAB) as well as other ministries such as the Ministry of Development and Prospective, the Ministry of Economy and Finance, the Ministry of Mining, Energy and Water, the Ministry of Environment and Nature Conservation and the Ministry of Interior, Public Security and Local Governance. It is convened at the time of submission of reports that constitute the turning points of the study like the interim report and the draft final report, and for the monitoring of pilot project. The members of the committee share the common information, and if necessary, correct the way of study and solve the problems encountered.

Chapter 2

General aspects of Benin

Chapter 2. General aspects of Benin

2.1 Natural environment

2.1.1 Relief

Benin is a narrow country extended from the north to the south between 6°30' and 12°30' north in latitude and between 0° and 4° east in longitude (see the map at the beginning of this document). Except Atacora chain of mountains in the northwest of the country, the land is almost flat. Some plateau which are 200m high extend immediately in the north of the coastal plain but they are disrupted by a little deep trough called "Lama" which crosses the southern region of the country in west-south-west and east- north-east direction. Beyond lama, the altitude increases again and the center-north plain reaches approximately 400m. In the extreme north, the altitude decreases up to about 200m toward the Niger River (see the map on the right).



Fig. 2-1. Physical feature of Benin

Source: EDICEF 1993

2.1.2 Climate

The climate is variable from north to south due to the elongated form of the country. There are roughly 4 climatic zones:

- i) Subtropical climate of 8° of north in latitude southward,
- ii) Savannah climate (south) between 8° and 10° north in latitude,
- iii) Savannah climate (north) 10° north in latitude northward, and
- iv) Climate of Atacora chain in the northwest.

In the subtropical zone in the south, there are two rainy seasons and two dry seasons. The annual average rainfall ranges from 900 to 1,300 mm. The 3 climatic zones in the far north are characterized by a single rainy and dry season. In the savannah climate area (south), average annual rainfall ranges from 1,100 to 1,300 mm, but in northern savannah climate area, it is a little lower, i.e. 800 to 1,100 mm because of the seasonal wind (harmattan) that blows from the Sahara desert. The table below shows the monthly rainfall of every region.

Table 2-1. Monthly and annual rainfall (2004)

CeRPA	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Rainfalls
Atacora/Donga	19	1	5	46	102	159	237	202	169	24	35	0	999
Borgou/Alibori	37	4	40	49	91	157	247	244	223	50	52	0	1,194
Zou/Collines	48	14	29	82	190	118	196	160	162	124	12	0	1,135
Mono/Couffo	25	24	67	63	241	133	72	79	213	198	23	3	1,141
Atlantique/Littoral	7	14	52	88	236	129	67	39	270	134	9	0	1,045
Ouémé/Plateau	62	19	60	114	246	165	87	34	206	171	26	1	1,191

Source: MAEP, 2004,

2.1.3 Water resources

Benin is rich in sources of natural water such as small rivers and lakes/marshes. The total length of the rivers that cross the country amount to 7,000 km, and the total area of the brackish lakes/marshes in the south is 330km². The main rivers are Ouémé (510 km), Couffo (170 km), Mono (120 km) and Niger river (150km adjacent to the border) (see the map at the beginning of this document). The watershed is located about 10° north in latitude and among the waterways flowing in the country, those in the south of this watershed flow into the Atlantic Ocean and those in the north into the Niger river .

The river with long flow such as Niger River and the Ouémé are featured by seasonal fluctuations of flow (see Fig.2-2). Even the flow of the Niger River that is one of the major rivers in Africa, decreases to a point that one can cross it on foot. On the contrary, during the period of high water, it overflows from its shores and create a vast flooded plain. The flooded plain is not easily accessible but flood generates every year lands rich in nutrients and a reproduction place for fish of the rivers, which makes it an important place for the economic activities of the inhabitants. The area of the flooded plain of the main rivers totals 117,000ha, namely 60,000 ha for the basin of the Ouémé River, 30,000ha for the basin of the Niger River and 27;000ha for the basin of the Mono River.

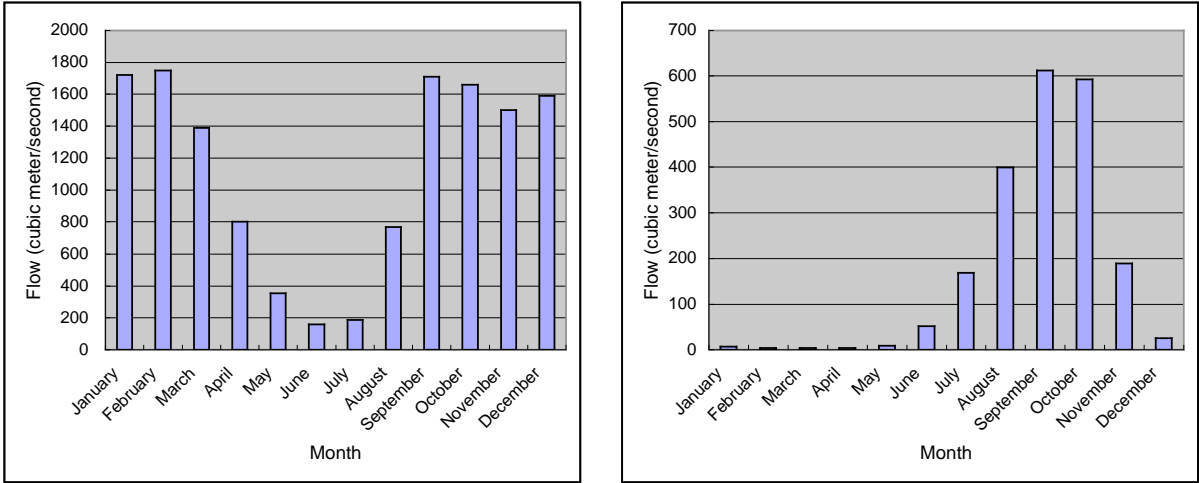


Fig. 2-2. Average monthly flow over the last 30 years
 Malanville, Niger river (left) and Bonou, Ouémé river (right)
 Source: Les ressources en en eaux superficielles de la République du Bénin

There are the main lakes and lagoons in the south with their surface area: Nokoué lake (150km²), Ahémé lake (78km²), Toho lake (15km²), Porto-Novo lagoon (35km²), and Coastal lagoons (40km²) etc. (see the map at the beginning of this document). The inland fishing is active, and the traditional “Acadja” is used everywhere on the Nokoué Lake and Porto-Novo lagoon.

The Acadja is a traditional extensive aquaculture technique that has been used for a long time in Benin. It is used on a large scale only on the Nokoué Lake and Porto-Novo lagoon, and forbidden on the Ahémé Lake since 1997. A part of the area of the lake is converted into closed water by enclosing it with bamboos etc. and branches of trees are thrown inside. The branches get rotten in water and provide organic substance that accelerate not only the formation of plankton used as food but also constitute a habitat and a laying place for fish. The Acadja consists in catching at once gathered fish but it is not part of this study.

There are also a lot of underground waters in Benin. At many places in the south, you just need to dig a few meters deep to find out underground water. There are 128 artesian wells all over the country but concentrated in Lama depression. The distribution of artesian well is shown in Fig. 2-3.

Moreover some swamps are scattered throughout Benin. The 914 swamps in the country have a total area of 205,000ha. They contain great development potentialities as farming lands, but currently few of them sufficiently exploited. The distribution of the swamps is shown in Fig. 2-4.



Fig. 2-3. Distribution of artesian wells
Source: Department of water

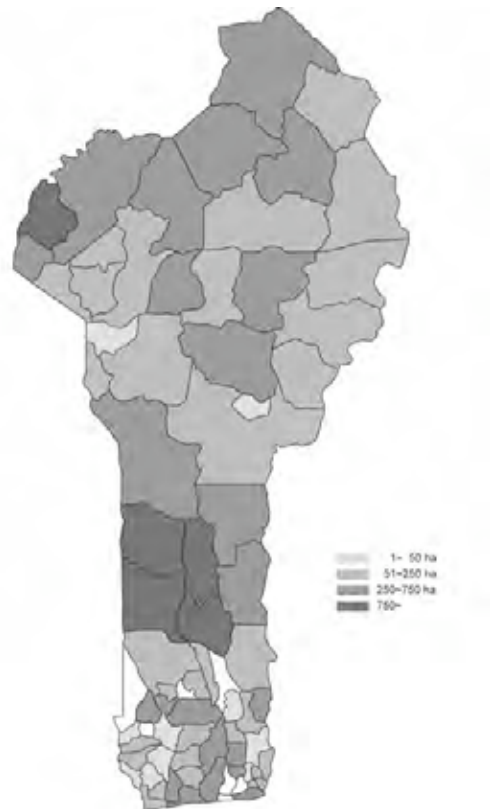


Fig. 2-4. Distribution of swamps
Source: Department of Rural Engineering

In addition, 243 reservoirs are also built for irrigation or water supply for livestock farming. Most of them are located in the 4 northern prefectures where animal rearing is active (see Fig. 2-5).

Every reservoir dam has a management committee established by the inhabitants around the dam. It is an organization in charge of effective use and maintenance of public facility like a reservoir dam with the financial source generated by the water sales for livestock farming in a resident's participatory manner. The reservoir dam belongs the city, and their use as well as their management is performed on the basis of a contract signed with the city council.

But as many reservoir dams are in fact constructed far from the villages, the inhabitants' will of using and managing the dam is weak. For this reason, most of management committees are not functional. Water accumulated in the reservoir dam but the controlled water flow mechanism is not developed, which hampers pretty much any use of lands downstream.

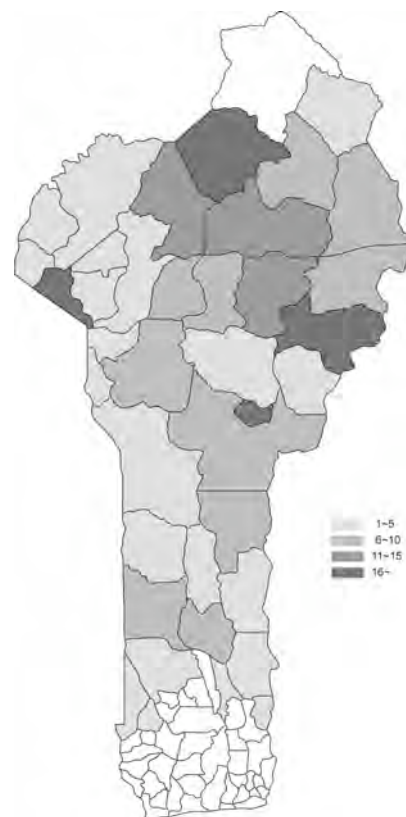


Fig. 2-5. Distribution of reservoir dams
Source: Department of Rural Engineering

2.2 Social environment

2.2.1 History

Before the arrival of the Europeans, there was rivalry between many kingdoms. Among them, three were powerful namely: Kingdoms of Allada (present-day city of Allada, Prefecture of Atlantique), Porto-Novo (present-day city of Porto-Novo, Prefecture of Ouémé) and Abomey (present-day Abomey, Prefecture of Zou). In 1650, the English first built a fort in Ouidah (present-day city Ouidah, in the Prefecture of Atlantique). Later, the French established a base in Ouidah in 1704, then the Portuguese in Porto-Novo in 1752. Both Kingdom of Abomey and Kingdom of Port-Novo attacked by the English who had established a base in Lagos (Nigeria) called for help from French, and these Kingdoms became French protectorates in 1863. In the same year, with the authorization of the King of Abomey, the French started the colonization of Cotonou. Finally, in 1894, France made of Kingdom of Dahomey a colony, and named the area “French Colony of Dahomey and its dependencies”. Then, France merged it into French West Africa in 1904.

The Republic of Dahomey, proclaimed in 1958 within the context of African colonies seeking independence at the end of the 50s, became independent two years later on August 1st, 1960.

There was a succession of unstable political regimes after the independence, and in 1975, the country adopted the socialist ideology: the republic of Dahomey became People’s Republic of Benin. But the socialist system failed, and in 1990, the country became again as Republic of Benin. The presidential election that was held in 1991 was the first multiparty election, and the whole international community congratulates the country as an excellent model of democratization in Africa.

2.2.2 People

Current population of Benin consists of ethnic groups that came from neighboring regions and of ethnic groups generated by melting pot. They are about forty ethnic groups. The main ethnic groups in the south are: Aja, Xueda, Ayizo, and Gun, Fon etc. the ethnic group Aja that originally lived in Tado, close to the Togolese border had, based on historical account, spread and gave birth to those ethnic groups. In the area between the southeast and central regions, there are a lot of “Yoruba”, and in the central region, a lot of “Mahi”, a variant of the “Fons”. In the north there are a lot of “Dendis” who came from Mali along the Niger River, many Bariba with Nigeria as origin and the city of NIKKI as their centre, and some “Peuls” who are nomads mostly established in West Africa.

There are many languages as ethnic groups: languages relatively similar in one hand, different in the other. In case of different languages even Benin nationals cannot communicate each other. This constitutes one of the obstacles to the development of the country. The common official language is French, but as the literacy rate is estimated at 34.7% (World Bank 2006), it is not a language that enables all the inhabitants to understand themselves mutually.

61% of the populations are traditional religions worshipers. The Catholics represent 19%, and are more numerous in the south. The Muslims represent 15% and are more numerous in the north.

The Third census (3rd General Population and Housing Census: RGPH3, 2002) permitted to confirm a population of 6,769,914 inhabitants. As that of the second census (1992) was 4,915,555 inhabitants, this implies an annual demographic growth rate of 3.25% over the last 10 years.

2.2.3 Administrative divisions

The Act No. 97-028 of January 15, 1999 moved Benin from a system of 6 prefectures to a system of 12 prefectures. The sub-divisions of prefecture referred to as “sous-prefecture” in the old system have been renamed parish “commune” under the Act No.97-029 of January 15, 1999. The boundaries of the “communes” are the same as those of the “sous-prefecture”. Under the “commune”, there are counties “arrondissement” made up of villages or city quarters. The county and village do not possess the legal personality of a local collectivity. The table 2-2 shows the number of regional administrative organs.

The prefectures are positioned as administrative divisions of the state, the Governor is appointed by

the Government. Moreover, the “communes” are also considered independent local governments. The “commune” is led by the city council consisting of members elected and the mayor elected among them. A head of county placed as the ruler of the county is elected among the members of the city council. Villages have a chief, who must in principle be elected but there is not a periodical election, and actually, it is as if the mandate of the chief of village is not defined.

Table 2-2. Regional administrative organs

Former division of prefecture	New division of prefecture	Number of communes	Number of counties	Number of villages
Atacora	Atacora	9	47	320
	Donga	4	26	178
Borgou	Borgou	8	43	304
	Alibori	6	41	230
Zou	Zou	9	76	424
	Collines	6	60	296
Mono	Mono	6	35	291
	Couffo	6	50	372
Atlantique	Atlantique	8	74	498
	Littoral	1	13	143
Ouémé	Ouémé	9	52	409
	Plateau	5	29	218
		77	546	3.683

Source: RGPH3, 2002,

2.2.4 Life Environment

(1) Creation of villages

Many villages have been created by visitors from other places who had liked the land and begun to settle in after obtaining permission of landowner or local authority. In many cases, the founders were hunters who have strayed in the land while chasing animals. The villages have two types of leaders. One is a traditional leader; the king of the village and the other a modern leader; the chief of the village. The king of village is hereditary post and the chief of the village is elected by villagers aged 18 years and older. The king of the village is respected by inhabitants, but as most of them are already older, the chief of the village is often the substantial leader in villages.

(2) Population

Villages' sizes are various ranging from some hundreds to more than 5,000 people. The big villages are divided into several wards in which a representative is elected by the ward residents. Therefore, there are several chief of village (of ward) corresponding to the number of wards in spite of a village in an administrative point of view. Organizations and activities of residents are carried out in a ward that brings the impression that this is “a village”.

(3) Geographical environment

The distance from villages to the main roads or regional centers are variable. There are some villages in good location and others serious situations. The former is located at the fringe of the main roads or not very far from the main roads and with a very good access to the regional centers. The latter is remote village. They are remote and/or with bad bumpy road that may be blocked in rainy season. The houses and the natural environment also vary from village to village, but the main road often crosses the center of the village, this leads to think that the village was at first formed on both side of the road. Hence the public places, the market, the public infrastructures (schools, health center, public fountains) were oriented toward the main road. Many houses are built within the intervals between afore-mentioned facilities. There are also schools, health centers etc. certainly built recently are situated at the extreme side of the village due to land problem or condition. The swamps or rivers located in the vicinity of villages are usually utilized for farming or fishing.

(4) Houses

Houses vary from luxury to poor. Houses relatively luxurious consist of enclosed land with a fence of palm wood or a wall made of bricks, a kitchen, toilets and inside garden. Houses for poor don't have fences and lot of them located along the road. According to the national census referred to RGPH3 (2002), the national average of houses with earthen walls is 55.3% and the percentage are higher in the Northern 4 prefectures with 70 to 90%. And the national average of inhabitations with roof made of galvanized iron sheet is 71.9%. These figures of the two northernmost prefectures are 43.5% (Atacora) and 57.1% (Alibori), which are lower than the national average. In the city of Malanville (Alibori), earthen roofs, a local peculiarity, are also numerous to prevent to be swept away by the seasonal wind (harmattan) during the dry season.

Kitchen building is often constructed separately but adjacent to house. There are kitchens accommodated in house, but most of them have a simple architecture with a roof protecting against rain and sun, which is supported by several pillars. In this kind of kitchen, there is a risk of fire during the windy season and a risk of extinction of cooking fire during the rainy season.

According to the RGPH3 (2002), as a national average, 75% of the households use firewood as fuel, and in the 4 northern regions, this percentage reaches more than 90%. In the north, although the frequency of use of firewood is high, the use of improved oven with a remarkable thermal effect is not widespread. There are families who attempt to save energy by piling up some stones in order to surround the oven but generally cooking is done without ingenuity and inefficiently in a very hot environment. For this reason, the workload and the length of time required for domestic works such as collection of firewood and cooking increase and damage the domestic work environment. Besides, the management of risk of fire for cooking is neglected. In the south also, 60 to 80% of the households use firewood, but there the improved oven is relatively disseminated through the assistance from which the region benefited.

In the families who own toilets, these are placed behind the house. Toilets are often stones placed in the middle of simple enclosure of palm wood without roof, or merely the dug hole. However, toilets are not familiar yet.

(5) Medical cares, health and hygiene

There are some gaps between the villages as concern the access to medical and health care. Some villages are without health center or dispensaries, and others have a hospital. According to the RGPH3, in 2002 there were 504 dispensaries in 3,683 villages, which mean that there was 1 dispensary for 7 villages.

Many villages have set a committee for health care management (COGES) so as to improve the access to medical and health care services. This committee is created on the initiative of the health centers and organized by population. It serves as a mediator between the health centers and the population. Members of the committee direct patient and their families to go to the health center.

Many families in the villages don't have toilets¹. For this reason, a nasty and acrid odor pricks the nose while walking in the small paths between the houses. The installation of latrines by relief organizations is done in some public establishments, in particular as auxiliary installation of school; we saw some in several villages. Among them, there is an exception: latrines built within schools are used and managed by the population as their common good.

Household waste collection is not done either. 78% of waste is thrown outside without any disposal process such as incineration or burning. In the regions of Alibori, Atacora, the Collines and Donga, the rate of waste disposal exceeds 90%. In several studied villages, women and youth as well as the

¹ The diffusion rate of toilets is 32.7% in the whole Benin. Diffusion rate of 82.4% in coastal region boost the national average, whereas it never reaches 40% in the countryside. The rate is especially low in the north: 10% in the Atacora region, 12.7% in the Donga, 15.9% in the Alibori, and 11.7% in the Collines (RGPH3, 2002).

COGES carry out village cleaning activities to prevent outbreaks of epidemic and to protect the village hygiene because hygiene conditions have deteriorated due to the increase of the non-burnt waste. However, this kind of activities is not yet frequent. The cleaning activities consist of cleaning of the paths and the public places of the village, waste processing (to collect each family's garbage and dump it in bulk at the dump place located far from the village), weeding etc.

(6) Water

In most studied villages, wells or fountains are installed. Except the difficulty to fetch water all the way from the well to the house, there is no problem for daily water supply. However the cleanliness of the water is another question. They haven't asked for an analysis of the water quality by a specialist. They just infer the water security from their experiences of diarrhea. Consequently the safety of the water is not guaranteed, even in the villages where there is no problem of access to the water.

In all villages, the drawing of water for housework is the work of the women and children. The children pull some buckets from the sources of common water of the village and the women carry water in plastic bucket of 20 to 30 l that they hold on their heads. The drawing of water for economic activities such as water supply for the livestock is the task of men.

(7) Education

Many villages have only primary school course². Some among them only have a first part of primary education course. Those who want to have an education, higher than junior high school, must go to a bigger village or town. Most of them stay at their relatives' house there. Priority is given to boys than girls to continue education out of village.

It is observed that school children play and help bringing water during school time in Cotonou because that two-class system is applied due to lack of classes. However, This system is not applied in rural area. Children found out of school are supposed to be those who don't enter school or lazy school children. It appears the low enrollment ratio or low attendance ratio.

2.2.5 People's organizations

There are many organizations in Benin, for example NGOs, associations, professional bodies, village organizations, farmers' organizations, etc. Most of their objective is the better life and improvement of quality of life

(1) NGOs and Associations

Associations and NGOs that meet stipulation, apply as a recognized organization for registration at the Ministry of interior, public security and local governance. An association or a NGO's registration requires more than one member and some documents (purpose of creation, activities, contact information, etc.). If it has no problem, the official registration will be awarded in three months. As registration is not challenging, 90% of application is accepted. But since registration securing is not tough, newly set up NGO's and associations mushroom while some already existing demise. Especially whenever a domestic or international projects start off, the number of newly created NGOs or associations will increase, because people try to receive a financial aid from these projects and establish a new one.

