



**Regional Study on Economic Opportunities in  
Sustainable Shrimp Farming in West Africa:**

**An Initial Review**

**S U M M A R Y**

**Working Document - not for citation**

February 2006

Le Seine Saint-Germain  
4, Boulevard des Iles  
92130 ISSY-LES-MOULINEAUX  
Tél. : +33 (0) 1 45 24 89 87  
Fax : +33 (0) 1 45 24 90 31  
<http://www.oecd.org/sah>

Adresse postale :  
2 rue André-Pascal  
75775 Paris Cedex 16



*Sahel and West Africa Club*  
*SOUTH-SOUTH Business Cooperation*

Regional Study on Economic Opportunities  
in Sustainable Shrimp Farming in West Africa:  
An initial review

SUMMARY

February 2006  
Working Document – not for citation



## **F**oreword

---

The Sahel and West Africa Club (SWAC) Secretariat is attached to the OECD<sup>1</sup> and supports the initiatives and efforts of West Africans to promote medium and long-term development strategies that build on the region's dynamics of change and facilitates constructive dialogue and debates that lead to innovative decisions for a better future for the region. SWAC facilitates North-South and South-South cooperation opportunities, working closely with a wide range of West African partners and international actors, including the private sector.

The present study, launched with the technical participation of the World Bank, and the financial support of the Japanese government, aims to promote South-South business cooperation between Asia and West Africa in a sector of importance to West Africa and of interest to Asian investors. As the region's population continues to expand from 290 million today to an anticipated 430 million in 2020, issues of food security and sustainable livelihoods for populations that rely heavily on fish products for daily consumption are of mounting concern. In the face of depleting wild fish stocks, these concerns have engendered keen interest in aquaculture solutions from both the public and private sectors. Taking into consideration the high market value that West Africa's wild caught shrimp currently receives on the world market, shrimp aquaculture could be a market-led solution to resources management with high economic potential. However, it is also a sector which presents serious environmental risks and therefore, careful planning, monitoring and mitigation are of utmost importance.

This study adopted an integrated and holistic methodology, incorporating the technical, marketing and investment, socio-cultural, environmental, political aspects of shrimp aquaculture. The results identify some possible investment and development strategies for different actors in light of existing constraints, and suggest ways to "close the gap" on missing links along the supply chain that may preclude shrimp aquaculture from becoming the region's sustainable compliment to wild catch. Technical and financial South-South Cooperation opportunities are highlighted to help connect these links, as there is much West Africa can learn from regarding Asia's experiences in this sector. Asian investors who are keenly aware of the social, environmental and ethical issues involved in shrimp farming will be a valuable resource to help West Africa develop investment strategies that reinforce these links for medium and long-term development of the sector.

We've called it an *initial review* because it is clear from this study that much more field-based data collection, research and dialogue will be needed to comprehensively address the complex issue of sustainable shrimp farming in West Africa. Nevertheless, what we present here are some essential starting points to help lay the groundwork for further work on this challenging topic.

We sincerely appreciate your feedback, comments and suggestions on this report, and welcome your participation in the region's efforts to develop shrimp aquaculture into a viable and sustainable investment opportunity designed to enhance local economic growth and contribute to local livelihoods in West Africa.

*Normand Lauzon, Director  
Paris, January 2006*

---

<sup>1</sup> Organization for Economic Cooperation and Development (OECD) based in Paris, France, groups 30 member countries sharing a commitment to democratic government and the market economy. With active relationships with some 70 other countries, NGOs and civil society, it has a global reach.



## Table of contents

|  |           |
|--|-----------|
| <b>FOREWORD .....</b>  | <b>3</b>  |
| <b>TABLE OF CONTENTS.....</b>  | <b>5</b>  |
| <b>1. INTRODUCTION .....</b>   | <b>7</b>  |
| 1.1 <i>International and Regional frameworks .....</i>   | 7         |
| 1.2 <i>South-South Cooperation Framework .....</i>   | 8         |
| <b>2. ABOUT THE STUDY.....</b>   | <b>10</b> |
| <b>3. GLOBAL SHRIMP MARKETS AND TRENDS .....</b>   | <b>11</b> |
| 3.1 <i>Potential commercial aquaculture species for West Africa.....</i>                           | 13        |
| 3.2 <i>Principle characteristics that meet world shrimp market specifications.....</i>             | 14        |
| <b>4. HOW TO PRODUCE SHRIMP IN WEST AFRICA FOR HIGH-RETURN MARKETS .....</b>                       | <b>16</b> |
| 4.1 <i>Value chain analysis .....</i>  | 17        |
| 4.2 <i>Prospects for most suitable operational formats.....</i>                                    | 19        |
| 4.3 <i>Environmental suitability in West Africa.....</i>   | 21        |
| <b>5. POSITIONING WEST AFRICAN SHRIMP PRODUCTS IN THE TARGET MARKET .....</b>                      | <b>24</b> |
| 5.1 <i>Accessing International markets for West African shrimp products .....</i>                  | 24        |
| 5.2 <i>Accessing Alternative Markets.....</i>  | 25        |
| <b>6. IDENTIFYING KNOWLEDGE GAPS TO MEET MARKET POTENTIAL.....</b>                                 | <b>27</b> |
| 6.1 <i>Requirements for West Africa culture systems and shrimp species.....</i>                    | 27        |
| 6.2 <i>Attracting Investment into Shrimp Farming.....</i>  | 29        |
| 6.3 <i>Using a Franchising System for Placing West African Shrimp Products on the Market.....</i>  | 29        |
| <b>7. MANAGING SUSTAINABILITY AND RISKS: CLOSING THE GAPS.....</b>                                 | <b>31</b> |
| 7.1 <i>Technical sustainability .....</i>  | 31        |
| 7.2 <i>Institutional sustainability .....</i>  | 31        |
| 7.3 <i>Social sustainability.....</i>  | 33        |
| 7.4 <i>Environmental sustainability .....</i>  | 33        |
| 7.5 <i>Financial sustainability .....</i>  | 34        |
| <b>8. CONCLUSION: SUGGESTED SHORT AND LONG-TERM STRATEGIES FOR SUSTAINABLE SHRIMP FARMING.....</b> | <b>36</b> |
| 8.1 <i>Adopting a blended value approach (economic, social, environmental values).....</i>         | 36        |
| 8.2 <i>Readiness for Investment .....</i>  | 36        |
| 8.3 <i>Opportunities for South-South Business Cooperation.....</i>                                 | 39        |
| 8.4 <i>Opportunities for Public and Private Sector interventions .....</i>                         | 41        |
| <b>WORKS CITED .....</b>   | <b>44</b> |





# 1. Introduction

---

In May 2004, the SWAC Secretariat, with technical support from the World Bank and with financial support from the Japanese government, decided to launch a market-led study to concretely identify the opportunities and challenges of sustainable shrimp farming in the region, and to use these findings to inform all stakeholders on the broader challenges and conditions necessary for developing sustainable businesses in West Africa through South-South private sector cooperation. SWAC's specific interest in this study is to help identify new economic opportunities for the West African private sector while promoting sustainable, equitable development.

As the West African population continues to expand from 290 million today to about 430 million in 2020, issues of food security and sustainable livelihoods, for a population that relies heavily on fish products for daily consumption and export, are of mounting concern. In the face of depleting wild fish stocks, these concerns have engendered keen interest in aquaculture solutions from both public and private sector actors.

The growth of the shrimp industry has generated considerable international debate about the adverse social and environmental costs which present major obstacles to production. Problems have been linked to poor management practices, planning and governance. As a result, low impact management practices, market-based initiatives and trade agreements have emerged to promote more responsible shrimp aquaculture in developing countries.

The overarching objective of this study is to begin to map out for all stakeholders how West Africa will be able to benefit from the important development potential of sustainable shrimp farming methods which can strike a balance between economic value and the broader social and environmental value of natural habitats and the local livelihoods that depend on them. Initial results of the study attempt to demonstrate that when shrimp culture is ecologically sound and socially equitable, the second-generation problems of environmental quality and disease control can not only be addressed, but more sustainable production systems also guarantee safer and more reliable exports, create new jobs and improve food security - key factors for implementing market-led pro-poor growth strategies.