Back in 1996, there was the National Union of NGOs that encompasses all NGOs. Today, instead of said Union, the civil society promotion center of the Ministry of justice is in charge of general information on activities of all of these organizations. Currently, the list of NGOs and associations for 2007 is under way with an assistance of UNDP. GATES (1991), SNV-Benin, DED, OXFAM-QUEBEC (1996) conducted a study on NGOs and associations but limited to those who aiming at helping women and associations operated by women, but the list for 2007 cover all NGOs or associations. (However, 70% of them is likely to be women's associations or associations whose target

² The education system of Benin consists of 6 years of primary school course (CI, CP, CE1, CE2, CM1 and CM2) and 6 years of secondary school course. The latter is divided into the first part (6th, 5th, 4th) and the second part (3rd, 2nd, 1st and final). Those who complete these courses are qualified to challenge "Baccalaureat" (qualification to enter university).

–group is women.)

(2) Group

Village groups made up of inhabitants of the same village who often carry on the same economic activity. Generally, villagers' group (groupement) consisted of more than six (6) persons, having decided their activities and bylaws are qualified to file an application for registration to the Rural Legislation Promotion Bureau (DPLR) of the Ministry of Agriculture, Livestock and Fishery (MAEP). The classification of group activities shows that farming producers group outnumber the other groups, therefore villagers' group registration is usually awarded by their local CeRPA. For reaching the required mark of six (6) members, some family members are also registered as group members, even their preschool kids. Since the registration process is not complicated and difficult like that of NGOs, many groups' activities and operation have come to a standstill despite the registration. Consequently, groups easily established are to be disappeared or stayed dormant. Many groups choose to stay registered to receive a financial aid some day. There are some groups who don't meet the requirement of membership of six (6) and has gone ahead with their activities for numerous years without getting their registration erased at CeRPA. Existence of such a ignorance means that there is no follow up after registrations.

There are a lot of villages that have several small groups of same activities. The reason is that it is easier to team up with neighbours. Most of groups complain about the lack of monies making them harder to perform their undertakings. But per-capita subscription of two hundred (200FCFA) paid by six (6) members is not enough to buy even a bucket. However, villagers don't like to increase number of member so as to increase their funds. There are some groups that iterate the vicious circle of deficit without requiring neither admission fee nor monthly dues, "Profit doesn't grow due to a lack of start-up funds." "As the profit doesn't grow, members are unable to settle their subscription". "As their subscription cannot be paid up, fund for coming activities is inadequate". Among women's groups engaged in small-scale business, there are some cases of groups that keep carrying out their activities in spite of its ineffectiveness and low profit. Even some are working in red. It shows a lack of business management skill of women's group.

Most of the groups established in recent years say that the motif of group formation is that aid cannot be given to individual but to a group. They are just waiting for an aid after the foundation. No group has worked on any outside organization for an aide.

In the surveyed villages (Agriculture is a principal activity and aquaculture is a secondary activity in most villages), aquaculture is often operated in groups. The aquaculture group has a small number of members compared with a scale of village. And there are few female members in it. There is no sexual profiling for group subscriber, but a heavy financial burden on subscription such as financing of activity fund, in many cases, limits the participation of women in a group due to higher poverty rate of women. There are two ways of money collection for activity; One which members pay high amount of initial dues at a start, and then they settle into low amount of monthly subscription after reaching their funds enough and another one which members pay needed amount of money as often as needed. Main troubles experienced vary slightly from one region to another. The lack of funds for construction and expansion of aquaculture ponds is often pointed out in the prefecture of Atacora, Donga, Borgou, Alibori, Oueme and Plateau. Inadequacy of fishing tools and feedstuffs are mentioned for aquaculture in the prefecture of Zou, Collines, Mono, and Couffo. Certain group ceases operating due to it.

Apart from producers' groups that exist with the aim of economic activities, there are social groups of inhabitants as well. For instance:

- 1) Village committee (CV), council (CC) and the committee on village development.
- 2) Village community's resources management committees (well management committee, reservoir dam management committee; etc)
- 3) Hygiene and health control committees for villagers (COGES, Sanitation village committee, etc.)
- 4) Security committees or/and annual event management committees (youth organization, etc.)

Committee types 1) and 2) are often set up by the initiative of external assistance organizations when projects arrive with facility construction and equipment supply. And type 3) and 4) are set up spontaneously and freely by inhabitants themselves. Since these committees aren't designed for profit, their financial means are poor. Some collect dues to maintain their activities and others do not. For example, some village cleaning groups collect small reserve fund after each cleaning session for free on the scheduled days. There are also youth organizations that set up a music band and go to families who have ceremonial event to play music for tips. They bestow these tips on their committee activities. They are women, youths and elders who support these contributive unpaid works for the entire village. Function levels of each peoples' organization also vary depending on villages and organizations but generally groups voluntarily founded by inhabitants tend to work well.

(3) Fishery related professional groups

National fishery organizations are:

- 1) National union of marine fishermen in Benin (UNAPEMAB)
- 2) National union of inland fishermen in Benin (UNAPECAB)
- 3) National association of middlemen and middlewomen in Benin (ANM)
- 4) Maritime exploiters Group of Benin (GEMB)

This paragraph explain more about the group 3) ANM. Among these 4 organizations, the group 1) and 4) don't relate to this study because they are of marine fishery. The group 2) is established recently and substantial activities don't start yet. ANM works relatively hard and active. And it has been selected as the sole association in Benin to which PMEDP provide support for organizations. ANM has regional divisions in each prefecture apart from Cotonou-based head office. Most of the regional divisions were established in 2005 on the headquarters' decision. Each division holds a monthly meeting in a main city of prefecture (The meeting date is set by each division, for instance the first Tuesday of each month) and the head of each regional division come and attend an annual general meeting of ANM in Cotonou. The association has a women and men mixed together. As the former outnumber the latter, most of regional divisions' chairpersons are women and they also hold executive positions of head office. The monthly subscription of two hundred (200) FCFA is collected at monthly meetings, but many members have fallen behind in their dues and some divisions have insufficient funds available for their activities (ANM regional division of Borgou, Oueme and Couffo prefecture). In remote regions especially, subscription are spent for chairperson's transport expense during the annual general meeting in Cotonou head office. There are regrets uttered as follow: "We have set up the group in hope to receive an aid, but we have gotten noting (association of middlemen in Borgou)" "We paid 2,000FCFA per person as a membership cards issuing commission one year ago, but we have still not received anything (association of middlemen in Ouémé).

2.2.6 Gender and Development

RGPH3 conducted in 2002 said that Benin's total population is 6,769,914, and women present 51.5% of total population. 70% of women live in countryside, and more than 60% of women in villages operate and support agriculture. Women fulfil also an important role in socioeconomic activities as well as in agriculture. Women make remarkable achievement in handicraft industry, social activities and community activities. Especially housework that has a great influence on family and community members is exclusively for women. But most of these activities are carried out in bad working conditions.

(1) Legal Protection

Benin has ratified in 1992 the Convention on the elimination of all forms of discrimination against women, the African charter on Human and People's Rights in 1986, and follows the African charter on children's rights and welfare or the Convention on the Right of Child that protect women and children. The Child trafficking prohibition law is in preperation since 2006, and National strategy for child protection and National action plan on the elimination of child labour is to be established by the end of 2007. Legal protections have began to guarantee the equal opportunity for both men and women in marriage and education, the prevention of violence against women and/or children, the inheritance

rights and the land ownership of women, etc. Actually, however, we could observe a major gap between the development of legal system and its operation.

(2) Health

Health status of female is poorer than that of male. Maternal mortality rate is 474.4 /100,000 at national level and 50.5 at rural areas (Across the board census referred to as RGPH3, edition 2002); thus risk in maternal health is high and also both mothers and children's health are not guaranteed because of the lack of knowledge of hygiene and basic health care. In addition to that, the difficulty of access to basic health care services is also one of the reasons to that. Despite it, family planning is not really accepted because of its negative image. Therefore, the modern contraception is only accounted for 3% in 1996 (National policy for woman's promotion (PNPF^o) 2002). There are many deliveries at risk too. For example, there are pregnancies in young age ranging from fifteen years old (15) to nineteen (19) years of age and pregnancy beyond thirty five (35) years old. And also married women in childbearing age who do not want to become pregnant as quick following a prior delivery, go for an illegal abortion. Moreover, Female Genital mutilation/ excision (FGM/E) eventually forbidden in 2003 is still practised. As other women's health problems, we can rehearse the contraction of venereal diseases, under nutrition and the uncompleted functions of COGES run by men. Given these problems, women exposed to infecundity, illness, and injuries. They experience a situation that further spoils their health.

(3) Education

As for education as well, women are faced up with challenging situation. At all education curriculums in Benin, girls' enrolment ratio is lower than that of boys. For example, primary enrolment ratio is 60.8% for boys and 49.4% for girls in rural area and 78.5% for boys and 58.1% for girls nationwide. Secondary enrolment ratio is 28.7 % for boys and 13.7% for girls. Adults' literacy rate is 45% for men and 21% women, therefore even not half the men's rate. Girl's access to education is hampered specially in villages without educational establishment, which have a significant impact not only on school-age girls but also on women's whole life prospects such as process to higher education or employment securing.

99.6% of women's workforce work. Benin nationwide women's unemployment rate is lower at 0.4% than total unemployment rate at 0.7%. 41.6 % in the aforementioned 99.6% is engaged in the primary sector –agriculture, animal-breeding/rearing, fishing; 7.6 % in handicraft industry, and 44.8 % in commerce. But most of them work in informal sector under bad working conditions. Many women and girls work as sellers on the street without neither umbrella nor shade screen to protect them. There are, in these sellers, also great deals of school-age girls who have dropped out of their school. Male street sellers' deal clothes and furnishing without use-by date. However female rather deal cheap vegetables, fruits or home-made foods, etc. with use-by date. Most of foods are manual fabrication without modern machines to reduce physical works, putting in long time on it.

In Benin, there are few full-time housewives because female householders work outside the home (Rate of family with female householder is 22.72% nationwide) and women who are not householder also work hard for their children. As well as working outside the home, they do obviously routine household work inside the home as a gender role.

In most of local social activities, women and youth support and contribute for security and hygiene with unpaid works. Hence local security and hygiene are ensured by them.

2.3 Economy

The Gross Domestic Product (GDP) was US\$4.3 billion and the growth rate 3.9% in 2005 (World Bank 2005). The percentage of every sector within the GDP was, 32.2% for the primary sector, 13.4% for the secondary sector and 54.4% for the tertiary sector. The trade balance was, US\$1,183 million of import whereas US\$610 million of export, hence a surplus of US\$573 million for imports (World Bank 2005). The leading export item is cotton that yields US\$257 million (42% of the total amount of exports). 55.5% of inhabitants dwell in rural areas (IFAD 2003) and as nearly all of them are engaged in agriculture and livestock farming. This sector constitutes the staple one in Benin.

2.3.1 Agriculture

(1) Utilization of lands


The national surface area is 114,763km² and 7,050,000 ha (61.4%) from these 11,476,300ha are deemed arable. According to the 2006 annual report of the Ministry of Agriculture, Livestock and Fishery (MAEP), the total area cultivated regarding staple farm produce during the growing season 2005-2006 was 1,894,431 ha which is tantamount to only 26.9 of arable.

(2) Agriculture zones

Benin is subdivided in eight (8) agriculture zones on the basis of geographic and climatic conditions. Maize is grown pretty much throughout the country. Cotton, hard currency yielding non food crop, is cultivated in the zone one (1) through five (5) in Benin's center-north. Millet and sorghum, grown able over little bit fertile soils with light rainfall, are centred on the belt 1.2 and bean are widely grown in the south.

Table 2-3. Agriculture zones

Zone	Surface (km ²)	Number of farms	Main products
1	9.057	9.843	Millet, sorghum, cotton, maize, rice, onion, potato
2	20.903	29.227	Cotton, sorghum, millet, Yam
3	23.400	36.229	Yam, cotton, maize
4	16.915	54.855	Millet, sorghum, maize, Yam, cotton
5	32.113	9.153	Cotton, maize, yam, cassava
6	6.351	144.715	Maize, cassava, peanut, bean
7	2.564		Maize, cassava, bean, tomato, pepper
8	3.460	65.120	Maize, cassava, bean, legumes



Source: annual report 2004-2005 of MAEP

(3) Agriculture production

According to the statistic of MAEP, agriculture production is classified in five (5) categories: grains, root crops, beans, vegetables and cash crops (table 2-4). Their respective yields are 1,151,853 tons for grains, 5,011,559 tons for root crops, 38,496 tons for beans, 285,846 tons for vegetables and 332,066 tons for cash crops. Since staple nutriment are maize, cassava and yam in Benin, they are grown in large quantity for domestic consumption. The production of grains raised approximately 1.6 fold over the past 10 years, thanks to the utilization of high yield varieties of maize and an increase of cultivated surface area. The production of rice also increased, although quantity is not so important, from 22,259 tons to 78,329 tons.

The production of root crops, beans and vegetables also registered a significant rise like grains. In particular, the increase in soybean production is outstanding, surging from 1,279 tons to 9,190 tons (approximately 7.2 folds).

In addition, the cash crop especially cotton that has been the basic crop even now, is rather going through a downward tendency. The reason of this trend is supposed to be that the price is low at international commodity market so that it is no longer feasible and the Government reduce support to cotton farmers.

Table 2-4. Evolution of agriculture production

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Crops										
Grains	712 554	874 940	865 641	972 973	991 315	940 639	1 084 105	1 041 236	1 107 973	1 149 969
maize	555 755	701 046	662 227	782 974	750 442	685 427	797 496	788 320	842 626	864 698
sorghum	110 259	120 173	138 425	126 440	155 275	165 342	182 639	163 276	163 831	169 235
rice	22 259	26 891	35 562	34 040	49 246	54 901	63 219	54 183	64 699	78 329
millet	24 281	26 830	29 427	29 519	36 352	34 969	40 751	35 457	36 817	37 707
Root crops	2 867 872	3 387 474	3 617 345	3 833 372	4 161 322	4 464 514	5 393 369	5 119 581	5 265 249	5 011 559
cassava	1 456 608	1 918 436	1 989 022	2 112 965	2 350 208	2 703 456	3 154 910	3 054 781	2 955 015	2 861 369
yam	1 346 070	1 407 677	1 583 713	1 647 009	1 742 004	1 700 982	2 151 452	2 010 699	2 257 254	2 083 785
sweet potato	61 516	57 193	40 854	68 847	65 592	56 996	83 800	51 098	49 999	64 005
taro	3 678	4 168	3 756	4 551	3 518	3 080	3 207	3 003	2 981	2 400
Beans	81 066	97 073	99 751	103 258	118 292	107 765	133 375	117 251	131 060	143 060
cowpea	60 971	73 749	75 452	74 237	85 613	78 353	95 332	81 823	93 789	104 564
Bambara groundnut	8 400	9 380	9 260	14 594	14 790	12 354	15 925	14 549	20 267	13 712
pigeon pea	2 687	3 588	3 490	2 952	3 302	3 363	3 712	3 116	2 969	3 174
soybean	1 279	1 203	1 995	3 444	4 296	3 543	4 744	6 812	5 525	9 190
goissi	7 729	9 153	9 554	8 031	10 291	10 152	13 662	10 951	8 510	12 420
Vegetables	173 897	195 709	178 866	203 542	231 480	204 971	246 268	231 663	247 336	285 486
tomato	101 765	121 477	105 626	124 401	139 231	117 563	134 820	141 815	144 234	143 312
pepper	20 508	23 900	20 070	24 562	33 293	29 309	36 624	25 222	33 563	50 892
okra	51 624	50 332	53 170	54 579	58 956	58 099	74 824	64 626	69 539	91 282
Cash crops	515 621	480 099	458 811	477 989	461 747	519 058	507 599	517 206	491 430	332 066
groundnut	84 787	102 341	98 897	101 943	121 159	125 377	130 008	143 516	151 666	140 329
cotton	430 398	377 370	359 331	375 586	339 909	393 060	376 739	372 967	339 153	190 867
tabacco	436	388	583	460	679	621	852	723	611	870

Source: MAEP

In order to have enough production, it is necessary to grow high yield varieties and to make use of a sufficient quantity of fertilizers. Thirty (30) corporations authorized by the government sell fertilizers and pesticides designed to cotton. They don't deal in those suitable for food crops. Farmers have only an alternative: either they use cotton fertilizers and pesticides or they buy them in Togo or in Nigeria. The sources of fertilizer in study areas are the Government organisations (CeCPA and CeRPA), farmers group, foreign countries and others. The major part (75%) is purchased from the Government ones. In fact, only big farmers of northern regions make use of fertilizer. Small farmers of south growing maize, cassava, groundnut, cowpea are engaged in extensive agriculture without fertilizers nor pesticides.

2.3.2 Livestock

Livestock is a sector that accounts for 6% of GDP, primarily focused on cattle, sheep, goat, pig, chicken, etc. The table beneath indicates the number of animals by CeRPA in 2005.

Table 2-5. Number of animals by CeRPA in 2005

CeRPA	Cattle	Sheep	Goat	Pig	Horse	Donkey	Rabbit	Chicken
Atacora/Donga	416,000	186,800	237,800	69,000	500	100	800	1,930,000
Borgou/Alibori	1,171,700	337,000	351,900	17,800	600	500	2,900	2,704,000
Zou/Collines	88,600	40,100	209,000	70,500		40	14,400	2,809,000
Mono/Couffo	12,400	59,200	289,600	35,200			11,700	2,330,000
Atantique/Littoral	30,900	51,200	132,000	32,400			46,800	1,647,000
Oueme/Plateau	43,000	50,100	165,300	77,600			28,500	2,180,800
Total	1,762,600	724,400	1,385,600	302,500	1,100	640	105,100	13,600,800

Source: Annual report 2005, Department of Livestock

(1) Cattle

The migration of beef cattle thrives in the north where the density of the population is low and lands are widely available. The ethnic group "Peulh" carries on mainly this kind of breeding. Migration sparks lots of troubles that sometimes end up into strife with farmers. Given this situation, some "peulh", with darkish complexion, although they are few, are settled and exercise both farming and animal rearing.

While pasturing, droves of cattle entail a great deal of contentious issues and, so as to figure them out

farmers and breeders from the prefecture of Borgou collaborate and have set up the prefectural union of ruminants raiser's professional organizations. This union's agenda consist in fixing problems such as those related to pasture lands, to the devastation of cereal fields, to water drinking places, to livestock market, to diseases etc., hard to cope with by a rearer alone. This union comprises 71 groups, who own on aggregate 81,000 heads of cattle. Ten (10) among these groups established by women and labelled as *Gogounou's* dairy of the association of women cattle breeders, have set up a milk processing center and go about manufacturing selling cheese and yoghurt. They collect two hundred litres of milk per day by bicycle, keep it in a refrigerator and process it.

Many farmers entrust their cattle to settled Peulhs and earn a return from it without working. The first-born calf belongs to the Peulh and the second-born to the owner. The spur for Peulhs lies in the milk gotten every single day.

The Department of Livestock, in the Livestock Development Project (Phase 3) financed by FAD/BAD and the Government of Benin, have conducted research and development on productivity improvement of cow, sheep and pig. In line with this activity, a study has begun in 2004 with introducing a meat/dairy breed "*Girolando*" from Brazil. *Giroland* is a breed combining three eighth (3/8) of the *Gir* breed and five eighth (5/8) of the *Holstein* breed that yield 12 litres of milk per day. Although a cow produced only 6 litres of mil just after the first delivery, she could produce 10 litres after second birth. Moreover, thanks to the improvement of feed, yield increased to 19 litres per day. Also the experimental cross-breeding between *Girland* and local breed called *Borgou* was carried out. She achieved to produce 6 litres of milk per day in average after second birth. There is also a local breed called *Laguna* in Benin. It is on the verge of extinction. Therefore, this local breed is protected at the Southern National farm.

(2) Goat

Goat is the second most numerous after cattle, they are left at large and no research development whatsoever or protection is ensured by the Department of Livestock, MAEP. The official name given to goat raised in Benin is West Africa Dwarf Goat. It's a goat of short height. In villages, it is bred outdoors and since there is no advice whatever from the Department of Livestock concerning its reproduction, this already short breed is getting dwarfed and dwarfed. The reason of on-going dwarfishness resides in that the males are slaughtered to supply meat when they grow to the market size, no bigger male individuals don't live. The milk of goat is not used at all. This short-leg goat is high fecundity. If the selection is performed, it would permit to get a small-sized but high fecundity breed. Invisibles in villages, bigger-sized goats from Sahel are sold on town's market places. Their appropriate name is definitely "Sudan desert goat". They withstand quite well drought and possess long ears. They should be utilized for reproduction purposes but they aren't available within villages.

(3) Sheep

The sheep herd holds the 3rd rank in terms of amount of heads. The breed of sheep that outnumber others is referred to as the dwarf sheep from West Africa "(local name: "Djallonke" that breeds in all villages throughout Benin. Selection trials relating to this breed are carried out by the national institute for research concerning animal rearing. This research record is satisfactory as respects the growth speed: a two fold increase in weight compared to the local breed is effected in average.

It took in average one year and half to attain 25 kg weight, now it is feasible within 9 months. But as concerns this method, the factor related to the amount of baby –goats bred per little is not taken into account through the selection and the afore-mentioned factor is very likely to be lost as a negative effect. In the North, a host of high –sized Sahel sheep brought from Niger and referred to as "Sheep from Sudan Desert" is bred. They are fed by gavages, fattened and marketed at a sizeable rate.

(4) Chicken

Poultry –farming started twenty (20) years ago by the construction of facilities at the division of animal –rearing of the Ministry of agriculture, animal, raising and fishing with Libya's help. Three big incubators were fitted and both layers and broilers –supply chicken are bred but the operating funds

went to a standstill as from the ending year of Libya's aid and the installations was conveyed to a privately – owned company. Currently the purchaser and three (3) additional corporation floated later market chicks. However as a result of the ongoing monopoly of these firms, the unit price of a chicken is pricey (600-700FCFA).

(5) Evolution of the number of livestock heads

The amount of animal heads has been increasing at a high rate so as to cater consumer's increasingly growing food requirements (See the table below). But as for pigs, the porcine plague which struck in late 1990s have caused the pig farming industry plummet. Consequently the number of pig heads slows small increase compared with other animals. Pig farming is still on the way to recover.