## 1.1 International and Regional frameworks

On the international level, a consortium of international organizations has been engaged in dialogues and research on environmentally sustainable aquaculture production methods in recent years. The Shrimp Farming and the Environment Consortium Programme (World Bank, FAO, WWF and NACA)<sup>2</sup> in their 2000 report entitled "Can shrimp farming be undertaken by a developing country profitably, sustainably and with limited impact on the environment?" demonstrated how sustainable shrimp farming methods can, when carefully planned, deliver blended value of financial return to investors, social and economic value to local communities and sustainability to the environment. This study attempted to analyse West Africa's capacity to adhere to the aquaculture principles of the FAO Code of Conduct for Responsible Fisheries and the international experiences of the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment, as the most widely recognized guidelines.

A Summit was recently organized in Abuja, Nigeria under the auspices of the New Partnership for Africa's Development (NEPAD) on "*New Directions for Fisheries and Aquaculture in Africa*", known as the "Fish for All Summit". Participants, drawn from twenty six (26) African Union member states, Regional Economic Communities, civil societies, local institutions and international organisations adopted the ***Abuja Declaration on Sustainable Fisheries and Aquaculture in Africa***.

---

<sup>2</sup> FAO, Food and Agriculture Organization, WWF, World Wildlife Fund, NACA, Network of Aquaculture Centres in Asia-Pacific.

The Declaration endorsed an Action Plan on supporting capture fisheries, sustainably developing aquaculture, improving fish market chains, increasing benefits from fish trade and supporting decision makers with information.

**As a result, in Abuja the following regional priorities for fisheries and aquaculture were developed for ECOWAS<sup>3</sup> countries:**

1. *Building capacity of African countries to harness the full benefits of marine and coastal fisheries.*
2. *Improving fisheries governance and participatory management.*
3. *Sustaining production through restoration of eco systems and integrated water resource management.*
4. *Management of coastal and inland environment.*
5. *Improving market access, in particular for small scale producers, processors and traders.*
6. *Promoting enterprise development through enabling institutions and policy frameworks.*
7. *Supporting post-harvest activities through adequate investment and policies.*
8. *Encouraging private sector investment across the sector.*
9. *Supporting the emerging regional trade in aquaculture products.*
10. *Expanding the adoption of integrated small-scale aquaculture as a means of increasing rural productivity and food security.*

In addition, the World Bank and its partners (FAO, the World Conservation Union, and World Fish) announced their new Global Programme on Fisheries (PROFISH). Through the Global Environment Facility (GEF), partnership initiatives and country-level projects, the World Bank currently has a portfolio of approximately US\$1 billion (over 50% in Asia and over 33% in Africa) in fisheries, aquaculture, coastal and aquatic environmental management and related projects serving coastal and fishing communities. The goal of PROFISH is to assist developing countries, including Sub-Saharan Africa, in the design and implementation of sector strategies and plans for sustainable fisheries; and to integrate, or mainstream these policies and plans into the national economic planning frameworks.

## **1.2 South-South Cooperation Framework**

Asian shrimp farming enterprises have developed and improved shrimp farming techniques to respond to different environments, communities, markets and risks around the world. The sector employs millions of workers and is viewed as a strong source of economic growth. Nevertheless, there are growing limitations in land and ecological risks related to massive soil contamination inherited from intensive agriculture activities and residual effects of poorly planned aquaculture operations. Therefore, Asian business operators in the sector are searching for new investment opportunities, including in West Africa. Asian expertise and demand, thus, provide a potentially valuable economic opportunity for joint-ventures, including subcontracting, franchising and out-sourcing production from West Africa, provided the right conditions are present.

One of the major environmental concerns with shrimp farming is the impact on coastal habitats, and particularly mangrove forests. This issue has received even more attention following the Asian tsunami disaster, and future aquaculture developments are expected to pay more attention to retaining a protective coastal belt of mangroves. Within the framework of South-South Cooperation, technical expertise and financial resources of Asian partners can bring valuable knowledge (and access to knowledge) as well as needed investment capital into the design, construction and management of sustainable shrimp farm sites.

---

<sup>3</sup> The NEPAD 'Fish For All' Summit<sup>3</sup> held in, Abuja, Nigeria, on August 22<sup>nd</sup>- 25<sup>th</sup>, 2005

The need for protection of critical habitats is increasingly being recognized in West Africa, and there are a number of Global Environment Facility (GEF) projects in the region supporting identification and building of institutions and policy frameworks for conservation and management of these critical habitats. Ideally, shrimp aquaculture development should proceed alongside coastal management plans where suitable areas for shrimp and other forms of aquaculture are identified and properly zoned in ecologically less sensitive areas.