Table. 2-6. Evolution of the number of livestock heads

Type of livestock	2000	2002	2005	Rate of increase on 5 years
Cattle	1,487,000	1,635,000	1,762,600	18.5%
Sheep and goat	1,907,000	1,940,000	2,110,000	10.6%
Pig	297,000	286,000	302,500	1.9%
Chicken	10,000,000	10,000,000	13,600,800	36.0%

Source: FAO 2005 Livestock Department 2005

(6) Meat Demand

The demand of beef, mutton and goat meat is balanced but the production of broilers, pork meat and milk doesn't reach half of the consumption. The deficit is offset by imports (see the table below). Among these imports, the percentage of imported broilers reaches 85 %. This cheap imported chicken (1,400FCFA/kg in average) hampers the endogenous development of poultry farming in Benin. The deep freeze chain for imported broilers is not fitted up, which precludes its marketing in all regions. This situation brings about a two-layer structure: imported broilers for wealthy urban residents and lean local chicken for rural poor.

Table 2-7. Evolution of supply and demand for livestock products

Livestock products	2000			2002		
	Production	Consumption	Self-sufficient rate	Production	Consumption	Self-sufficient rate
Beef	18,000	18,100	99%	19,800	19,000	104%
Mutton and goat meat	6,500	6,500	100%	6,800	6,800	100%
Pork	3,800	3,800	100%	3,600	7,300	49%
Chicken	11,600	67,400	17%	11,600	79,200	15%
Milk	29,900	55,900	53%	32,100	73,100	44%
Egg	7,200	5,400	133%	7,200	5,600	129%

Measure : ton / Source: FAO 2005

(7) Processing of livestock products

9,817 oxen, 19,719 sheep and goats and 3,945 pigs were slaughtered last year at slaughterhouses in Cotonou. This is tantamount in average to 35 oxen per day and an average weight of 150kg. Beef wholesale price is 1,450FCFA/kg (bones inclusive). The retail price ranges from 1,700 to 1,800FCFA/kg (bones inclusive) and boneless meat is sold at 2,200FCFA/kg. Skin of oxen, sheep and goats is sold for human consumption to middlemen at a price ranging from 5,000 to 15,000 FCFA. No processing of skin is taken. For the time being, there is no possibility to enhance the leather industry. Middlemen are gifted the blood and sell it, the same holds true for the bones.

2.3.3 Fishing

Fishing is a sector that accounts for 2% of the GDP and is subdivided in three (3) components: marine fishery, inland fishery and aquaculture. Marine fishery is subdivided into two, industrial fishery and artisanal fishery. The former is fishing carried out by trawlers to catch prawns and noble bottom fish. The latter is fishing carried out with motorized canoe with gill net or seine net to catch sardines and

noble bottom fish. 4,345 artisanal fishermen exercise fishing with 825 canoes, of which Ghanaian fishermen make up half this number.

Inland fishery is exercised in southern lakes such as lake Nokoué, the Lagoon of Porto-Novo, lake Ahemé and in all sizes of rivers. In lake Nokoué and lagoon of Porto-Novo, inland fishery is carried out with “acadja” at any places. In some rivers and small lakes / marshes, fishermen catch tilapias with gill net. 56,876 fishermen exercise fishing with a total number of 42,187 canoes. The fishery production is shown below.

Table 2-8 Evolution of fishery production

Type of fishery	2001	2002	2003	2004	2005	2006
Marine fishery	4,814	10,670	11,618	11,788	10,093	10,064
Industrial fishery	268	183	609	845	1 393	1,064
Artisanal fishery	8,146	10,487	11,009	10,943	8,700	9,000
Inland fishery	30,000	30,000	30,000	28,200	29,100	29,550
Fishery production	38,414	40,670	41,618	39,988	39,193	39,614

Measure: ton

Source: Department of Fishery

Fishery production is stable at around 40,000tons. It is shared by marine fishery for 1/4 of total production and by inland fishery for 3/4 of all. The share of the latter is important. The population is on an ongoing rise whereas the fishery production stagnates. The gap between supply and demand is getting wider and wider. The amount of imported seafood is soaring (see the table below). Frozen horse mackerel and mackerel are imported from Senegal and Mauritania.

Table 2-9. Evolution of sea food export / import

	2001	2002	2003	2004	2005	2006
Export	733	680	367		125	96
Import	15,181	10,102	18,025	19,090	45,228	46,466

Measure: ton

Source: Department of Fishery

Apart from fishermen, about 20,000 middlemen work in the fishery sector. Most are women and their task consist in purchasing, selling and smoking the fish.

Chapter 3

Current situation of inland aquaculture and its potential

Chapter 3 Current situation of inland aquaculture and its potential

3.1 Role of inland aquaculture

The inland aquaculture represents one of the economic activities of the fishery sector. There is no concrete statistical data but its contribution to the fishery sub-sector in the whole country is considered very limited. The share of fishery sub-sector in the Gross Domestic Product (GDP) is estimated at 2% only, and that of inland aquaculture is a part of this 2%. Thus its contribution to the national economy is extremely low.

Regarding the employment, number of households practising aquaculture activities is said to be about 3,000. Now, the number of farmers' household living in the rural communities would reach 570,000. The percentage of the aquaculture-related households is 0.5% accordingly.

Among the households of farmers living in rural areas, those who earn their living in the cashing crops like cotton are relatively favoured. But those who grow crops such as cassava, yam, or maize generate lower income. Most of those who live below the poverty line in terms of the incomes belong to the latter category. They produce and sell all they can at the price they are giving: cassava, yams, maize, beans, tomatoes, vegetables, sugar canes, chickens, rabbits, goats etc. Aquaculture is one of those economic activities in the village. When aquaculture, which represents one of these various economic activities, could be developed, it would contribute not only to increase the total income of the rural households, but also to generate the funds to be required for other economic activities.

As for domestic supply of aquatic products, there exist high expectations for inland aquaculture. The current fishery production is about 40,000 tons, of which 10,000 tons from the marine fisheries and 30,000 tons from the inland fishery. The potentials for developing the marine fisheries resources stated by Food and Agricultural Organisation (FAO) are 12,000 tons, and it is no exaggeration to say that the exploitation has already been exceeded. As for inland fishery, there is no official estimation of the total allowable catch, but they assume according to the testimonies of the fishermen and the fish catch trend that inland fishery as well as marine fisheries, has reached to the level of maximum resource use. There is no potential for increasing fishery production in those capture fisheries facing over exploitation of natural resources. On the other hand, the national population keeps on growing. According to the RGPH3 (Census) of 2002, the total population has reached 6.7 millions that year, recording a great annual increase of 3.25% since the previous census. If the population keeps on growing at the rate of 3% annually, it will exceed eleven millions in 2020. Per capita fishery consumption of the country is currently 8.9kg. This statistical data is relatively low comparing with those of neighbouring countries (29.2kg in Senegal, 12.8kg in Guinea, 23.5kg in Gambia, 13.6kg in Cameroon, according to PMEDP). Assuming that this amount is maintained in future, 104,000 tons of fishery products will be required in 2020. Importation will compensate the difference between 40,000 tons and 104,000 tons. Importation of frozen fish was less than 20,000 tons till 2004 but increased to be 45,000 tons after 2005. Therefore total supply of fishery products is calculated to be 85,000 tons at present. Even if the import is maintained at the same level, there is still significant deficit of 20,000 tons. The role of aquaculture is to correct this gap.

3.2 Upper programs

The Poverty Reduction Strategy Paper (PRSP) 2003-2005 represents the core of the upstream government program. The PRSP suggests the poverty line in the villages at 51,413 FCFA per person per year (amount of expenses) and plans to reduce the percentage of people living under this poverty line from 33% in 2000 to 15% in 2015. It elaborates the following five strategies for this purpose.

- Acceleration of the economic growth
- Development of the infrastructures
- Reinforcement of human resources
- Promotion of good governance
- Balanced and sustainable development of the national territory

The PRSP 2003-2005 is followed by the next version of the document called the Poverty Reduction and Growth Strategy Paper (PRGSP) 2007-2009. The purpose and the strategies remain the same.

Nevertheless, the “growth” issue was added to the title of the new document, which shows the will of the government to emphasis on the economic growth to reduce poverty instead of focusing only on the assistance about basic human needs.

There are two documents which constitute the baseline of PRSP, namely the Population Policy Declaration (DEPOLIPO) and the National Strategic Vision of Benin for 2025. These 2 documents show a long term orientation and vision.

Concerning the rural development, the Agricultural and Rural Development Master Plan (SDDAR) was launched, and following this plan the Strategic Operational Plans (PSO) and the Rural Development Policy Declaration (DPDR) were also publicised in 2000-2001.

The new Yayi Boni government started from April 2006 reviewed the agricultural policy on the basis of previous considerations and launched the Strategic Plan for the Boosting of Agricultural Sector in Benin 2006-2011. The concrete political targets to be achieved by the year 2011 are shown as follows.

Agriculture sub-sector

- Uphold the production of cotton to a level of 600,000 tons.
- Increase the production of cashew nuts from 40,000 to 60,000 tons.
- Increase the production of maize from 841,000 tons in 2005 to 1,100,000 tons in addition to securing the production of 250,000 tons for non-food purpose
- Increase the production of cassava by 20%, and reinforce the processing industry not only for domestic consumption but also for export market of the neighbouring countries.
- Increase the production of rice by 70,000 tons by increasing the volume of the harvest per surface unity.
- Increase the production of palm oil by more than 400,000 tons through modernisation of plantations.
- Realisation of a self-sufficiency rate of 100% for vegetables.

Livestock sub-sector

- Increase the meat production by 45% and improve the self-sufficiency rate to 70%.
- Increase the production of chicken from 20,000 tons in 2005 to 30,000 tons and improve the self-sufficiency rate to 50%
- Increase the production of milk from 85,000 tons in 2005 to 124,000 tons.
- Increase the productivity of laying hen from 220 to 250 eggs per chicken annually and suppress importations.

Fishery sub-sector

- Reduce the amount of imported fish by 20% through increasing the aquaculture production.

Thus, the Strategic Plan for the Boosting of Agricultural Sector 2006-2011 stressed the reduction of 20% of fish import, which is equivalent to 9,000 tons calculating from the current imported volume of 45,000 tons in 2006. Shortly, aquaculture is expected to compensate for these 9,000 tons.

The mutual relation among the different upstream and downstream plans can be consolidated as shown in Fig. 3-1.

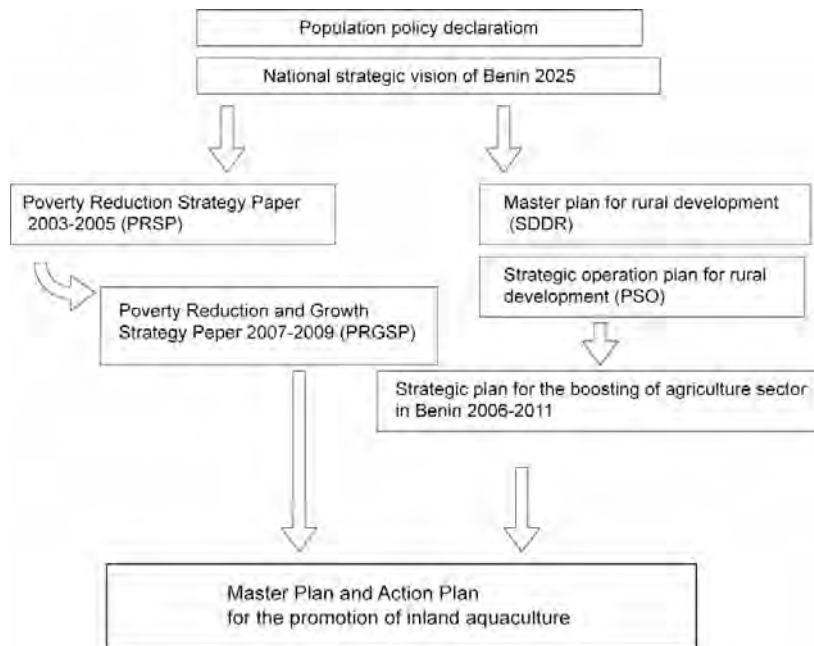


Fig. 3-1. Mutual relations of relevant upper programs and the Master Plan of Inland Aquaculture

3.3 Relevant programs

Currently there are two aquaculture development projects that are in progress, such as 1) the program for supporting participatory development of traditional fishery (PADPPA) and 2) the program for supporting the development of agricultural productions (PADFA).

PADPPA is an eight years program with a total budget of 26 million dollars, jointly financed by the International Fund for Agricultural Development (IFAD) (10 million dollars) and the African Development Bank (ADB) (10 million dollar). The Government of Benin also financed 2 million dollar for this program. The program aims at sustainable use of fishery resources and conservation of water areas, and implements re-forestation of the watersheds, stocking juveniles in dam reservoirs, and promotion of income generation of fishers from activities other than fishing. As for the actions related to aquaculture, PADPPA provides technical and financial supports to the fish farmers who are producing the fingerlings for the releasing to the reservoirs. However, no systematic assistance is conducted for increasing the production of edible size fish. In order to promote income generation other than fishing, the trainings on rabbit breeding and vegetable culture are now carried out.

PADFA is a project entirely financed by the Benin Government to support all the agricultural sectors including aquaculture. The implementation period is five years (2006-2011) and the total budget amounts to 7,985,340 FCFA (not only for aquaculture but the whole agriculture sector). The major supporting menus for fish farmers are as follows.

- Financing the operation cost like expenses for feed and seeds (0% interest reimbursable over five years)
- Subsidising the material investments (the project pays up to 75% of the material investments)
- Covering 100% of the expenses related to technical trainings

The purpose of the project is to increase the aquaculture production by 15,000 tons and to create direct employment of 47,000 people through aquaculture.

PADPPA will not directly contribute to the increase of aquaculture production, whereas PADFA sets concrete target production and aims to encourage aquaculture production directly.

It is noted that the Department of Fisheries (DOF) manages none of the two projects directly. For example the direct implementing organization of PADFA is the Department of Planning and

Prospective, DPP of MAEP, and the DOF is only a member of the steering committee.

3.4 Past aquaculture projects

The first aquaculture project in Benin is the Project of Aquaculture Development (PDP), financed by the European Development Fund (EDF) during the period of 1978 -1987. This project consists of 1) establishment of the Godomey aquaculture center, 2) pen culture of tilapia and 3) construction of feed plant. The purpose of this project was farming of tilapia in the Nokoué Lake. It was an integrated project for tilapia culture consisting of seed production at the center, installation of pens in the lake, release of the fingerlings there and giving them with compound feeds produced at the feed plant. However in 1978, the dike which separated the lake and the Atlantic Ocean was cut and opened artificially so that seawater flew in the lake. Accordingly tilapia in the pens having less resistant to the saline water were said to be died. Like this, pen culture had entirely ceased operation and the feed plant has been closed until now. After the project, the Godomey aquaculture center continued operation. It functioned as a center of seed production and the marketable fish production. However, due to the failure in management, it was then abandoned. At present the site of the center is facing the conflict about land with neighbouring land lords and there is no prospect about restoration.

Because of the uncertainty of aquaculture development in the Nokoué Lake, namely suspension of activities at Godomey aquaculture center and the saline environment of the lake, the development target has been shifted to tilapia culture in ponds and a new aquaculture center was established in 1995 at Tohonou, Bopa commune of the Mono prefecture. The objective of the center was to supply sufficient amount of seeds and compound feeds to fish-farmers in the vicinity. At the beginning this center was managed well, but various problems appeared thereafter, such as high operation cost due to pumping up of water, intrusion of brackishwater, etc. As the results, it is not functioned well at present. Today the center belongs to CeRPA Mono/Couffo.

3.5 Donors and NGO

The donors supporting aquaculture include Japan, Belgium Technical Cooperation (BTC), the Food and Agriculture Organization (FAO) and the European Union (EU). The cooperation of Japan on aquaculture started from 1999 shifting its cooperation scheme from the maintenance of boats engine to encouragement of inland aquaculture, for which long-term experts have been allocated continuously until now. Belgium has suspended the cooperation to fishery sector including aquaculture after the Rural Community Development in Mono prefecture (PAMAR). Recently it planned to formulate a project concerning the quality assurance of fishery products in conformity with the policy of EU. The FAO has finished the PMEDP, which was lasted for 8 years, and is now considering the next project together with finance source. The EU, which is now carrying out technical cooperation for the quality improvement of exporting fishery products, allocates a long-term expert in the DOF.

The largest NGO in agriculture sector in Benin is the Songhai Center. The Songhai is founded by an American of Nigerian origin aiming at integrated development of rural community though balanced development of the 3 sub-sectors such as agriculture, livestock and aquaculture. It has received financial assistance of USAID. The headquarters is located in Porto-Novo and has branches in Parakou and Lokossa. Recently the activities of Songhai expanded to the processing of agricultural products, craft industry, and management of restaurant and cybercafé. Songhai offers various training courses organized by itself and also carries out trainings in collaboration with donors and other NGO based on the contract. Aquaculture training organized by JICA is implemented at the facility of Songhai.

As for other NGOs, there are “Aquaculture promo” that is specialized for the aquaculture techniques and “CREDI-ONG” that covers aquaculture and aquatic environment.

3.6 Administrative organs

(1) Department of Fisheries (DOF)

The administrative organ responsible for inland aquaculture is the Department of Fisheries (DOF), which belongs to the Ministry of Agriculture, Livestock and Fishery (MAEP). The current structure of the DOF was defined in 2005 by the ministerial ordinance 537/MAEP/D-CAB/SGM/DRH/DP/SA.

According to this ordinance the DOF is comprised of 5 Divisions such as Financial and Administrative Division, Marine Fishery Division, Inland Fishery and Aquaculture Division, Division of Control and Supervision of Fishery Products, and Division of Monitoring and Evaluation. It has a Secretariat. The exact division responsible for inland aquaculture is the Inland Fishery and Aquaculture Division. This division is comprised of the Section of Inland Fishery and the Section of Aquaculture. Presently 3 officers are allocated for inland aquaculture development, namely the division chief and 2 officers in the Section of Aquaculture. The organizational chart of the DOF is shown below.

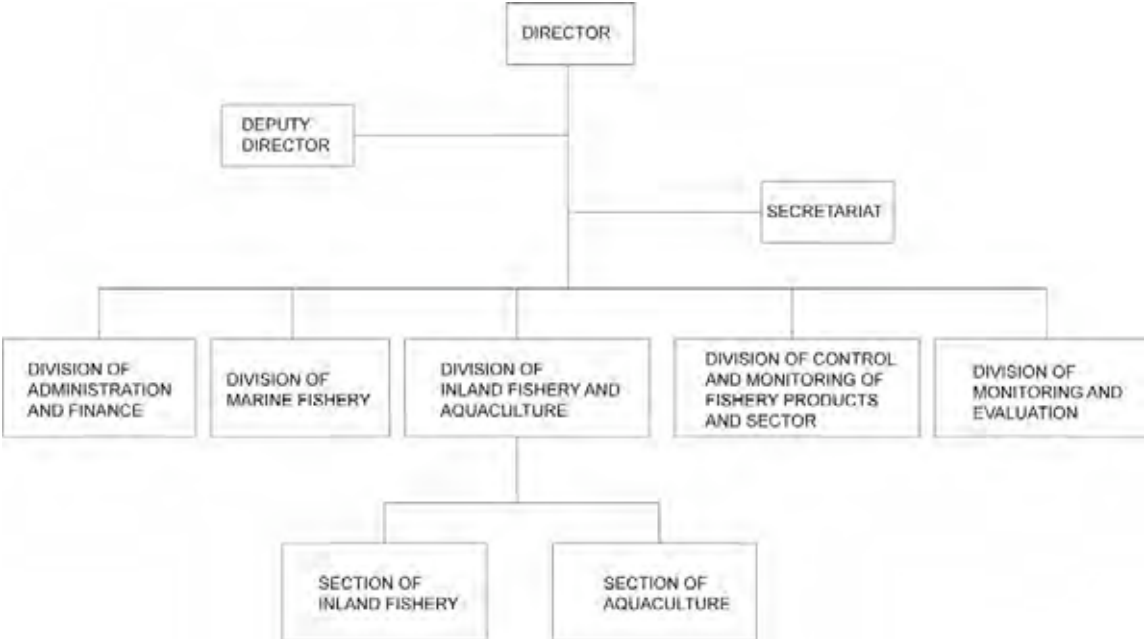


Fig. 3-2. Organization chart of the Department of Fisheries

(2) Ministry of Agriculture, Livestock and Fishery (MAEP)

The Ministry of Agriculture, Livestock and Fishery (MAEP) in which the DOF belongs to, was established in 2000 by renaming from the Ministry of Rural and Development. It is comprised of 16 departments for specific technical fields and 13 corporations and external organizations. The DOF is one of the 16 technical departments. The CeRPA is one of the 13 corporations/organizations. Total number of personnel of the 16 technical departments and the 13 corporations/organizations is 2,538 and 3,345, respectively including contractual staffs. Thus, total number of personnel in MAEP is 5,883. The organization chart of MAEP is shown below.

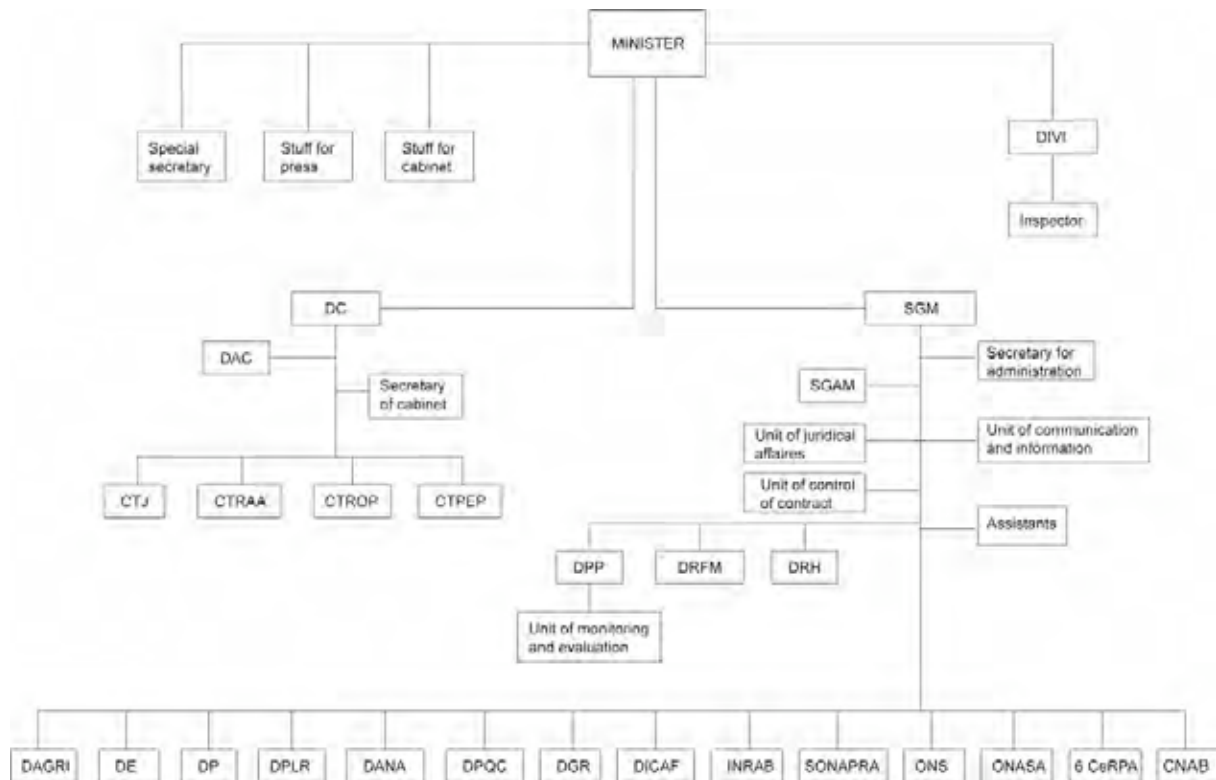


Fig. 3-3. Organization chart of the Ministry of Agriculture, Livestock and Fishery (MAEP)

(3) CeRPA

Extension activities concerning all the primary sectors under MAEP are entrusted to CeRPA, which were created by the ministerial ordinance No. 773-778/MAEP /DCAB /SGM /DRH / SA enacted on June 3rd 2004. The CeRPA has inherited the responsibility and the administrative area from the former “Regional Center for Rural Development” (CARDER). There are six CeRPAs nationwide. In the year of decentralisation in Benin or the year 2002, the former local government units namely 6 prefectures were divided respectively into two in order to assure better administrative services and now there are 12 prefectures. However, the administrative areas of CeRPAs are unchanged, and one CeRPA covers two prefectures.

CeRPA is comprised of five different departments (refer to the organization chart shown below):

- Department of Regulation and Control
- Department of Promotion of Agriculture Sector and Food Security
- Department of Exploitation and Management of Natural Resources
- Department of Information, Training and Support to Organizations
- Department of Planning, Administration and Finance

The Division of Promotion of Agriculture Sector under the Department of Promotion of Agriculture Sector and Food Security is responsible for development of aquaculture. Contrary to the industry supportive activities, inspection and monitoring activities are also required. Those activities were attached to the Division of Control of Fishery and Livestock Products under the Department of Regulation and Control. As shown in the structure of MAEP, staffs of CeRPA are not in commanding line of DOF although they are working in fishery sector. CeRPAs are considered autonomous local bodies directly attached to the Minister

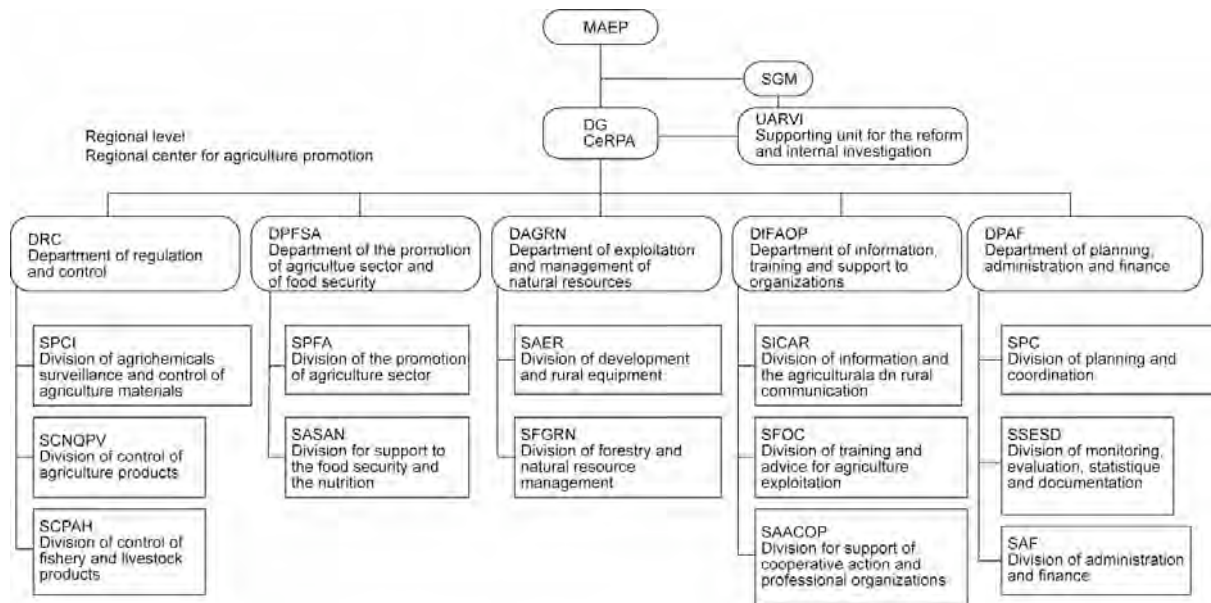


Fig. 3-4. Organization chart of CeRPA

Because there are only 6 CeRPAs nationwide, they are difficult to provide direct support to farmers. Therefore the Communal Center for Agriculture Promotion (CeCPA) is organized under each CeRPA at commune level.

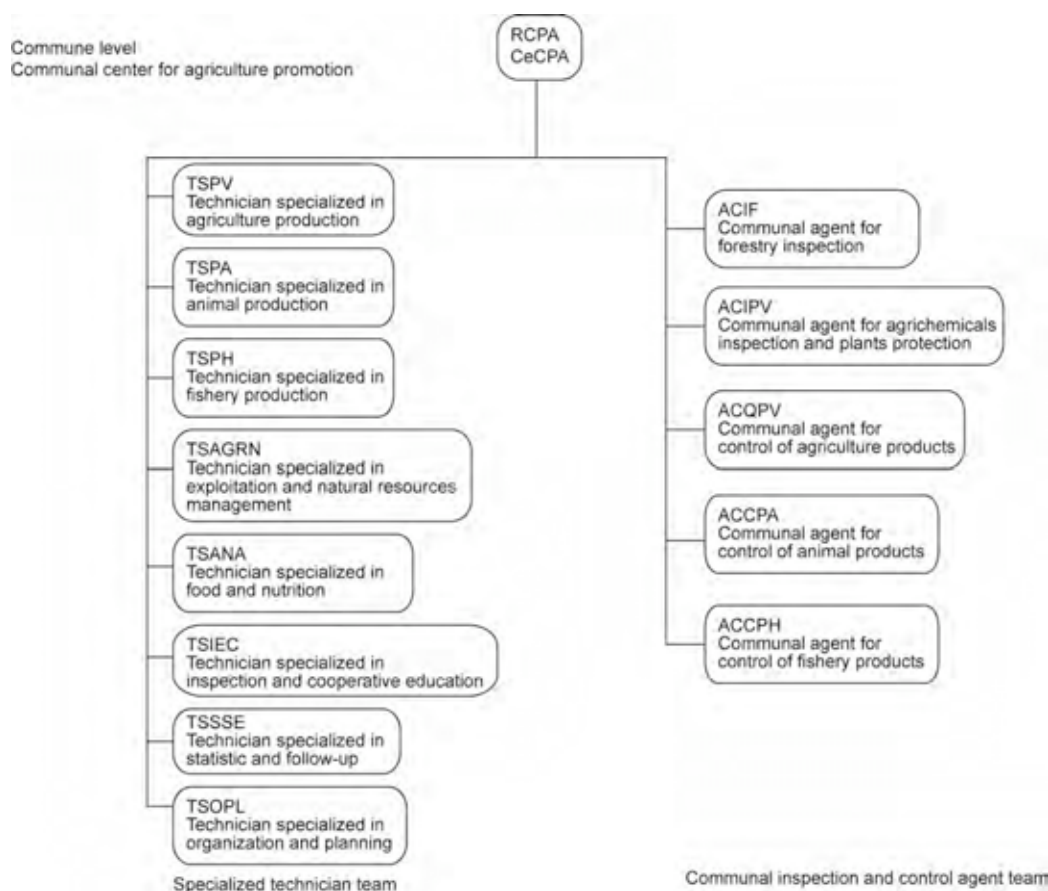


Fig. 3-5. Organisation chart of CeCPA

The organizational arrangement of CeCPA is made in the same concept as CeRPA. The administrative

units are arranged by two sides, namely promotion side and control side, to achieve the balanced development. In the field of aquaculture, the promotion is carried out by the specialized technical officer on fisheries (usually called as “fishery extension officer”) whereas the control is done by the fishery product control officer.

Since 2006 in order to promote the extension services closer to farmers, the extension officers are going to allocate at the town level. But number of town level officers is limited due to budgetary restriction.

Approximately 2,100 new extension officers were recruited in the CeRPA and CeCPA from May to July of 2007. Among those, more than 200 officers were recruited for the fishery sector. They are assigned for important communes to strengthen the services as well as to extend the services to the new communes.

(4) Benin National Agriculture Research Institute (INRAB)

This institute is conducting studies and researches related to the primary industry sectors. It consists of a headquarters and 5 external centers such as 2 specialized research centers, cotton center and plant center, and 3 regional centers. The research on aquaculture and fishery is rendered for the headquarters where 3 permanent staffs are assigned.

3.7 Characteristics and management of aquaculture

3.7.1 Overview of aquaculture activities

Except for the extremely extensive forms of aquaculture namely “acadja” and “whèdo” which might be classified as a kind of fishing activities, there is no traditional aquaculture activity in Benin as in other African countries. The aquaculture has just begun. The inland aquaculture might have been started at the colonial era in the middle of 1950s by some newly steted French colonists probably aiming at both self consumption and sale. It is only 10 years after independence in 1970s that fish production acquired more commercial vision. The history of aquaculture in Benin is extremely new comparing to China where carp production might have been practised since more than 2,000 years ago and many other oriental countries such as Japan and those in Southeast Asia.

In Benin statistical investigation on aquaculture has not been carried out systematically so that the DOF asks CeRPAs and CeCPAs to collect information about the number and location of fish farmers whenever the necessity arises. In the southern region of the country, number of small- and medium-scale fish farms is increasing slowly through the several donor-assisted projects. In addition, some new activities were launched by private initiative such as establishment of a large-scale Clarias seed production and aquaculture farm facilitated with modern equipments and the attempt of pen culture of the tilapia. In the northern region on the other hand, there are few fish farms having economic viability in rural areas, except for a facility of Songhai and a fish farm operated by an expatriate fish culturist near Parakou. Under such situation, an extremely extensive aquaculture has been developing in “whédo” of Malanville and Karimama having peculiar natural environment as the flood plain of the Niger River.

The inland aquaculture activities of Benin are overviewed hereinafter based on the field investigation and the result of questionnaire survey extended in the whole country.

3.7.2 Target species

Most of fish farmers practice Tilapia (*Oreochromis niloticus*) culture. The fingerlings of 20-30g are reared in earthen pond for about 6 months with fertilization and various feeding, and harvested at the size of 100-150g. Cultured Tilapia are sold at about 1,000 FCFA/kg. As the quantity of Tilapia is not sufficient, they are rarely sold in market. The buyers are government workers or middle scale farmers who come to the farms according to the local communication about fish sale.

In the prefectures of Ouémé and plateau, located in the south-east part of the country and close to the border with Nigeria, aquaculture of a catfish, Clarias (*Clarias gariepinus*) is developing. Clarias is

highly demanded in Nigeria as well as in Benin. So the buyers from Nigeria used to cross the boarder to get the fish. The purchase price is between 1,000 and 1,500FCFA/kg. Although Beninese were aware of the potential of Clarias culture, aquaculture development of this species has been hindered due to the technical problems about seeds and feeds. Traditionally there are many ponds in Ouémé and Plateau so that they have development potential of Clarias culture if these two problems are solved. In this context, the expert of JICA organized a training course on the technique of artificial seed production of Clarias and thus, one of the constraints is going to be solved. The problem of feed has naturally disappeared with the development of trade with Nigerian buyers. Indeed, the feed used in Nigeria was imported on private basis.



Fig. 3-6. Tilapia (*Oreochromis niloticus*)



Fig. 3-7. Clarias (*Clarias gariepinus*)

Source: Poisson d'eau douces et saumâtres de l'Afrique de l'Ouest (IRD)

Apart from the aforementioned two species, creation of new Tilapia strain acquiring high saline resistance was attempted during the time when the Godomey Aquaculture Center was operationed,, but it was failed. Considering there are several big lakes exploitable for aquaculture, such as Lake Nokoué, lagoon Porto-Novu or Lake Ahémé in the south of the country, it would be rational to develop the strain suitable for brackishwater environment.

3.7.3 Different forms of aquaculture

(1) Type of fish pond

Almost all the inland aquaculture of farmers are carried out in earthen ponds. Two types of water intake system are employed for these ponds, one is irrigation by gravity possibly for multiple ponds and the other is shallow ground water for individual pond. In the former system, water sources are various surface waters such as river/stream, flowing well, swamp, reservoir, etc., and the water is supplied to the ponds through canal by gravity. The pond water is basically drainable. On the other hand, in the latter system groundwater is supplied from the pond bottom and walls naturally so that the pond water is basically not drainable. This type of fish pond is very common in Benin where the level of groundwater is very shallow.

In this master planning study, the pond of the former type is called as “drainable pond”, and the latter type, “non-drainable pond” according to the wording popularity in Benin. In general the ponds for which surface water is supplied are drainable, and the ponds for which water is filled with penetrated groundwater are non-drainable. However, it shall be reminded here that “drainable pond” located in low land is often not drainable by gravity, while “non-drainable pond” constructed in slope topography is drainable. The categorization of pond type and the terminology shall be discussed more in further.

(2) Other forms of aquaculture

Apart from pond, such forms of aquaculture are performed, i.e., floating net cage culture, pen culture, rice-cum-fish culture and small-scale plastic sheet tank culture (simple water tank made of wooden case of ca. 1 x 5m in which plastic sheet is placed as an inner film). However, aquaculture activities by these forms are now very limited in number and scale.

(3) Whédo

In Benin, the concept of aquaculture includes “the actions to catch wild fish that have been entrapped in artificial structures for a certain period of time” as “extensive aquaculture”. Concretely those are

“Acadja¹”, “Aholo²” and “Whédo”, which are considered also as traditional fishing methods. Examination on “Acadja and “Aholo” has been excluded from the current study. As for “Whédo”, although basically it is considered as a type of fishing method, in recent years there were some cases that the activities should be categorized as aquaculture so that it is now vague about the terminology.

Whédo is a traditional fishing method carried out in flood plain, catching wild fish that have been entered in artificially-dug holes/ponds/canals after flood is ceased (see Fig. 3-8 below).

Whédos have been developed in the flood plain of the Niger River in Alibori prefecture (Communes of Malanville and Karimana) as well as on the sandbanks of lower Ouémé River in Ouémé and Plateau prefectures. In both regions, whédos belong to individual owners or farmer’s group and they are not public property.

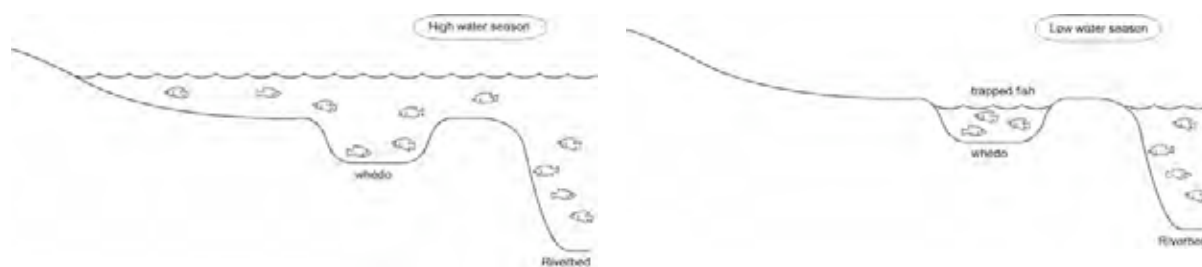


Fig. 3-8 Mechanism of whédos

It is interesting that the shape of whédos is completely different in two regions. In the Ouémé and Plateau prefectures, they are extremely elongated, having 1 to 2 meters in width and several meters to several hundreds meters in length, whereas those of Malanville and Karimama are flat shape having an area of 100-400m². Whédos in Ouémé and Plateau are traditional ones. The sandbanks where many whédos are operated form a fertile agriculture fields mainly for vegetables. Whédos serve as a fish catching devices as well as water recharge source for vegetable culture. Thanks to the narrow width, fish can be caught with a small-scale seine net. On the other hand, whédos in Malanville that have been rapidly developed in recent years, focusing on additional fish catch. The whédo areas are usually parts of pasture ground for cattle, and agriculture is not carried out there.

Aquaculture using whédos has not been undertaken positively in the whédos of the Ouémé River except for experimental rearing for research purpose. On the contrary, in Malanville and Karimama, there have been some farmers who attempt to grow trapped wild fish by artificial feeding or release artificial seeds in whédos after catching of wild fish in order to increase the productivity.

3.7.4 Fish farms and their scale

(1) Number of fish farms

According to the questionnaire survey of this study (hereinafter called as “Aquaculture Census 2008”) implemented in June-August 2008 at the commune level, total number of fish farms were 931 (except whédos) for the whole country, 93% of those (865 fish farms) are concentrated in 6 southern prefectures (Mono, Couffo, Atlantique, Ouémé, Plateau and Zou) (Table 3-1). In the 5 prefectures of the northern Benin (Borgou, Alibori, Atacora, Donga and Collines), the number of fish farm is only 66 or 7% of the country despite the broad land area.

¹ A traditional method, putting a large volume of branches in the shallow area of approx. 2m depth, waiting several months and catching fish attracted in and around a mass of branched.

² Other type of acadja practiced in closed and separated area with branched from the river. They are often seen along the big rivers.

Table 3-1. Number of fish farms in Benin (2008)

	Type of management body					Total
	Individual	Group	Commune	NGO	Govern-ment	
Northern region						
Borgou	9	2	1	2	0	14
Alibori	3	5	0	0	0	8
Atacora	0	1	2	1	3	7
Donga	4	18	0	0	1	23
Collines	11	1	1	1	0	14
Sub-total	27	27	4	4	4	66
Southern region						
Zou	41	11	1	1	0	54
Mono	29	41	0	2	2	74
Couffo	29	8	1	0	1	39
Atlantique	256	60	1	3	0	320
Littoral	0	0	0	0	0	0
Ouémé	274	29	0	2	0	305
Plateau	65	8	0	0	0	73
Sub-total	694	157	3	8	3	865
Total	721	184	7	12	7	931

Note: Whédos are not included.

Source: Aquaculture Census 2008

Fish farms are classified into individual, group and others (commune, NGO and government) by types of management. Ratio of individual and group management was approximately 50-50 in the northern region, while it was 80-20 in the southern region. The average age of individual farmers was 54 years old.

The individual farms are managed mostly by men with a proportion of 93%. On the other hand, the group members consist of 67% men and 33% women, indicating active participation of women in aquaculture.

(2) Scale of fish farms

Scale of fish farms in terms of area of fish ponds are shown in Table 3-2 by individual and group farms. It tends to be slightly bigger in farms operated by group than individual farms. In either management, small-scale farms of less than 1,000m² are dominant, but that ratio was higher in the individual operators as 74% than in group management as 60%. There is no conspicuous difference between the northern and the southern regions about the scale of farms.

Table 3-2. Scale of fish farms (2008)

	Individual				Group			
	<1,000 m ²	1,000-4,999 m ²	5,000 m ² <	Sub-total	<1,000 m ²	1,000-4,999 m ²	5,000 m ² <	Sub-total
Northern region								
Borgou	5	3	1	9	1	0	1	2
Alibori	3	0	0	3	4	1	0	5
Atacora	0	0	0	0	1	0	0	1
Donga	2	2	0	4	11	7	0	18
Collines	11	0	0	11	1	0	0	1
Sub-total	21	5	1	27	18	8	1	27
Southern region								
Zou	35	6	0	41	10	1	0	11
Mono	10	19	0	29	8	31	2	41
Couffo	17	12	0	29	0	7	1	8
Atlantique	202	47	7	256	50	10	0	60
Littoral	201	67	6	274	17	12	0	29
Ouémé	50	14	1	65	7	1	0	8
Sub-total	515	165	14	694	92	62	3	157
Total	536 (74%)	170 (24%)	15 (2%)	721 (100%)	110 (60%)	70 (38%)	4 (2%)	184 (100%)

Note: Whédos are not included.

Source: Aquaculture Census 2008

3.7.5 Role of aquaculture in rural communities

(1) Ratio of fish farms

The number of agriculture household was of 566,071 for the whole country in 2002. Supposing that a fish farming group is made up with an average of 8 members, the number of aquaculture-related households is calculated to be 2,193 (721 individual farmers +184x8 group members according to Table 3-1). Considering that all of them are mainly farmers, the percentage of fish farmers in rural area was 0.4% in the whole country, whereas 0.1% in the north and 0.6% in the south.

(2) Objective of aquaculture

According to the Aquaculture Census 2008, 67% of fish farms answered that the objective of aquaculture is rather for sale and 33% rather for self-consumption in Benin. In the northern prefectures, ratio of farms answering rather for self-consumption tend to be higher as 37-50%, while in the southern prefecture, farms aiming at income generation dominated as 63-80%.

(3) Additional occupation

Table 3-3 indicates other economic sources of fish farms. Although the result of the Census included answers not only of individual fish farms but also of those operated by commune, NGO, etc., there is a tendency that agriculture area is larger in fish farmers as more than 6 ha comparing to the national average of about 3.3ha. There is significant number of fish farms additionally obtaining salaries.

Based on those analyses, it is suggested that that farmers engaging in aquaculture are relatively well-beings and progressive minders in rural communities.

Table 3-3. Economical activities of fish farms other than aquaculture

	Number of fish farms	Other economical activities (multiple answers)			Average area agricultural land (ha)
		Salary	Agriculture	Livestock	
Northern region	66	9	35	32	6,4
Southern region	865	123	582	495	6,0
Total	931	132	617	527	6,2

Source: Aquaculture Census 2008

3.7.6 Aquaculture facility and production

(1) Aquaculture facility and its scale

Scale of aquaculture facilities is given in Table 3-4. The most popular type of aquaculture facility is non-drainable ponds occupying 67.57ha followed by drainable pond of 23.35ha in the country. However, it is noted in the north that the scale of drainable ponds is pronounced as 6.90ha rather than non-drainable ponds as 2.11ha. This is due to difference in topography and geological natures between the south and north.

The aquaculture in floating net cages is scattered in certain places, i.e., Songhai Center, Parakou (Borgou prefecture), Grand-Popo (Mono prefecture) and So-Ava (Atlantique prefecture). Pen culture has rarely been observed in Benin. A pioneer fish farmer of Adjara (Ouémé prefecture) started this type of aquaculture in 2008. These situations are explained later in this report. Plastic sheet tank was introduced recently in the south for Clarias culture. It has not been practiced in the north at present. Concrete tanks or ponds are also found but they are not popular with total areas of 0.7ha only.

Table 3-4. Scale of aquaculture facilities (2008)

	Drainable pond	Non drainable pond	Floating net cages	Pen	Plastic sheet tank	Concrete pond
	(ha)	(ha)	(m ³)	(m ²)	(m ²)	(m ²)
Northern region						
Borgou	4.49	0.67	350	0	0	166
Alibori	0.22	0.17	0	0	0	0
Atacora	0.27	0.16	94	0	0	250
Donga	1.93	1.09	0	0	0	0
Collines	0.00	0.02	147	0	0	1,097
Sub-total	6.90	2.11	591	0	0	1,513
Southern region						
Zou	0.63	1.24	0	0	0	1,611
Mono	11.92	3.49	216	0	0	604
Couffo	2.07	4.28	0	0	0	204
Atlantique	0.79	26.64	56	364	10	2,064
Littoral	0.00	0.00	0	0	0	0
Ouémé	0.67	24.11	200	1,750	2	624
Plateau	0.37	5.70	0	0	0	394
Sub-total	16.45	65.46	472	2,114	12	5,501
Total	23.35	67.57	1,063	2,114	12	7,014

Source: Aquaculture Census 2008

(2) Operating status of aquaculture facilities

Current operating status of major aquaculture facilities is shown in Table 3-5. In the south, the percentage of operational ponds is estimated about 60% (61.5% for drainable ponds and 57.9% for non-drainable ponds), suggesting there are many abandoned fish ponds. The percentage of the operational ponds is calculated higher in the north. However, since this result was obtained by simple averaging of prefectures having a limited number of farms, it would not exactly reflect the reality.

Table 3-5. Percentage of operational ponds (2008)

		Drainable ponds	Non-drainable ponds	Concrete tank/pond
Unit: %				
Northern region				
Borgou		90.2	60.9	100.0
Alibori		100.0	100.0	-
Atacora		29.9	100.0	28.8
Donga		61.1	76.0	-
Collines		-	0.0	54.7
Sub-total		80.0	74.3	55.4
Southern region				
Zou		85.7	63.7	21.2
Mono		58.4	53.7	100.0
Couffo		68.5	85.1	68.6
Atlantique		75.9	57.8	62.2
Littoral		87.9	52.9	82.4
Ouémé		0.0	59.9	100.0
Sub-total		61.5	57.9	59.6
Total		67.0	58.4	58.7

Source: Aquaculture census 2008

(3) Aquaculture production

Aquaculture production was estimated based on the Census data as shown in Table 3-6. The total production of Benin was estimated as 159 tons in the year 2008, of which 106 tons (66%) were sold with 112 millions FCFA (228,000 USD). The unit price of fish is calculated exclusively high in Borgou prefecture. It is likely that sales of Clarias and seeds (both Clarias and Tilapia) at the two modern farms, Songhai Center, Parkou and Hillary's aquaculture farm would affect the calculation. Except for Borgou prefecture, the average price of fish was calculated around 700-1,000 FCFA/kg,

which corresponded to the real situation.

Table 3-6 Aquaculture production and sales (2008)

	Total Production (ton)	Sales volume (ton)	Sales value (1,000 FCFA)	Unit price (FCFA/kg)
Northern region				
Borgou	7.21	5.15	9,388	1823
Alibori	3.21	2.48	1,736	701
Atacora	0.35	0.28	39	140
Donga	2.90	2.53	2,303	919
Collines	0.00	0.00	0	-
Sub Total	3.66	10.44	13,465	1,290
Southern region				
Zou	2.31	1.92	1,766	918
Mono	16.83	15.19	14,317	942
Couffo	13.07	11.94	10,883	911
Atlantique	49.77	46.78	27,622	590
Ouémé	43.53	0.00	22,809	-
Plateau	20.32	19.39	20,692	1,067
Sub Total	145.82	95.23	98,089	1,030
Total	159.48	105.67	111,554	1,056

Source: Aquaculture census 2008

Based on the above data, the productivity of fish pond is examined. The area of operational ponds can be calculated from Table 3-5 and 3-6. It is 15.6 ha for drainable ponds, 39.4 ha for non-drainable ponds and 0.4 ha for concrete ponds, and totally 55.5 ha in the country. Since the production of other forms of aquaculture could be ignorable³, the average productivity of fish ponds in Benin can be obtained by dividing the aquaculture production of 159.5 tons (Table 3-6) by the 55.5 ha of pond area. It would be 2.87 ton/ ha.

3.7.7 Aquaculture activities by prefectures

(1) Prefecture of Atacora

There is no practical aquaculture activity in Atacora at present. In the past some aquaculture activities of farmer's group in Natitingou was assisted by NGOs, but the facilities were abandoned due to difficulty in management (village of Perma) or destructed by flood (village of Kota Monongou). The farmer's group of Kota Monougou wish to start again the aquaculture, but their approach is just to waiting for donor's assistance for facility renovation and operation budget.

At the manmade reservoir of Tchakalakou, Toucountouna Commune located in the southern part of the prefecture, the DOF attempted an experimental net cage culture in 2000, but this attempt had to be terminated in the following year 2001 because a tank lorry overturned on the adjacent road and a huge amount of fuel intruded to the reservoir. Thereafter PADPPA released the reservoir fingerling of Tilapia in 2005. However since villagers don't have fishing gear and know-how on fishing, fish have not been caught until now. In Tanguiéta commune, north-west of the prefecture, an American NGO "Mission Jesse" runs a technical training center for rural development. It constructed aquaculture ponds in the center, but the pond water could not be maintained so that the aquaculture activity is not carried out adequately.

(2) Prefecture of Donga

In the villages of Karoum Yaourou and Karoum Dora, Kopargo commune (located at the northern part of the prefecture neighbouring the Atacora prefecture), pond culture of Tilapia is going to get on track using water from small-scale barrage. The aquaculture here is employed by farmer's groups with about ten members each and receiving continuous technical guidance of JICA experts since several years ago. On the other hand, in the neighbouring village of Tanéka Koko, the DOF constructed and managed an

³ Fish production from floating net cages at Grand-PoPo and So-Ava is about 2 tons in total. Pen culture has produced few fish until now.

experimental aquaculture facility in the 1990s and then the activities were transferred to farmer's group. Thereafter, the representative of this group absconded with the money in 2001 so that the activity has been suspended and the facilities have been abandoned since then. Although the farmer's group expresses their will to re-start the aquaculture, opinion about the operation and management has not been united among villagers.

The rural development center (CPR) of CeRPA, village of Kpabegou, Kopargo commune has aquaculture ponds for demonstrating to agriculture trainees. CPR is operated in other CeRPAs but they said that aquaculture ponds are facilitated only at this center.

In Bassila commune, southern part of the prefecture, a fish farm has been operated by a group of farmers with technical assistance of the chief of the Penessoulou township who was fishery extension staff before. This group was founded in 2002 with 13 people. They excavated five ponds of 100 to 200 m² and started aquaculture. The construction works were done by group members and each member offered 100FCFA per day for 6 months to be used for meals during the construction and consumables (100FCFA/day x 30 days x 6 months = 18 000F CFA/person). Now some cultured fish can be sold, but the benefits are not shared by members because they are used or reserved for reinvestment.

In the dam reservoir for drinking water in the commune of Djougou, experimental net cage culture was conducted by the water management committee, CeRPA and the Djougou commune of those days in 1999. However, the expected result could not be achieved and the net cages have been abandoned.

(3) Prefecture of Borgou

One of the biggest private fish farm in Benin called "Projet Piscicole de Parakou" with total site area of 5ha has been operated since 1995 near Parakou, capital of the prefecture. The owner/chief technician of the farm is Mr. Hilary, an English aquaculture expert. In the commune of N'dali, Parakou branch of Songhai (the biggest NGO in agriculture sector in Benin) produces Tilapia and Clarias in ponds and floating net cages. The Songhai-Parakou carries out seed production of Tilapias aiming to meet the demand in the northern region as well as its own utilization. However, except for those two entrepreneurs, there are no fish farms operating continuously in Borgou prefecture.

In the village of Baka, the commune of Parakou, a center for producing Tilapia fingerlings was constructed in order to release them in reservoirs of the northern region in 1996. The center was facilitated 10 ponds of 200-500 m² and operated by the association of cotton farmers under supervision of the water management committee of those days. However, it was abandoned without any remarkable result.

Aquaculture development potential has been suggested for manmade dam reservoirs distributed widely in the northern region, which were constructed mainly for water supply to cattle. In fact, at the downstream of the Sakarou reservoir (30 ha), which was constructed with financial assistance of Saudi Arabia in the commune of N'dali, ponds for seed production of Tilapia and warehouse for stocking the feeds were constructed and operated partly using water from the reservoir under the supervision of the water management committee. However, it is appeared that proper management of facilities located far from the village was difficult, and the seed production is not carried out now.

On the other hand, it was observed in this study that a large-scale agriculture farm in N'dali operated an experimental aquaculture in the private dam reservoir and associated small non-drainable ponds. In the case that fish ponds are operated in large-scale by workers without anxious of robbery of fish, it might be possible to develop feasible aquaculture entity like the above-mentioned Songhai-Parakou.

(4) Prefecture of Alibori

Inland capture fishery is actively carried out along the Niger River in the commune of Karimama and Malanville. However, due to the decreasing tendency of fishery production in recent years, aquaculture is receiving the interest. At the present experimental aquaculture of Tilapias is seen in the farm on the dyke of Niger River, the village of Gazeré Tounga (commune of Karimama) as well as in non-

drainable ponds in the township of Wollo (commune of Malanville). A group of farmers of Monkassa village (commune of Malanville) has a plan to carry out rice-cum-fish culture with technical guidance of fishery extension staff this year.

In the township of Wollo, Malanville, thanks to the aide of China, a pump station and irrigation channels were constructed and then immense rice fields of 516 ha have been developed. A small-scale experimental aquaculture is carried out in this paddy area by fishery extension staff of CeCPA Malanville.

There are few fish farms in the prefecture of Alibori except for the above Malanville and Karimama at present.

(5) Prefecture of Collines

There are few fish farms in this prefecture because of the land around the northern Zou prefecture and Collines forms upland where water resources are very limited for aquaculture.

(6) Prefecture of Zou

In the central and southern parts of the Zou prefecture ample amount of underground water is available and Tilapia culture in ponds is getting popular. There are two types of aquaculture management body as follows.

1) Individual (Owner +workers)

Agriculture farms of several to 20 hectares are managed by a family of owner and some permanent workers, producing various agriculture products, fruits such as oranges or mangoes, vegetables such as tomatoes, maize or plant of coconut tree. Chicken, goat and sheep are semi-farmed or reared freely in the farm. The underground water table of these farms is shallow, and there are farmers who constructed non-drainable ponds to practice aquaculture. Some of them take water from streams by gravity. This type of exploitation is often observed in the southeast part of the prefecture like communes of Zopota, Cové and Zagnanado. However most of these trials are at experimental scale having one to several small ponds (100 to 200 m²) and their technical knowledge is insufficient.

2) Farmer's group

About ten farmers form a group and they collectively manage the aquaculture ponds. This type of aquaculture is practised in the communes of Agbagnizoun or Zogbodomey in the southeast part of the prefecture. They operate some non-drainable ponds or drainable ponds for which water is supplied from flowing well. This type of aquaculture management works well in some places but not in other places depending on the sites. For example in the village of Saheta (commune of Agbanhinzoun), the abandoned aquaculture activity was going to be recovered by technical guidance of DOF in cooperation with the JICA expert. On the other hand in the village of Djodigon (commune of Zogbodomey), facilities were not managed well by farmer's group and unused now. In the village of Za -Kékéré (commune of Za-Kpota), a package of aquaculture facilities including drainable ponds, canals, warehouse, etc. was constructed by using subsidy of MAEP since 2005, but they have never been operated due to the shortage of operation budget.

In general, the individual management (owner+workers) is pronounced in the southern region namely the south of the Zou prefecture, while collective management by farmer's group is common in the northern region.

(7) Prefecture of Mono

There is a seed production center in the village of Tohonou (commune of Bopa) located in the north of Lake Ahémé in the eastern part of the prefecture. This center has been operated mainly for the seed production of Tilapia and as a training center in PAMR (1999-2003). It is now managed by 2 officers of the CeRPA Mono/Couffo and 6 temporary employees. But its activity is not very vigorous presently because of malfunction of pumps and feed making machine.

In the PAMR project, numbers of fish farms have been established in the prefectures of Mono and Couffo and aquaculture technologies are disseminated. As the result, aquaculture in non-drainable ponds and managed by individual fish farmers (owner + workers) is getting popular in the communes of Comè and Grand-Popo, the southern Mono prefecture. On the other hand, numbers of fish farms being managed by farmer's group are suspended operation after termination of the project, for example a women's aquaculture group in the village of Tohonou, Bopa. It is important to reconsider the adequacy of the management type because some of the ex-members of the farmer's group are stating that we wish to try again aquaculture in the individual manner if possible.

(8) Prefecture of Couffo

There are many sites of flowing well in the stretch extending from the commune of Lalo and Dogbo-Tota (the southeast part of the Couffo prefecture) toward the southern Zou prefecture, and farmer's groups that have been received some assistance from donors carry out Tilapia culture thanks to those rich water sources. Among those farms, some are success in management (for example the farmer's group in the Agbédranfo village, the Dogbo-Tota commune) but some others stopped operation after termination of donor's assistance (the Adoukandji village, the Lalo commune)..

In the village of Tchi-Ahomadegbé (the commune of Lalo) combined agriculture-aquaculture was introduced by Songhai Center from the year around 1989 including rice cultivation and pig breeding. However, after the support of Songhai was ended in 1997, the activities about aquaculture and pig breeding have suspended. At present the aquaculture group captures Tilapia and wild fishes occurring in about 30 ponds of 500m² each 3 to 4 times a year, and consumes by themselves or sell them partly.

In addition to the aquaculture activities of small-scale farmers as described above, there is an advanced fish farmer integrating aquaculture with agriculture and animal husbandry in the commune of Aplahoué, the western part of the Couffo prefecture. This aquaculture farm was established by a retired commander with his own investment of about 12 million FCFA. Piggery, rabbit cage and hen house are arranged around the fish ponds (10 ponds of about 500m² each) in order to provide their manure to the ponds as organic fertilizers. Pond water is supplied from reservoirs through artificial canals. Using the excess water, he cultivates seed plants of palm oil, acacias, eucalyptus, papaya, etc.

(9) Prefecture of Atlantique

In the Atlantic prefecture, Tilapia (and partially Clarias) culture is carried out in non-drainable ponds in and around Zinvié (the commune of Abomey-Calavi) in the eastern part of the prefecture as well as the Tori-Bossito commune in the central part of the prefecture. Those fish farms are generally managed by individual (owner+workers). Since the Atlantique prefecture is located close to Cotonou, there are many farm owners staying in Cotonou and not engaging farming activities directly. On the other hand, there are also significant numbers of small-scale farmers who manage the farm and fish ponds without permanent workers.

Apart from the said "owner + workers" type of aquaculture in non-drainable ponds, a various unique aquaculture activities are seen in this prefecture as follows.

i) Aquaculture demonstration farm of NGO (Zinvié, Abomey- Calavi)

An aquaculture demonstration farm, "Pantoden Aquaculture", has been operated by an NGO named CREDI-ONG since 2006. The NGO was founded by an agricultural engineer graduated from the university of Abomey-Calavi. Upon the establishment of this farm some financial assistance was given by the French Ministry of Youth and Sports. The farm is demonstrating not only Tilapia culture but also seed production of new species such as catfishes and ornamental fishes.

ii) Small-scale aquaculture supported by an American NGO (Wawata village, Zinvié, Abomey-Calavi).

The American NGO Hunger Project has been formulated several agriculture development projects focusing on poor farmers. Small-scale aquaculture trial by a group of farmers is one of those and carried out in the Wawata village since 1998. However at present the aquaculture of group management is not managed well and the fish production does not meets the expectation of farmers.

iii) Aquaculture group conducting individual management of fish ponds (Govie village, Allada)

In aquaculture of farmer's group, it is common that several fish ponds are managed collaboratively by a group of farmers. On the other hand, in the Govié village of Allada commune, although members work together for construction of ponds and harvest of fish, daily pond operation is carried out individually. Now each of 8 members operates 1-2 fish ponds, respectively. They said that fish sale was managed by a responsible member and it will be shared by members according to the contribution.

iv) Restoration of abandoned fish ponds (Tori-Bossito).

In the commune of Tori-Bossito, there are many non-drainable fish ponds which have been abandoned due to the inferior production. Although the farm owners are used to live in Cotonou, fishery extension officers of CeCPA try to restore the activities through technical guidance at the time of villagers' meeting. Some fish farms has restarted aquaculture (village of Wênoko and Maguevié), but the present extension approach is not efficient for instance extension materials are lacking. Besides, it is essential to give more technical advice and training to achieve sustainable aquaculture.

v) Large-scale integrated aquaculture (Gasa village, Ouidah).

There is an integrated fish farm carrying out Tilapia culture in non-drainable ponds (about 10 ponds of 1,000m² each) coupled with intensive poultry and rabbit breeding. The walls of the fish ponds are lined with concrete.

vi) Brackishwater aquaculture (Kpomassè).

In the villages of Dékamè and Couffonou, the commune of Kpomassè located in the coast of Ahémé Lake, many non-drainable ponds were developed around the year 1996 with the assistance of NGO named IMAD, and aquaculture by farmer's group was pursued. However, the project was not managed well. Number of farmers withdrawn from the project increased every year until the suspension of the activities in 2004. The number of abandoned pond is said to be 142 (approx. 300m² each). It is suggested that high salinity caused slow growth of Tilapia and frequent robbery affected negatively the management of the group.

The participants of this brackishwater aquaculture project were agro-fishers possessing 1 to 1.5 ha of farm land and their main income source was fishing in the Ahémé Lake. Since fish catch in the lake is decreasing every year, there is a high expectation about alternative means of livelihoods including aquaculture. It seems important to reconsider the possibility of brackishwater aquaculture from both technical and management points of view.

Besides, one farmer carries out pen culture in coastal water of Ahémé Lake in the Kpomassè village. However, this activity would be not feasible.

vii) Aquaculture in floating net cages (Sô-Ava)

An experimental net cage culture of Tilapia, like in Grand-Popo, Mono prefecture, has been carried out in a fishermen's village along the Ouémé River (Sô-Ava commune) under the supervision of the DOF. The participants are fishermen operating acadja, and development of this type of aquaculture is expected to contribute the reduction of fishing effort. Similar to the case of Grand-Popo, the financial feasibility is difficult to be secured considering construction of floating net cages, fish production is continued without serious consideration of the compensation.

(10) Prefecture of Littoral

The Littoral prefecture is an urban area including the national capital Cotonou City. Few aquaculture activities are practiced.

(11) Prefecture of Ouémé

There is a headquarters of Songhai Center, one of the biggest NGO of Benin in agriculture sector in Porto-Novo, capital of the prefecture. The Songhai offers a series of technical training programs on

rural development integrating agriculture, livestock and aquaculture. Its facilities were partly constructed by receiving assistance of USAID. The outline of aquaculture training courses organized by the DOF in cooperation with the expert of JICA and implemented at the Songhai Center in recent years is summarized in Table 3-7. The Songhai recognised inland aquaculture as a sector which has a high develop potential and plans to expand its aquaculture-related activities three times in the coming three years.

Table 3-7 Outline of aquaculture training courses organized by DOF and the JICA expert

Period	Title of the training courses	Target group	Duration and number of participants	Location	Trainers
July - September 2004	Reactivation of the activities of extension officers of CeRPA	Fishery extension specialists of CeRPA	1 week per training course, about 20 participants x 3 training courses (total : 53 participants)	Songhai (Porto-Novo and Parakou)	Staff of Songhai, staff of the DOF, and JICA expert
November 2004 to November 2005	Group training of aquaculture farmers (Tilapia culture)	Existing fish farmers and groups having emotions	1 week per training course, about 20 participants x 15 training courses (total of 291 participants for 166 groups)	Same as above	Same as above
2005	On farm training to fish farmers (Tilapia culture)	Existing fish farmers other than those participated in the above training	1 day per training course in each site, 10 to 20 participants x 5 sites (total about 100 participants)	Local farms having fish ponds	Extension staff of CeRPA and fish farmers being participated in the above training courses and the staff of the DOF.
July 2006	Training on artificial seed production of Clarias	Existing Clarias farmers having emotions	1 week training (total : 10 participants)	Songhai (Porto-Novo)	Staff of Songhai, staff of the DOF, and JICA expert

In the Ouémé prefecture, aquaculture of Tilapia in non-drainable ponds has mainly been carried out like in other prefecture. However, in recent years number of fish farms converting the species form Tilapia to Clarias is rapidly increased because the demand for Clarias is getting high not only for domestic consumption but also for the export market and in addition seed production of this species is started by Songhai and other progressive private fish farms. A new type of Clarias culture system using small-scale plastic sheet tank, which is said to be extended well in neighboring countries, is experimentally introduced in some private fish farms in Porto Novo.

There is a medium-scale Clarias seed producing farm in Avrankou, which was established as a pilot project of PADFA with financial assistance in terms of loan of 9 million FCFA. An aquaculture union of Avrankou was founded with the initiative of this farmer on May 29, 2007 and registered officially as a social organization. This is the first example in Benin that aquaculture farmer's organization is registered officially As of July 2007, a total of 36 farms, which represent more than 50% of the fish farmers of this commune, has been participated in this union. The CeRPA supported the foundation of the union and the relevant activities.

Between 2007 and 2008, there were two new events regarding aquaculture development. The one is the launching of "Royal Fish Benin", an intensive aquaculture entrepreneur equipped with modern infrastructures introduced from Europe, and the other is investment of advanced local fish farmer to pen culture. Information on these two topics is briefly given below.

i) Opening of the Royal Fish Benin

The Royal Fish Benin is the first aquaculture entrepreneur in Benin founded by a Beninese Mr. M. Dandjinou who worked for 30 years in a French construction company. It is equipped with modern seed production and breeding facilities, and started operation in April 2008. Among the total investment of 1.2 million Euro, 400,000 Euro was financed by the Dutch government, and the remaining 800,000 Euro was invested by himself. Although the building was constructed by a Beninese company, all the aquaculture-related facilities and equipment were installed by the Dutch aquaculture company named HEST. A former engineer of Songhai was picked as a manager of the farm after technical training in Holland.

The target species of the Royal Fish Benin is Clarias. It is said that genetically improved broodstock of Clarias was introduced from Israel and the Republic of Central Africa. Rearing of larvae and juveniles is carried out in glass containers or in PRP tanks equipped with UV sterilization and complete water recirculation system. The company targets to produce one million Clarias fingerlings per year mainly for domestic market. It plans to sell Clarias seeds coupled with feeds, and foresees to buy the produced table fish in priority.

Also it has a total of 32 circular FRP tanks of 2 tons each for direct production of marketable-size fish. These rearing tanks are equipped with water recirculation system and fish will be produced by feeding on imported pellets using automatic feeding machines. The company plans to sell the fish mainly for Nigeria at present, but in future it expects to export them to European market.

In November 2008, it has just starting shipping of juveniles.

ii) New attempt on pen culture

Mr. Akplogan, one of pioneer fish farmers in Adjarra, started pen culture of Tilapia from May 2008. The site is a part of the Porto Novo lagoon, in front of his house. Total invest for this enterprise was 9.6 million FCFA, of which 8.6 million was procured by loan of PADRO with an interest of 8.5%. His own farm land serves as a mortgage.

The two pens with a surface area of 15x25m (375m²) each were made of bamboo pegs and surrounding nets, which is the same material as floating net cages. The basement of these nets was buried on about 50cm with an aide of high-pressure pump. The Tilapia seeds produced by himself were released in July immediately after completion of construction. The daily feeding and night watch is managed by an employee specifically stationed besides the pen. In November, growth of fish looked well.

Mr. Akplogan expects the future potential of pen culture and foresees to expand the pen culture getting the financial assistance of PDFA.

(12) Prefecture of Plateau

In the southern part of the prefecture, fish farms converting the species from Tilapia to Clarias are going to increase in number. The center of aquaculture activities are the communes of Ifangni and Sakété, and some seed producers has been in operation. The area in the south of the commune of Pobé and Adja-Ouéré is considered as an integrated Clarias culture zone combined with the Ouémé prefecture.

3.7.8 Current status and problems of aquaculture activities

(1) Management aspect

1) Two types of management system

There are two types of aquaculture management system in Benin, one is the individual operation (a farm owner + workers), essentially practiced in the southern Benin and the collective operation by farmer's group frequently found in the northern Benin. Some fish farms are run by a family, but their number is comparatively not abundant.

Although rate of fish farms that are operated continuously is low for either types of management, relatively higher percentages of successful fish farms are observed for the individual operation namely "owner + workers" during the PACODER survey in 2007. Fish farm operation by farmer's groups was often terminated due to failure in personnel management (Figure 3-9). The characteristics of these two types of aquaculture operation are preliminary examined according to the 5 evaluation criteria which are applied in the course of the project cycle management (PCM) method and shown in Table 3-8. When aquaculture management is evaluated only by cost-benefit, it would be reasonable to encourage the management type of "an owner + workers" at relatively large-scale. However, it

shall be considered that few farms are financially independence particularly in the central and northern regions, and therefore, only grouping of farmers can launch themselves in such new activities.

Even in the case of collective management, it is needed to make a rule in order to elaborate the management responsibility to individual farmers as much as possible. It is also necessary to examine the third type of management system in which the merits of individual and collective management are combined, like the one practiced in Allada, in addition to the supportive activities for grow-out of leaders and formulation of rules and regulations of farmer’s organization.

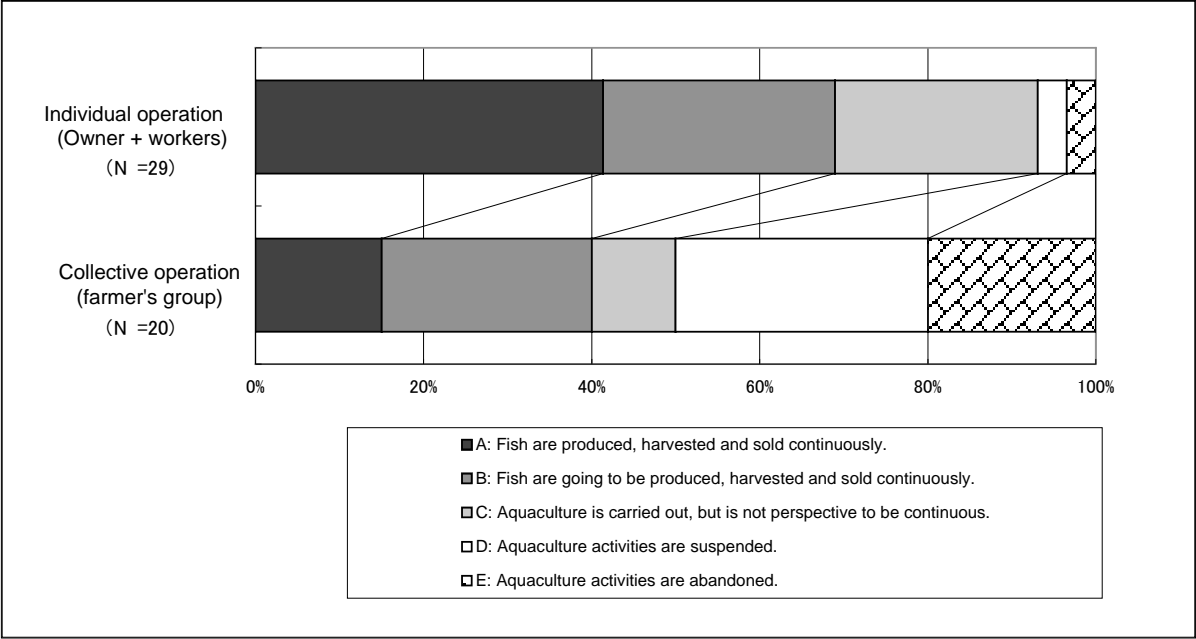


Figure 3-9. Instantaneous assessment of the management of fish farms
 Source: This study (2007)

Table 3-8. Preliminary evaluation of aquaculture activities managed by both farmer's group and individual farm (owner + workers) using 5 evaluation criteria.

5 evaluation criteria	Aspects	Aquaculture of farmer's group	Aquaculture of individual farm (owner + workers)
Relevance	Contribution to poor people ?	Even farmers having low initial investment capacity can participate. Enable repartition of risks. Selection criteria of target groups shall be examined well in case that assistance program is applied.	Farmers having a capacity of initial investment have an advantage for participation, but it will be possible to overcome the situation by application of some appropriate assistance programs
Efficiency	Possibility of extension considering the past experiences?	This agricultural type is popular in the northern Benin having limited aquaculture experience, but is also found in parts of the southern Benin. Many of them obtain input assistances from donors or NGOs. The past experiences suggest that this type of aquaculture is not sustainable if there is no farmer who has strong leadership.	It will be extended spontaneously if the benefits of aquaculture become clear (example; Clarias culture in the Ouémé/Plateau prefectures). As for the governmental support, it would be effective to provide indirect assistances such as technical improvement and verification, provision of information about management skill as well as technologies, and encouragement of farmer's organization.
Effectiveness	Cost and time necessary for extension?	Based on the past experiences, continuous assistance for 1-2 years will be required including input assistance.	Individual farms shall go in for training programs. But relatively less cost is required for the monitoring training.
Impact	Are there impacts for the other groups and individuals?	There is a case that a neighboring village (Karoum Dra) started aquaculture after being inspired by the existing activities (Karoum Yaourou). However, a similar donor's assistance is necessary for the neighboring villages, too.	In future, farmer-to-farmer type aquaculture extension in which seed producing farms act as core farmers shall be considered. The administration side shall provide the supports to make this extension system functional.
Sustainability	Are aquaculture activities continuous ?	Although there are some successful cases, there are many that the activities have been abandoned due to the collusion of mutual understanding.	Largely depending upon management capacity of individual farm.

2) Marketing and sale

It is true that Benin is suffering from a chronic shortage of fish and there is a high demand for cultured fish. However, the actual demand of people depends basically on the sale price.

In general fish farmers are not aware of the production cost and lacking knowledge and information on marketing and sale. Therefore there are cases that fish price is determined solely by the consumer, which restricts the benefits of aquaculture. This is one of the main reasons why aquaculture could not be continued.

It is consequently important to aware the fish farmers of various production costs such as seeds, feed and transportation/marketing before starting aquaculture. In addition, training on the sales promotion inside and outside of villages will also be significant. From this point of view, development of

aquaculture would be difficult in the northern Benin where higher transportation costs are required comparing to the south which is closer to consumption areas.

(2) Technical aspect

1) Inbreeding in Tilapia culture

In many Tilapia culture ponds, breeding of small individuals and their stagnant growth were observed. This is a well-known stunt phenomenon of Tilapia caused by inbreeding.

Complete drainage of pond water is impossible structurally for the most popular type of fish pond namely "non-drainable pond" so that fish harvest from those ponds is carried out by using seine net and significant percentage of juveniles propagated in the ponds remained non-harvested. In small-scale fish farms, those juveniles are often cultured continuously in the next rearing cycle.

Even if the farms are equipped with breeding ponds, broodstock are not properly renewed and inbreeding occurred elsewhere for several generations. Also, the pond depth often less than 80 cm causes a high thermal difference between the day and night, which accelerate the maturation and spawning of small-size Tilapia broodstock.

2) Problems in procurement of fish seeds

Except for a part of southern region, procurement of fish seeds is difficult. Securing independency of fish farmers and sustainable aquaculture are almost impossible because of high procurement cost of seeds due to their long transportation. The seeds of Tilapia shall be locally procured (at an accessible distance by motorcycle). Also the price of Clarias seeds tends to keep at high level reflecting the current demand and supply mechanism. Price down of the seeds is indispensable for extension of Clarias culture not only in the south but also broadly in the country.

3) Aquaculture with fertilization.

Tilapia is basically phytoplankton feeder. Therefore it is possible to save the cost of feed through facilitating the propagation of phytoplankton in the pond using organic fertilizers like excreta of livestock. Also propagated zooplankton is excellent food organisms for Clarias juveniles, indicating effectiveness of fertilizer for this species. Fertilization is practiced in progressive fish farms having henhouse and/or piggeries. However, it is not common among ordinary fish farms.

Since the pasturage is the main form of cattle breeding in Benin, it is noted that stable procurement of animal manure as fertilizer is not so easy. In Southeast Asia cows are commonly reared near the residents because they are used as the draft cattle in various agriculture works so that the collection of cow dung is very easy. It is difficult to apply the same collection method in Benin.

4) Feeds

Powder-type feeds are popular for fish culture in Benin. The ingredients are either purchased or home-made and single or mixed, consisting of fish meal, maize bran, wheat bran, brewer bran, sorghum bran (Son de Tchoukoutou), etc. However, powder-type feeds are difficult for fish to eat at once, and feed efficiency tends to be lower.

Advanced aquaculture entities like the Songhai Centre, the Parakou Aquaculture (Projet Piscicole de Parakou) and some Clarias seed producers apply pellet-type feeds produced by themselves using locally assembled pellet-making machine, and the pellets can be manufactured for sale if ordered. In fact there are fish farms purchasing those locally produced pellets, but generally they are too expensive for small-scale farmers and accordingly not disseminated at present.

The Tohonou seed production centre has formulated a standard composition of locally available feed materials and has been selling the mixed form of powder-type feeds. However, the composition was determined empirically not based on the rearing experiment and the feeding table has not yet prepared. The composition of feed ingredients for Tilapia for sale as a package in the centre is shown in Table 3-9. It is said that the protein content is about 30% with the unit price of 124FCFA/kg at the time of

the study in July 2007 (it was hiked to be 200 FCFA/kg in November 2008).

Table 3-9 Composition of feed for Tilapia standardized by the Tohonou seed production centre

	Characteristics			Proportion (%)
	Protein content (%)	Energy value (Cal)	Unit price (FCFA /kg)	
Fish meal	45	3000	225	25
Cotton seed bran	41	1945	100	34
Maize bran	9	3400	125	10
Wheat bran	16	1870	70	30
Shells	-	-	45	1
Total	30.9	2312	124	100

Source: Department of Fisheries, Benin

The unit price of feed for Clarias is generally more expensive than that for Tilapia, because Clarias is carnivore and protein requirement is higher. In order to reduce the feed cost, the Songhaï Centre applies fry larvae as a major food item, which are cultivated using animal gut and chicken manure. Fry larvae have not been popularly utilized among ordinary fish farms until recently, however, some simplified methods of fry larvae propagation as subsidiary fish feeds are going to be practiced in Abrankou using small containers such as plastic buckets or small basket according to the method taught by a core farmer. Some progressive farms are going to supplement the required animal protein of fish by using earth worms propagated in composts, slaughter by-product, etc.

5) Problems about harvest

As mentioned previously, there are many non-drainable fish ponds in Benin, and the fish harvest is carried out by using seine net. On the other hand, the structure of ponds is rarely suitable for the harvest by net. Some roots or branches of trees are often observed in ponds, and the ponds are too big in area or not adequately designed for netting. In addition, since equipment for harvest like seine net and scoop net are not sufficient in both quality and quantity, fish are difficult to harvest and significant number of fish remain in ponds.

6) Others

- Due to insufficient height and solidity of pond dykes, the dykes are repeatedly damaged and demolished by flood so that fish escape occurs frequently before harvest.
- Fish predation by wild predators such as frogs, snakes, lizards, crocodile, birds and so forth occurs frequently.
- Aquaculture methods other than pond culture such as floating cage culture, pen culture, rice-cum-fish culture, etc as well as fish culture in brackishwater environment have not been verified from the economical point of view.

Problems, causes and countermeasures examined above are consolidated in Table 3-10.

Table 3-10. Problems, causes and countermeasures found in inland aquaculture in Benin.

Problems	Causes	Countermeasures
<ul style="list-style-type: none"> - Reproduction by smaller broodstock and stagnancy in growth (Tilapia) - Deterioration of broodstock quality due to inbreeding of several generations (Tilapia) 	<ul style="list-style-type: none"> - Shallow depth of ponds - Non-drainable 	<ul style="list-style-type: none"> - Increase of the pond depth (particularly for broodstock pond) - Elimination of fishes remained in pond before stocking of new juveniles, e.g., complete draining of water by pump and scattering of lime - Broodstock are reared in relatively low water temperature or in floating cages.
<ul style="list-style-type: none"> - Difficulty in procurement of seeds 	<ul style="list-style-type: none"> - Long distance transportation of seeds - High cost 	<ul style="list-style-type: none"> - Establishment of seed production centers and core farmers (seed producers) - Efforts for reducing the marketing price of seeds particularly for Clarias.
<ul style="list-style-type: none"> - Insufficiency in amount of fertilizer. Effect of fertilization is not clear and number of farms implementing fertilization is few. 	<ul style="list-style-type: none"> - Difficulty in procuring animal excreta as fertilization materials. 	<ul style="list-style-type: none"> - Encourage farmers who have some investment funds installation of henhouse and/or piggery. - Extend aquaculture in priority among farms that have been carried out animal husbandry.
<ul style="list-style-type: none"> - Fish do not feed on well showing slow growth, even in feeding aquaculture 	<ul style="list-style-type: none"> - Inferior quality (low diet value) and high price of feeds given. - Inadequate feeding method - Inadequate shape of feeds 	<ul style="list-style-type: none"> - Examination on alternative feed materials such as agricultural by-products - Cost cut through cooperative procurement - Acclimation of fish on daily feeding through careful observation of the appetite of fish. - Standardization/extension of feeding rate, feeding frequency and quality of feed according to the type of aquaculture in Benin and the target species. - Encouragement of pellet making instead of powder-type feeds. - Adaptation of the size of feeds in conformity with the growth of fishes.
<ul style="list-style-type: none"> - Difficulty in harvest - Inefficient works in daily aquaculture 	<ul style="list-style-type: none"> - Inadequacy in structure and shape of ponds, harvesting technique, and equipment 	<ul style="list-style-type: none"> - Improvement of pond structure, e.g., installation of harvesting area in pond - Hand-making and dissemination of small equipment and tool necessary for daily aquaculture practices, e.g., scoop net and happa net.
<ul style="list-style-type: none"> - Lost of fish due to flood and damage of pond dykes - Predation by wild predators - Stealing 	<ul style="list-style-type: none"> - Weakness of ponds - Ponds without protection 	<ul style="list-style-type: none"> - Strengthening of training about ponds excavation and construction techniques. - Installation of traps and fence for wild predators

(3) Examination of aquaculture extension method

Fish farmers who attended technical training courses organized by the DOF in cooperation with the JICA experts appreciate and agree with their good contents and coordination. However, technical knowledge of farmers on aquaculture is still insufficient and there are high demands for further trainings and acquisition of additional technical knowledge.

On-site aquaculture extension has been conducted at several localities with technical assistance of the JICA experts. As the results, following procedures regarding input supports of seeds and feeds are suggested necessary for stabilizing aquaculture activities by farmer's group in addition to other necessary approaches such as confirmation of the capacity of leader and technical training menus.

- 1st rearing cycle (6 months): Provision of seeds and feeds
 2nd rearing cycle (6 months): Provision of feeds (seeds shall be procured by each farmer's group)
 3rd rearing cycle (6 months): No input support (seeds and feed shall be procured by each farmer's group)

Particularly in the northern region, there are many farmers' groups saying "we want to start aquaculture eagerly, if somebody supports the activities". However, it is difficult for the DOF and CeRPAs that have limited budget and personnel to disseminate small-scale aquaculture spatially by applying the above suggestion.

3.8 Categorization of development potentials

3.8.1 Regional aquaculture development potential

(1) Categorization in broad sense

Based on the analysis about aforementioned aquaculture types and the management systems, regional aquaculture development potential in broad sense could be consolidated into the table below.

Table 3-11. Nationwide aquaculture development potential in Benin

Regions	Characteristics	Development Potential
Karimama and Malanville in the Alibori prefecture	Located along the river-bed of the Niger River, this area possesses ample water resources including irrigation channels. Having a potential of rice-cum-fish culture.	Middle
Northern region: All the 5 northern prefectures except for the above two communes (prefectures of Atacora, Donga, Borgou and Alibori)	There are abundant water resources such as swamps, springs, man-made reservoirs, etc., but farmer's interest about aquaculture is lower than the southern region because of short history of aquaculture. Due to the low population density and isolation from the consumption areas, economic efficiency is inferior in general. On the other hand, large-scale aquaculture development might be possible technically considering the availability of huge open lands.	Middle
Central region: Collines prefecture and northern part of Zou and Plateau prefectures	This region forms uplands having limited water resources for aquaculture.	Low
Southern region: All the 6 southern prefectures except for the above (prefectures of Zou, Mono, Couffo, Atantique, Ouémé and Plateau)	Thanks to abundant water resources such as swamps, springs, rivers, lakes, etc., many farmers are interested in aquaculture. This region is close to the consumption areas such as Cotonou, Porto-Novo, and Nigeria. Comparing to the north, individual fish farms having relatively large capital are pronounced.	High

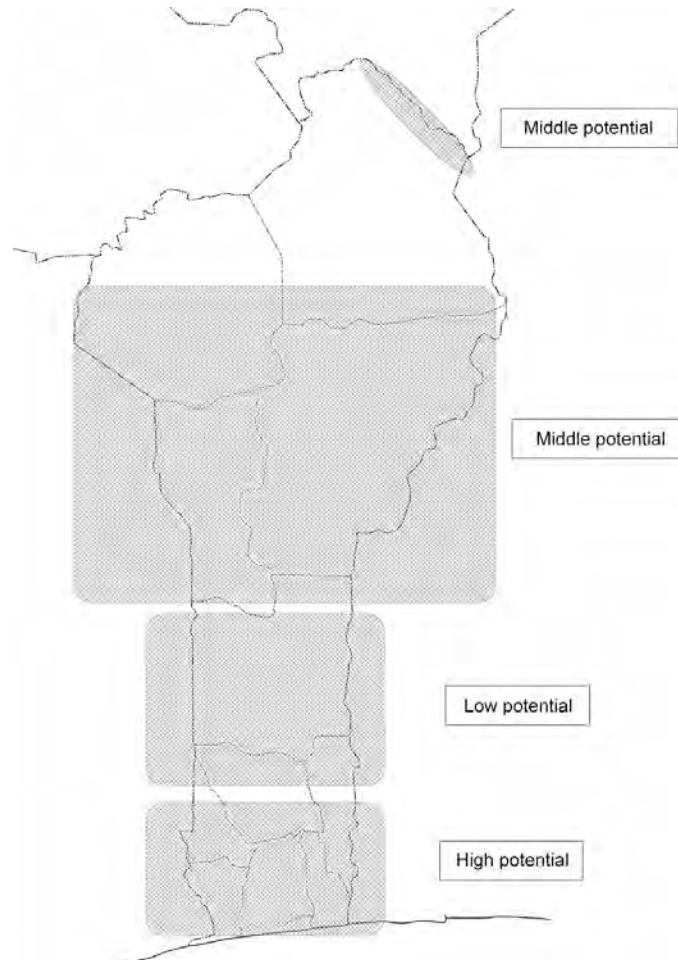


Figure 3-10. Nationwide aquaculture development potential in Benin

(2) Aquaculture potential zoning in the southern region

As overviewed in the above, higher aquaculture development potential is recognized in the southern region in Benin, namely the area of the south of the central part of the Zou prefecture. The potential in the southern region is further examined and categorized into several zones based on the typical or representative aquaculture type (Figure 3-11). Characteristics of each zone are explained here. Since the zoning is conducted exclusively for the purpose of examination of this master planning study, suitable aquaculture type at each farm shall be examined considering respective natural environment and socio-economic circumstances.

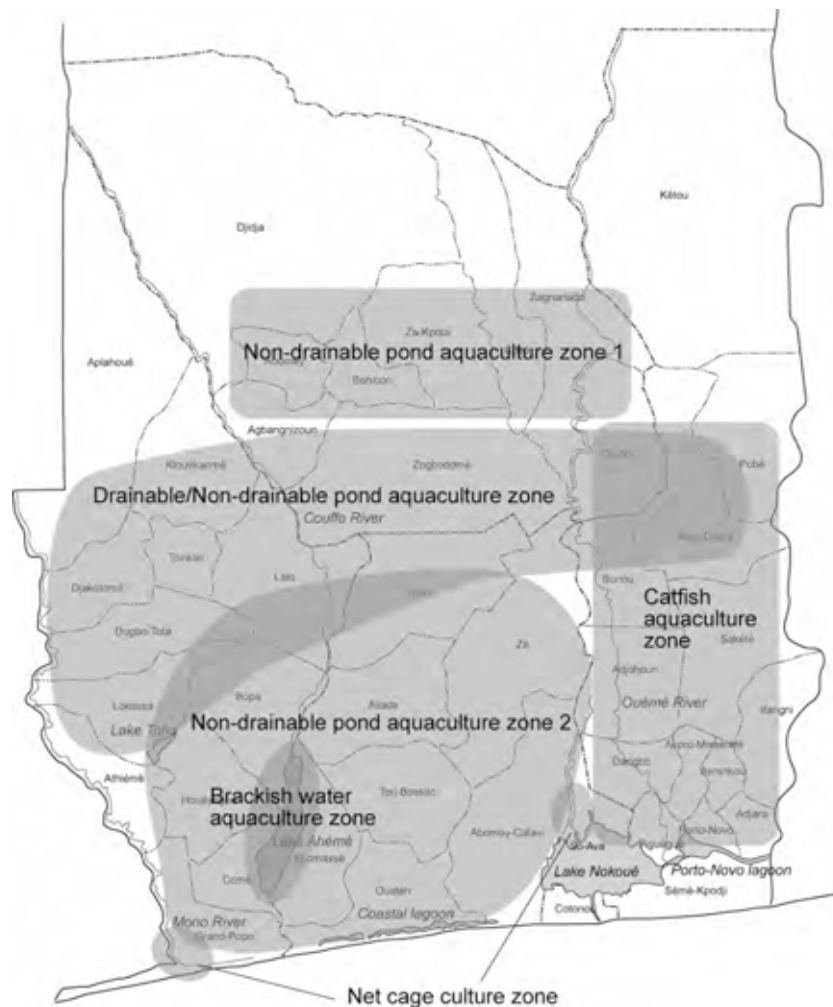


Table 3-11. Zoning of aquaculture development potential in the southern region

1) Drainable/non-drainable pond zone

There is a shallow rift valley called “Lama” running diagonally between the northern Mono prefecture and the central Plateau prefecture. This area around the rift valley is endowed with rich underground water resources forming many flowing wells, and also rich in surface waters such as streams, swamps and ponds. Therefore, this zone has development potentials not only for non-drainable pond but also drainable ponds in which surface water is introduced through canals.

The drainable ponds possess many advantages in operation and management comparing to non-drainable ponds, namely water depth can be controlled, fish harvest is easy because the water can be drained by gravity, and decomposition of bottom substrata and elimination of harmful organisms can be realized by complete dry-up of the pond bottom before stocking of seeds. On the other hand, surface water is of importance also for agriculture and animal husbandry so that participatory discussion about water use right will have to be necessary.

2) Non-drainable pond zone 1.

This zone is identified in the centro-eastern part of Zou prefecture composed mainly of such communes as Za-Kpota, Cove and Zagnanando. There are numbers of individual agriculture farms operated by “owner + workers” cultivating orange, mango and vegetables, and small-scale aquaculture in non-drainable ponds have been started by some progressive farmers. However, their technical knowledge is not sufficient and the production is not stable. It is expected through strengthening the extension activities that the fish farms are increased in number and the productivity is also increased.

3) Non-drainable pond zone 2.

Mainly Mono and Atlantique prefectures are involved in this zone. Due to the shallow underground water, it is possible to construct non-drainable ponds at most of the agricultural lands. The development potential would be the same as that in the above non-drainable pond zone 1. However, aquaculture by farmer's group will also be considered as well as individual farms. In this zone there are numbers of fish farms that has stopped operation due to low yields in the past. Restoration of those farms will be one of the important issues. Since the zone is close to the Cotonou city, the major consumption area of the country, it would be possible to increase profit through improvement of marketing methods.

4) Catfish commercial culture zone

This zone consists of entire Ouémé prefecture and the southern Plateau prefecture. In this zone, aquaculture of Clarias has been developing rapidly in addition to Tilapia in both drainable ponds to which water is supplied from streams and non-drainable ponds. By further improvement of farming technology associated with organization and networking of fish farms, commercial culture of catfish is expected to be enhanced and stabilized as a local industry.

5) Brackishwater aquaculture zone

Areas around Ahémé Lake particularly for its eastern periphery around Kpomassè commune in Atlantique prefecture are identified for this zone. Restoration of abandoned brackishwater ponds is the issue to be considered. However, since the adequate aquaculture species for brackishwater environment has not yet identified, the development potential is unclear at present.

6) Net cages/pen culture zone

At present net cage culture and pen culture are carried out at some specific sites individually not forming clusters of facilities. For descriptive purpose, the sites explained in Table 3-12 are identified as the net cage/pen culture zone. Since their construction costs are very high, they are not considered as the aquaculture method in which small-scale farmers and fishers can participate presently.

Table 3-12. Sites of net cage culture and pen culture

Types of aquaculture	Sites	Remarks
Floating net cage culture (in operation)	Sô-Ava of Atlantique prefecture, and Grand-Popo of Mono prefecture	Assistance of DOF
Floating net cage culture (in preparation)	Azili Lake in Zagnanado of Zou prefecture, and Tévèdji along the Ouémé River which belongs to Ouinhi commune of Zou prefecture	The facilities have been installed with the assistance of PADFA, but the practice has not yet started as of November 2008.
Pen culture (in operation)	Porto-Novo Lagoon and Ahémé Lake	Tried by pioneer fish farms
Floating net cage culture or pen culture (in examination)	Ancient Lagoon located in Ouidah and Abomey-Calavi, Atlantique prefecture, and Toho Lake located in Houéyogbé and Lokossa, Mono prefecture	In the course of evaluation by PADPPA

3.8.2 Development potential by type of aquaculture

Taking into consideration the regional development potential as discussed above, the development potential by type of aquaculture is examined here for the approximate period of the next 10 years. The examination is carried out based on the following 3 evaluation criteria. The result is quantified by giving different scores from 1 to 3 for each criterion, and the final evaluation is done by the sum of the score.

Evaluation criteria and score

i) Potentials from the aspect of natural conditions.

(Whether the areas that the said type of aquaculture can be adoptable are abundant or not)

Abundant (3 points), Medium (2 points), Less (1 point)

ii) Potentials from the aspect of technology

(Whether the economic feasibility of the said technology is verified or not)

Yes, already (3 points), Will be (2 points), Difficult without accomplishment of specific condition (1 point)

iii) Potentials from the aspect of rural development (extension to ordinary farmers)

(Whether the said type of aquaculture is extendable among farmers considering their capital and management capacity)

Yes, relatively easy (3 points), Medium (2 points), Difficult (1 points)

Table 3-13. Development potential according to the type of aquaculture and region

Type of aquaculture	Evaluation criteria and score				Development potential	Potential regions and zones								
	Nature	Technology	Extension	Total		Karimama and Malanville	Northern region (except for the left)	Central region	Southern region					
									1) Drainable/non-drainable pond zone	2) Non-drainable pond zone 1.	3) Non-drainable pond zone 2.	4) Catfish commercial culture zone	5) Brackishwater aquaculture zone	6) Net cages/pen culture zone
1) Non-drainable pond	3	2	3	8	High	△	○	-	⊙	⊙	⊙	⊙	○	-
2) Pond taking water from swamp	2	3	2	6	Middle-High	-	○	-	○	○	△	○	-	-
3) Pond taking water from flowing well or stream	2	3	3	8	High	○	△	-	⊙	○	○	○	-	-
4) Pond taking water from dam reservoirs	2	2	1	5	Middle	-	○	△	-	-	-	-	-	-
5) Floating net cages in dam reservoirs	2	1	1	4	Low	-	○	△	-	-	-	-	-	-
6) Floating net cages in natural lake and river	2	2	2	6	Middle	-	-	-	-	-	-	-	-	⊙
7) Aquaculture of Clarias	3	3	3	9	High	○	△	-	○	○	○	⊙	△	△
8) Rice-cum-fish culture	2	2	1	5	Middle	○	△	-	△	-	-	-	-	-
9) Pen culture	1	2	1	4	Low	-	-	-	-	-	△	△	△	○
10) Small-scale plastic sheet tank	2	2	3	7	Middle-High	-	-	-	-	-	○	⊙	-	-
11) Aquaculture in brackishwater	1	2	1	4	Low	-	-	-	-	-	-	-	○	-
12) Aquaculture in “whédos”	2	2	2	6	Middle	⊙	-	-	-	-	△	○	△	-
13) Aquaculture in happa net or wooden cages.	3	2	2	7	Middle-High	-	-	-	○	○	○	○	○	○

Remarks: For evaluation criteria and score, see text.

⊙: potential sites are found in very high abundance, ○: Abundant, △: Less, -: Few

The results of evaluation according to the type of aquaculture are shown below.

1) Non-drainable pond ----- Development potential: High

Non-drainable ponds have been developed due to the specific natural conditions of Benin, and the sites for this type of aquaculture can be found elsewhere in the country. Most of the ponds can not be drained water by gravity so that the fish shall be harvested by using seine net. This type of aquaculture has been extending mainly in the rural communities in southern region, but there is

significant number of ponds which were abandoned due to difficulty in sustainable operation and management. Further technical improvement is required to enhance the profitability.

2) Pond taking water from swamp ----- Development potential: Middle-high.

The sites endowed with necessary natural conditions are abundant in number in the northern Benin. Technical feasibility has already been shown. Nevertheless it is necessary to clarify the water use right as well as implementing organization of aquaculture. When farmer's group is needed to be trained, time and budget are required.

3) Pond taking water from flowing well or stream ----- Development potential: High.

Technically similar to the above, water is introduced to the pond through canal, and the technical feasibility has been proved. Extension of this type of aquaculture is comparatively easy if the water can be utilized by individual farm. It might be possible technically to develop large-scale aquaculture along the main roads in the northern region.

4) Pond taking water from dam reservoirs ----- Development potential: Middle

There are many man-made reservoirs constructed for water supply to the cattle in the northern region. However, most of them are located far from the village and the management is difficult. The aquaculture site shall be protected from stealing. When favourable conditions are accomplished, it is possible to develop aquaculture in the same approach as the above (3).

5) Floating net cages in dam reservoirs ----- Development potential: Middle

Due to the same reasons as the above, it would be difficult for farmers to operate this type of aquaculture in public reservoirs. On the other hand, it might be feasible for a large-scale farmer who has a right of exclusive use of water to carry out net cage culture, considering an example of Songhai Parakou.

6) Floating net cages in natural lake and river ----- Development potential: Middle

There is high demand of fishers, but not profitable at present. Since there is anxious about physical damages on the net cage facilities and stealing of fish, this type of aquaculture is considered still risky for farmers and fishers. It becomes financially viable if the floating net cages are granted by government or donor and compensation cost is not necessary to take into account.

7) Aquaculture of Clarias ----- Development potential: High

An integrated production system of Clarias from artificial seeds to table-size fish is going to be established by private initiative in Ouémé and Plateau prefecture. In addition, a company-based aquaculture farm has launched operation using advanced facilities. In order to secure sustainable development of Clarias aquaculture, strong demand for this species from Nigeria must be maintained and extreme price hike of feeds shall not occur.

8) Rice-cum-fish culture ----- Development potential: Middle

Because of shallow water depth of paddy, productivity of fish in rice fields is much lower comparing to that in ponds and likewise the size of fish in the paddy is smaller. This type of aquaculture has not yet extended in Benin although several successful results are reported in other countries including Nigeria. They say that farmers who manage the modern paddy fields equipped with irrigation canals would show little interest for this type the aquaculture.

9) Pen culture ----- Development potential : Low

Pen culture had been introduced experimentally around the year 1978 in the Nokoue Lake (see Section 3-4 of this report), but there has been few attempt thereafter. Under such situation, a pioneer fish farm newly started this type of aquaculture in the Porto-novo Lagoon in the year 2008. Its feasibility and sustainability is unknown at present. Anyway, it is noted that pen culture would be costly and difficult in operation and management from the view of rural development.

10) Small-scale plastic sheet tank ----- Development potential: Middle-high

This type of aquaculture is said to be developed in neighbour countries such as Nigeria for culturing Clarias. Although there has been little verification study in Benin, it is plausible that the aquaculture in small-scale plastic sheet tank is extended in the catfish commercial culture zone since it requires small space and small investment.

11) Aquaculture in brackishwater----- Development potential: Low

As for the target species for brackishwater aquaculture, a catfish species, *Chrysichthys* and a tilapia species, *Sarotherodons* would be considered in addition to the Tilapia, *Oreochromis*. There were some aquaculture trials for those species and potential has been suggested. However, it will take time to develop feasible aquaculture techniques for those new species and to popularize them among small-scale fish farmers.

12) Aquaculture in “whédos” ----- Development potential: Middle

Recently extensive aquaculture has been introduced in some “whédos” located along the Niger River in Malanville and Karimama. Also, experimental aquaculture of Clarias is reported for “whédos” in the sandbank of the lower Ouémé River after catching of wild fishes there. When those preliminary attempts are improved technically and considered economically feasible, aquaculture extension would be possible for those environments.

13) Aquaculture in happa net or wooden cages----- Development potential: Middle-high

In Southeast Asia, aquaculture in happa net and in wooden cage has been developed. The former is mainly for nursing of juveniles and the later for grow-out culture. Those equipments are much cheaper than floating net cage. At present, those types of aquaculture have not yet introduced, however, they would possibly be extended in future when they are introduced as a model of small scale aquaculture.

3.9 Social survey on the rural communities

In order to understand the socio-economical situation of the potential areas of aquaculture which were categorized in the previous section, a questionnaire survey was carried out in terms of sub-contract. Two kinds of questionnaire were prepared, one is for individual villagers about their socio-economic situation and the other is for representatives of the villages asking about outline of the villages. Number of target villages was 30 in total, and the sample size of individual villagers was 20 each.

Upon selection of target villages, it is considered to cover the aquaculture potential areas categorized in the previous section and they are sorted according to the number of fish farms shown in the preparatory aquaculture survey of the DOF in 2004 and the number of extension staff of CeCPA. Thereafter, they were finally determined taking into account the opinions of counterparts and extension staff of CeCPA who work intensively in those villages (Table 3-14 and Figure 3-12). Basically one village was selected from one commune, and the study covered almost entire country except for Collines prefecture of the central region and cotton cultivation areas in the north where aquaculture development potential is considered low.

Table 3-14. Target villages of rural socio-economic survey

Prefecture	Commune	Township	Village	Aquaculture potential
Atacora	Materi	Materi	Materi	Man-made reservoir
atacora	touncontouna	Touncontouna	Tchakalkou	Man-made reservoir
Borgou	Nikki	Nikki	Gan maro	Man-made reservoir
Borgou	Chaourou	Alafiarou	Alafiarou	Man-made reservoir
Colline	Glazoué	Kpakpaza	Sowe I et II	Man-made reservoir
Colline	Ouessé	Challa-ogoi	Botti-houégbo	Man-made reservoir
Atlantique	Ouidah	Avléketé	Adounko	Net cage culture
Atlantique	Sô.Ava	Ahomey-lokpo	Ahomey-lokpo	Net cage culture
Donga	Bassila	Penessoulou	Penessoulou	Ponds taking water from swamp
Donga	Djougou	Djougou I	Senlo	Ponds taking water from swamp
Plateau	Saketé	Takon	Dra	Ponds taking water from swamp
Zou	Agbangnizoun	Kpota	Zounmé	Ponds taking water from swamp
Atlantique	Abomey-calavi	Zinvié	kpotomey	Brackishwater ponds
Atlantique	Kpomassé	Dédomé	Coffonou	Brackishwater ponds
Ouémé	Sémé -kpodji	Djérégbé	Houintor	Brackishwater ponds
Atlantique	Tori-Bossito	Tori-Bossito	Tocoli	Non-drainable ponds
Couffo	Lalo	Adoukandji	Adoukandji	Non-drainable ponds
Mono	Bopa	Bopa	Tohonou	Non-drainable ponds
Mono	Grand popo	Grand popo	Houdioundji	Non-drainable ponds
Zou	Zagnanado	Zagnanado	Zoumon	Non-drainable ponds
Couffo	Dogbo	Ayomi	Agbedranfo	Ponds taking water from flowing well
Zou	Zogbodomé	Zoukou	Hanhonnou	Ponds taking water from flowing well
Ouémé	Adjohoun	Akpananou	Dekoumey	Catfish culture
Plateau	Ifangni	Banigbé	Banigbegare	Catfish culture
Plateau	Pobè	Ahovévé	Okeita	Catfish culture
Alibori	Malanville	Garou	Monkassa	Rice-cum-fish culture
Ouémé	Dangbo	Zoungùè	Zoungué	Rice-cum-fish culture
Zou	Come	Naogon	Noagan aga	Rice-cum-fish culture
Alibori	Malanville	Toumboutou	Toumboutou	Whédo
Ouémé	Aguégués	Aragbodji	bembéI	Whédo



Figure 3-12
Distribution of communes in which target villages are located

The average annual income of the 600 villagers investigated was as low as 1,039,115 FCFA. This data is considered reasonable because the villages culturing cotton, which is the only cash crop, were not included in the target villages of this questionnaire survey. Although no conspicuous regional trend was observed, rate of income from salary was higher in the villages near urban area such as Adounko of Ouidah and Houinta of Seme Kpodji (55% and 47%, respectively), and accordingly their annual income tend to be higher.

Number of people having fish pond was 168, and their average annual income was calculated to be 1,514,209 FCFA or significantly higher than the aforementioned gross average. Their income sources are comprised of agriculture 37%, animal husbandry 6%, aquaculture 18%, salary 33% and others 6%. Even in the case of farms conducting aquaculture, income from agriculture exceeds that of aquaculture. Average size of agriculture land is 2.7 ha, and kinds of culturing crops were corresponding to those shown in the previous Table 2-3.

Probably due to low mobility of lands, the owner farmers who employ workers permanently consisted 28% of the total. Those who employ workers temporary were counted 77%. Landless farmers or farmers having little land have to cultivate the lands rented from owner farmers at the price of some 15,000 to 25,000 FCFA/ha per year. This situation is typical in the fertile Ouémé basin.

In the southern Benin, two annual crops are possible for maize, peanut, bean, etc. in accordance with the two rainy seasons. On the contrary, maize is able to be cultivated one time a year in the northern Benin having only one rainy season. Tubers like cassava and yam have relatively longer cultivation period of about one year, and their harvests do not correspond to the number of rainy seasons. Since average cultivated areas are small, draft cattle are not used except for very large-scale farms in the north. As chemical fertilizers are not available in sufficient quantity in the market, cultivation with non-fertilizer is pronounced in the country particularly in the south.

Number of ponds of the 168 people who answered to own fish ponds in this investigation were 427 in total, in which 12% are drainable and 88% are non-drainable. As for the current situation of ponds, it is cleared that only 30% of ponds are operational and seeds were introduced, but the other 70% remain non operational.

As for the causes of such stagnation of operation, 45% of fish farmers pointed out the difficulty to obtain the finance, 17% of them answered that the techniques were not sufficiently acquired, and 10% suggested few cooperation of the government. As for the reason why farmers are not involved in aquaculture, lack of initial capital occupied 42%, lack of land 18% and lack of technology and equipment 15%.

In conformity with the result that lack of finance is suggested as the first problem, 91% of the interviewee answered they have never accessed to the credit.

Concerning the technical training, 56% of the interviewee answered they received technical advices from CeRPA and CeCPA. However, 65% people confessed they are not able to read the technical manuals or texts, suggesting the difficulty of technical extension.

Chapter 4

Master Plan

Chapter 4 Master Plan for Promotion of Inland Aquaculture

4.1 Issues in the rural development considering the promotion of inland aquaculture

Based on the analysis of current situations, issues in the rural development considering promotion of inland aquaculture can be summarized as follows.

Table 4-1. Issues in the rural development considering promotion of inland aquaculture

Subjects	Issues
Inland aquaculture	<ul style="list-style-type: none"> - It is difficult to procure seeds and feeds timely, and their prices are high. - Costs for both aquaculture equipment and excavation of fish ponds are high. - Productivity of aquaculture is low, which is caused partly by genetic degradation of Tilapia - Species suitable for brackishwater environment have not been developed. - Information is limitedly shared.
Agriculture and animal husbandry	<ul style="list-style-type: none"> - High yield seeds and fertilizer are difficult to obtain. - Productivity of livestock is low.
Rural society	<ul style="list-style-type: none"> - Educational level of farmers, especially women, is low. - Farmers' groups are not organized well. - Farmers are addicted to development aids and passively wait for them - There is a high risk of fish in pond to be stolen by theft.
Rural economy	<ul style="list-style-type: none"> - Capital for business is limited.

Although it is difficult to solve all the above development issues at once, this master plan (hereinafter referred to as “M/P”) will cover them as much as possible.

4.2 Basic concepts

4.2.1 Target fiscal year

The target fiscal year of the M/P is set as 2020. Considering the linkages with the relevant national development plans, it might be logical to adjust the target year with the one shown in “National Strategic Vision of Benin 2025” or the year 2015 in “National Political Declaration”. On the contrary, it would be realistic to decode the practical target year for this M/P, instead of those target years, considering the nature of the issues to be achieved, such as development or extension of technologies which take some time. In addition, the target year of the M/P does not follow the “Strategic Paper for Poverty Reduction” which is prepared based on the said two national plans with the 3 years of target period in order to fit with the various socio-economical changes flexibly. The 3-year period is apparently too short as the target of this M/P.

4.2.2 Purposes

Two major purposes are proposed in the M/P, such as “income generation of farmers and diversification of their income sources” and “increase of fish production through aquaculture”

- Income generation of farmers and diversification of their income sources
Farmers in rural areas are still engaged in agriculture relying on uncontrollable rainwater. Their main income sources are sales of the crops. These crops are produced mainly for self consumption and only some left are sold for cash income. In rural areas, most of the villagers employ several kinds of economic activities, such as agriculture, livestock raising, aquaculture and/or fishery. Especially in the southern region, considering both natural and social advantage, such as rich water resources and good access to big markets, it is promoted to enhance aquaculture as an additional income source in order to increase earning and to diversify the income sources.

- Increase of fish production through aquaculture
Population is increasing at 3.25 percent per year in Benin, which causes increase of demand for food. At present the per capita fish consumption is less than that of the neighboring countries or 8.9kg. Fishery production from marine capture fishery is only 10,000 tons at maximum, because the area of continental shelf is small and the unproductive Guinea Current flows in off-shore waters. In order to

compensate the limited supply of food, it imports more than 40,000 tons of frozen fish, which is resulted in low rate of self food sufficiency, namely less than 50 percent. In such a developing country as Benin, outflow of foreign currency shall be decreased as much as possible. In short, increase of domestic productivity is an urgent issue to be dealt with for both food security and saving of foreign currency.

4.2.3 Target area

The M/P will cover all the potential areas of aquaculture development in Benin specified in the Section 3.8 of this report. The southern region which is confirmed higher potential will be targeted in priority, and thereafter the achievements in the south will be extended in the northern region.

4.2.4 Target group

As discussed in the above 4.2.2, the M/P covers farmers (both individuals and groups) who are engaged not only in aquaculture but also in small scale income generating activities, such as agriculture and animal husbandry in rural areas. However, farmers of more than middle scale will be covered at the initial stage of M/P, because aquaculture activity requires relatively large capital for pond facility. Accordingly, they are farmers in southern region who own agriculture land larger than 2 to 3 ha, producing crops both for self consumption and income, as well as cash crops, such as beans and fruits. Farmers who have additional regular income from livestock raising, such as pig, goat and poultry farming, can also be selected as ideal targets for this M/P. Through the aquaculture promotion to these middle scale farmers, the proper techniques and an approach of extension will be established. In this process, the aquaculture related industries such as production of seed and feed, these materials will be supplied in proper time and price. And based on this result, aquaculture will be extended to small scale farmers and those who are placed in difficult condition of lower potential.

It is generally said that the Beninese people does not cope well with the group activities which include distribution of profit. Therefore, the M/P will target individual villagers at lease in the southern region having better access to water,. On the other hand, in the north, there is limited access to water and the people need to share those water resources. The M/P will focus on both individuals and groups in the north.

4.3 Direction of issue-based approaches for development of inland aquaculture

In order to achieve the two purposes shown in 4.2.2, activities not only aquaculture but also other livelihoods which are mutually related physically and financially must be sustainable. In order to do so, the four conditions shall be satisfied, i.e., activities must be technically simple, profitable, able to start when deemed, and durable using locally available materials. With taking these points into account, competent approaches towards the issues of rural development mentioned in Section 4.1 are consolidated in the following Table and explained hereinafter.

Table 4-2 Approaches and activities to solve the issues in rural development

Approaches	Activities
(1) Capacity development of villagers	① Support to the capacity development of villagers' organizational skill
(2) Cost down of aquaculture business	① Improvement of productivity of fish ponds through fertilization ② Extension of small-scale net cage culture ③ Promotion of catfish culture by using plastic sheet tank
(3) Improvement of productivity of aquaculture	① Improvement of the broodstock of Tilapia ② Improvement of pond culture technology ③ Improvement of feeds and their extension ④ Improvement of seed production technology of catfish
(4) Strengthening of technology extension system	① Extension through "farmer-to farmer" training ② Development of training materials ③ Training for extension officer of CeRPA ④ Establishment of a data collection system for aquaculture statistics
(5) Collaboration with agriculture and livestock activities	① Establishment of a distribution system of high yield seeds and fertilizers ② Introduction of rabbit farming to improve the cash flow

4.3.1 Capacity development of villagers

① Support to the capacity development of villagers' organizational skill

It is common that villagers who do not possess sufficient capital and capacity in literacy and math tend to participate in productive activities by forming villagers' groups. Although groups are established every year, those which are established as a recipient body of development assistance tend to stop operation following the termination of external support. There are many cases that conflicts among group members occur regarding the distribution of the profits or allocation of activities among them even in villagers' groups established voluntarily. Although these problems are often considered owing to the nature or individualism of the Beninese, the reason behind would not be so simple because some groups can continue activities for more than twenty years, and some have been able to succeed the activities to younger generation. As also seen in the case of individual economic activity, limited management capacity of the members is often considered as an obstacle of group activities. Due to lack of basic knowledge on group management, unnecessary doubts or misunderstandings (non-transparent management) are elaborated about money, materials and labor allocation, and members tend to complain about the monopoly of the selected leaders (lacking of concepts on equality and equity in group). Above all, limited transparency in the distribution of profits is considered as the biggest reason for conflicts among group members.

With taking these situations into account, it is necessary to introduce group management technologies in order to strengthen group organization, such as supporting establishment of voluntary groups, maintaining the transparency in a group management including book keeping, securing fair distribution of profits, and securing of an equal voice among members. It is also essential to provide literacy education in order for the members to learn about knowledge and skills of group management, and utilize management tools. It might be easier to provide commission to external development organizations or local NGOs about these assistances. However, it would result in limited accumulation of the knowhow for the government meaning little acquisition of sustainability. Therefore, TSIECs (extension officer for strengthening villagers, organization) under CeCPA shall be trained to function as trainers who closely work with villagers..

4.3.2 Cost down of aquaculture business

① Improvement of productivity of fish ponds through fertilization

In the southern Benin, Tilapia culture has been carried out in various types of ponds, which include so-

called “non-drainable spring ponds”, ponds filled with water from small barrage, and ponds filled with water from natural fountain and rivers. Fish in those ponds are fed on with home-blended powder feeds made from agriculture by-product having low economic value like rice bran. However, there is a common problem, namely, low productivity relating to limited fertility of water and poor feeding practice. In the case of Tilapia whose major feed item becomes phytoplankton as they grow after juvenile stage, fish can be grown without artificial feeding. Therefore it is important to reduce cost of feed by improvement of fertilization techniques for phytoplankton propagation. Non-feeding aquaculture will also be possible, if ponds are adequately fertilized.

In the rearing experiment of this study to verify improvement of fish productivity through fertilization, pig excreta from piggery were introduced to fish pond through a small manure pit where they were manually mixed well with water, and it was clarified that Tilapia culture is basically possible without feeding. This method directly realizes cost cut on feeding and accordingly for aquaculture operation. It is noted that the method must be collaborated with livestock farming since a significant amount of animal excreta is required. So far in Benin, construction of a poultry hut above the fish pond had been disseminated as a fertilization method. It was, however, often observed that villagers discontinued this fertilization method due to failure of poultry farming. This M/P proposes an alternative fertilization system using the manure pit excavated beside the fish pond. Excreta or manure of animals are once stocked in the pit and the fertile upper water is introduced to fish pond. This method would be applicable for non-drainable spring ponds that are popular in the south, because direct dumping of excreta will cause sedimentation problems of solid materials like fibers. Removal of the bottom sediments or oxidation of the pond bottom is possible for drainable ponds but difficult for non-drainable pond.

② Extension of small-scale net cage culture

Net cage culture has already been practiced in several sites supported by the government budget. The net cage culture enables high density aquaculture of Tilapia (100 fish per m³) so that high profits are expected when seeds and feeds can be procured on time and the problem of robbery can be solved. However, constraint is the initial investment. So far, the net cages constructed by the governmental budget cost more than four million FCFA for one unit which is composed of four cages with 4m x 3m size each with 2m in depth. This means that, fish farmers who can construct the net cages by own budget must be very limited in number. Even if some one can construct them, it is almost impossible to recover the investment by the profit of Tilapia culture. Therefore, this M/P proposes to alter the construction materials of net cage with the locally procurable one at low price.

Materials locally procurable, such as bamboo or teaks, would be utilized as a frame for fixing nets. Mesh net with reasonable price, which is not fishing net, will be utilized as a material replacing cage net which shares major part of the construction cost. Specifically assembled floats made of foam polystyrene would also be replaced with 25-litre polyethylene tanks that are available anywhere. Likewise, construction cost of net cages shall be reduced largely and thereby, anyone can start this type of aquaculture. However, since the platform is not facilitated in this simple net cage, workability is not as good as existing high cost net cages. All the management of cage culture including daily feeding and harvest has to be carried out using boats.

Lakes and lagoons in the southern region is considered as potential areas of net cage culture. These waters have been utilized for “acaja” and various inland fisheries. However, since the fishing efforts would be reached at the saturation level and increase of fish catch is considered almost impossible, introduction of net cage culture could be contribute for diversification of income sources of fishers in the future. In the experimental rearing of potential aquaculture species in brackishwater environment, Tilapia (*Oreochromis niloticus*) showed the best growth and it can grow well at the salinity of 10-15 ppt without difficulty. Also considering that Tilapia net cage culture in Grand-popo, which has been managed by a fishers’ group in brackishwater environment, has produced some profits, there would be no concern about the biological characteristics of the species.

③ Promotion of catfish culture by using plastic sheet tank

There are many villagers who have neither fish ponds nor lands preferable for aquaculture but have a desire to try fish culture as a part of daily agriculture activities. An aquaculture method which those people can participate in is catfish culture in small wooden tanks lined with plastic sheet (2.8-4.0m in length and 0.8-1.0m in width). This method is commonly employed in a neighboring county, Nigeria where catfish culture has been developed, and it has been practiced by several farms in the southern Benin (Ouémé and Plateau districts). The aquaculture in small-scale tanks has some merits comparing to pond culture, for example, it is easy to harvest and to minimize anticipation on theft, because the tanks can be installed close to residence such as in a garden and watched frequently. And it can be managed by women as a part of housework because heavy labor is not required for this aquaculture.

4.3.3 Improvement of productivity of aquaculture

① Improvement of the broodstock of Tilapia

Quality of seeds depends basically on the quality of breeders or broodstock. Continuation of the natural breeding in ponds at the Tohonou seed production center has caused degradation of the genetic quality and downgraded the size of broodstock, being about 200 to 250g at present. Moreover, it can also be observed that some broodstock reared by private seed producers weigh only less than 100g. Juveniles produced from these fish show a slow rate of growth and do not reach to the commercial size, if they are reared relatively long time, since they inherit the inferior genetic characters. This is one of the big obstacles for expansion of Tilapia aquaculture. There have been many attempts about genetic improvement of Tilapia in the world, and so it may be possible to introduce quality broodstock strain that has been established in other countries. However, since their adoptability is uncertain, it would be realistic to conduct selective breeding using present strain. More concretely, it should be carried out with the first criterion of the growth rate during the juvenile stage, and selected juveniles are grown-out and cross-bred for the next generation. At the same time, preferable water environment, feed, stocking density, etc. for broodstock to spawn are examined and the date are consolidated for extension to seed producers, which are necessary at the time of distribution of broodstock. Thus, fostered quality broodstock will be provided for seed producers through regional broodstock management centers (distribution centers) in order to improve the productivity and quality of local seeds. The distribution centers will also function to produce quality broodstock continuously as well as a simple stockyard of broodstock.

② Improvement of pond culture technology

In the fish ponds in Benin, it is common to harvest fish by seine net or cast net partially. In this way, however, it is impossible to harvest all the fish in the pond so that the Tilapia left in ponds repeat natural breeding, namely inbreeding that is known as a cause to produce smaller the size of fish. It is also reported that large-size predator fish left in ponds eat seeds introduced in the next rearing cycle so that the survival rate becomes low. Moreover, it is often found that fish farmers have to give up fish harvest and abandon aquaculture due not only to lack of materials necessary for harvest, such as scoop net and seine net matched with the size of fish ponds, but also to lack of technical information about equipment and adequate harvest method. The M/P will distribute seine net for harvest, machineries like drainage pump with engine, scoop net and happa net usable for selection of feeds, temporary rearing of seeds and nursing of advanced juveniles, etc in order to lead fish farmers in the country accessible to those equipment. Through this project, efficient fish harvest as well as production is achieved and the productivity of pond culture will be improved significantly.

③ Improvement of feeds and their extension

There have been various examinations on the feeds for Tilapia and catfish using locally available materials such as agriculture by-product having low economic value, e.g., cotton seed bran, maize bran, bean bran, wheat bran, rice bran, etc., blood of livestock and Azolla (a kind of floating waterweed with high protein). However, there are no comprehensive studies on evaluation of nutritional value of various materials, arrangement plan of the materials, and no systematic research and analysis aiming at development of adequate feeds considering fish species, aquaculture method and development stage of fish. Therefore, it is urgently needed to develop low cost and extendable

feeds through systematical research analysis and verification experiments. Upon the development of feeds, it is important to develop not only on-farm blend pellets which are extendable for fish farmers but also on-farm blended crumble, paste and boiled feeds depending on the situation of local aquaculture farmers. In order to introduce pellets for rural fish farmers who are spread spatially, it would be realistic to produce them at each farm using locally available materials rather than establishment of feed manufacturing center (feed factory).

④ Improvement of seed production technology of catfish

Seed production of catfish is carried out by artificial insemination using striped eggs after acceleration of broodstock maturity administrating with pituitary gland. At present, serious problems are not reported about fertilization of eggs and their incubation process in this method. On the other hand, since the early feeding regime is started with *Artemia* and then shifted to imported compound diets which are expensive, there are possibilities to improve the feeding regime using natural feed organisms such as zooplankton and sludge-worms, and home-blended compound feed containing high protein. In addition, considering catfish culture has been received strong interests particularly in the southern region such as Ouémé and Plateau districts, the demand for catfish seeds can be expanded rapidly to emerge deficit of seed supply, and it would be necessary to foster catfish seed producers in those areas as a whole. The M/P will select candidate seed producers, who practice actively fish production, have proved the high yields and posses enough space of additional facilities, and support them comprehensively as a package of technical training on catfish seed production and assistance for establishment of necessary facilities.

4.3.4 Strengthening of technology extension system

① Extension through “farmer-to farmer” training

Most popular type of aquaculture in terms of area and number is pond culture of *Tilapia* in Benin. As an approach to further extends it domestically, intensive assistance to core farmers is proposed. In this approach, the target group will be limited in number so that work loads of donor organization will be relatively less, but there might be a sort of vulnerability that technologies cannot be extended to villagers in the grassroots level, if these core farmers do not function as they are expected. Nonetheless, considering that many of the former extension approach through aquaculture development center, which has been applied by various donor countries and FAO since 1960's, had been resulted in failure, the trend of donor's approach is going to shift to the one which encourages private initiatives as to be adopted in this M/P, although this approach takes relatively long time. In Benin, there have been several fish farmers already to be functioning as core farmers. The present plan focuses on them and provides further technical and financial assistance including education and training to be private technical instructors for other fish farmers.

In Benin, aquaculture is still a new industry with short history. Therefore, it is important to promote and stimulate the people who are interested in aquaculture in order for them to start or re-start aquaculture practically, in short to increase number of fish farmers. Through this approach, it is expected that core farmers could receive orders for seeds and feeds from increased number of fish farmers, by which positive business cycle will be formulated. When the cycle is expanded, it is expected that various types of aquaculture business will be emerged as in the Southeast Asian countries, i.e., farmers that producing only juveniles, those producing only table fish, those producing only feeds, etc., so that opportunity for entering aquaculture business is increased.

② Development of training materials

Training materials developed by the JICA expert and the Department of Fisheries (DOF) receive a good reputation among villagers because of the adequate explanation with many pictures. In future, various training materials shall be developed regarding different aquaculture techniques to meet the villagers' needs in suitable formats not only booklet but also poster and calendar. It is also important to develop training material in local languages for the farmers who do not understand French.

③ Training for extension officers of CeRPA

CeRPA extension officer work closely with villagers in the field. However, most of the extension

officer mass-employed in the year 2007 has little field experiences. It is indispensable to train them, considering the necessity to develop inland aquaculture in collaboration with other extension officer at different grade and having different expertise in future. The DOF which shares the same necessity has already started its own training for the fishery extension officer. It is important to improve contents of the training and enhance their capacity.

④ Establishment of a data collection system for aquaculture statistics

Currently there is no statistical data collection system about aquaculture. It is urgently needed to establish a statistic system that makes possible to understand the present situation in order to ameliorate relevant policies periodically. The characteristics that are peculiar to the statistical data of aquaculture are firstly the easiness in confirmation of data because the production site is fixed and secondary limited frequency of harvests, one to two times a year. These are common with those in agriculture. If the data can be collected through interviews, instead of direct observation or measurement of the products, it would be possible for current extension officer to collect statistical data. In this case, following procedures are proposed. The DOF that is responsible for final review and analysis and CeRPA/CeCPA that collect primary data in the field prepare collaboratively a form of data collection sheet. Extension officers of CeCPA visit fish farms at least once a year, ask fish production in a year, and fill the data sheet. The data sheets are once compiled at CeRPA, and then consolidated and administrated totally by the DOF. In this M/D study, nationwide aquaculture census was carried out preliminary and now basic data are available. Therefore it is efficient to update these data periodically. It is important for the DOF officer and CeRPA/CeCPA extension officer who are major users of statistics to acquire basic operation skills of related software.

4.3.5 Collaboration with agriculture and livestock activities

① Establishment of a distribution system of high yield seeds and fertilizers

The yield of maize which is the principal food crop for Beninese is not so high, only 1.0 ton plus per ha in average due to continuous cultivation of local variety and no application of fertilizer. When improved maize variety is planted and composted fertilizers made of weeds or animal manure are utilized, the yield would be improved so that food for self-consumption is secured and the surplus can be given to fish and livestock.

② Introduction of rabbit farming to improve the cash flow

The pregnancy period of rabbit is as short as only one month and they give birth in maximum six times per year. Moreover, they deliver about 8 rabbits per pregnancy, meaning that a female rabbit can produce more or less 42 young rabbits a year, even taking mortality rate into account. An adult rabbit is sold at about 2000 FCFA, which can be a good income for villagers. As for the feed, the daily consumption of grain is only 50 g to 200g per head, because they eat plenty of grass instead of grain. Therefore, rabbit farming is considered as a preferable side business for poor villagers, especially for women's group to make considerable profit. Since the period from birth to the marketable size is only about four months that means superior in cashing in short-term, rabbit farming is considered suitable as a source of relief fund in Tilapia culture which requires more or less 6 months for harvest.

4.4 Regional developmental directions of inland aquaculture

Although this M/P covers whole potential areas in the country, the developmental direction of inland aquaculture would be different in northern and southern regions in which natural and social environments are different. The southern region covers six districts, such as Mono, Couffo, Atlantique, Ouémé, Plateau, Zou, while the five districts are involved in the northern region, such as Collines, Atacore, Donga, Borgou and Alibori. The Littoral district, which is almost the same as the capital Cotonou city, consists mostly of urban area so that it can not be considered as a target of rural development. Different regional developmental directions are explained here.

4.4.1 Developmental direction of inland aquaculture in the southern region

In the southern region having higher developmental potential, improvement of productivity of existing fish ponds is set forth as a basic approach through extension of appropriate techniques. There are two categories of fish ponds, operational and non-operational, and firstly re-activation of non-operational

ponds shall be achieved through farmer-to-farmer training which is explained later. Thereafter, developmental direction will be shifted to improve the productivity of operational ponds, and to strengthen aquaculture business as a whole by training of new fish farmers. Core farmers who are the hubs of farmer-to-farmer training play a central role in production of seeds and compound feeds, and the supply network of aquaculture equipment shall be expanded spatially. Likewise, through various supports to candidate core farmers and then increase in number of networking centers, costs for dissemination of techniques and transportation of materials are to be reduced, and finally improvement of profitability and productivity of aquaculture will be achieved.

At present most of fish farmers cultures Tilapia, and only progressive farmers are culturing catfish in Ouémé and Plateau districts. The future development direction is not only to improve productivity of Tilapia, but also to extend catfish culture in the whole southern region and to raise profitability of aquaculture in this region. Particularly for Tilapia, production cost shall be reduced by utmost application of livestock manure as fertilizer. From this aspect, farmers who are currently operating pig farming are ideal candidates for extensive aquaculture using organic fertilizers.

4.4.2 Developmental direction of inland aquaculture in the northern region

Due to the low population density in the northern region, it is difficult to apply farmer-to-farmer training approach as in the south. Accordingly, production capacity of existing fish farms is strengthened individually, and then based on the activities of these farmers, fishery extension officer disseminate aquaculture to the neighboring villagers. Since the distance between villages is longer in the northern region than in the south, seeds (Tilapia) and feeds are basically not to be purchased but to be self-produced and to save the cost for seeds and transportation in the north. In the northern region, many manmade reservoirs are scattered in addition to aquaculture ponds. However, at present they are not considered as preferable waters for aquaculture. They might be a sort of fishing grounds not only for wild fish but also for catching Tilapia which juveniles have been released. Recently whédos have been developed increasing the number rapidly along the seasonally flooded river beds of the Niger River in Malanville and Carimama. This is considered as the result of intensive instruction of the fishery extension officer. In addition, short-term rearing of fishes in whédos is also attempted after the harvest of wild fishes there. It is said that the fish resources have been decreasing in the Niger River because of the sand sedimentation. From the view of fishery resource management, operation rules and regulations shall be established for those whédos, and the operators shall obey with them.