Lessons can be learned from Asian best practices like Bangladesh and Vietnam, where adaptive shrimp farming systems led to an increase in technical and marketing abilities of small-scale shrimp farmers<sup>4</sup>. These adaptive systems, which are needed to work locally with shrimp farmers to build collective structures of representation in countries with dispersed small-scale production, help to address complex social, cultural and environmental problems.

Although not usually considered a “South” nation, Japan in terms of investment opportunities has one of the largest shrimp markets. For this reason, Japanese business leaders have extensively invested in fishing activities in Africa, however mostly in high seas “shrimping”. Developing opportunities for South-South cooperation in coastal or inland shrimp farming in West Africa can, therefore, be of particular interest to Japanese investors in search of diversifying their investments, especially knowing that Japanese business leaders have already invested in large shrimp farms in Madagascar and smaller pilot projects in other areas in Africa.

West Africa has a unique opportunity, in its early stage of shrimp farming development, to correctly apply these conservation frameworks and lessons taken from the Asian experience to generate sustainable, profitable shrimp aquaculture production that will enhance, instead of hinder, the natural environment and local livelihoods.

---

<sup>4</sup> ‘Investment mechanisms for socially and environmentally responsible shrimp culture’, Nautilus Consultants Ltd/IIED, 2003

## 2. About the Study

---

The *Regional study on economic opportunities in shrimp farming in West Africa: An initial review* consists of three parts: **1) a summary (present document), 2) five individual expert reports** and **3) a synthesis document** which highlights the different individual reports with a particular emphasis on marketing, product development and investment opportunities for a West African shrimp product. The summary attempts to lay the groundwork for short, medium and long-term follow-up actions for public and private sector actors, local and regional institutions, international cooperation partners and potential investors who are interested in sustainable shrimp farming operations in the region. The individual reports are in-depth technical analyses in specific issue areas of interest to producers and investors alike. The synthesis document places the report findings in the context for those particularly interested in questions related to marketing, product development and investment.

The **five individual expert reports** are structured as follows:

- 1- Marketing and processing report by John Dallimore, TNC Partners, Germany
- 2- Environmental aspects and sustainable development report, by Dr. Michael Phillips, NACA, Thailand
- 3- Shrimp aquaculture specialist report, by Dr. Janet Brown, Stirling University, UK
- 4- Socio-cultural aspects report, by Dr. Pierre Failler, University of Portsmouth, UK
- 5- Investment promotion report, by Jegathesan, JJ International, Malaysia

The **synthesis document** is structured as follows:

Chapters 1 through 3 are the introduction, executive summary and general arguments for placing West African shrimp on the world market and in niche markets.

Chapters 4 through 7 discuss the challenges and opportunities of starting a market-led West African shrimp aquaculture sector by following the supply and value-added chain for shrimp and concentrating on the three main clusters of supply chain activities: marketing shrimp to the target markets, producing and processing shrimp in an aquaculture project to the specifications demanded by the target markets, and sourcing the supply for producing shrimp by either establishing broodstock or catching post-larvae.

Chapter 8 presents considerations on the promotion of foreign direct investment for shrimp aquaculture in the situation currently found in West Africa and described in the previous chapters.

Chapter 9 reinforces the study findings by bringing together the supply chain clusters and the investment promotion considerations, giving an overview over the most salient results. It also presents the suggestions and recommendations for investment strategies to support private sector development within the targeted cluster of shrimp aquaculture.

All documents are available on the SWAC website [www.oecd.org/sah](http://www.oecd.org/sah) or by contacting the Secretariat. In addition, a CD-Rom of the reports and data is available.

For further information about the study and related activities, please contact:

**Sunhilt Schumacher and Sara Minard**  
**Sahel and West Africa Club Secretariat /OECD**  
**4, Blvd des Iles**  
**92130 Issy-les-Moulineaux, FRANCE**  
**Direct: +33(0)1 45 24 84 83**  
**Fax: +33 (0)1 45 24 90 31**

### 3. Global shrimp markets and trends

Shrimp is the world's most important seafood commodity accounting for about 19 percent of international trade in value terms. World shrimp production from fisheries and aquaculture has soared over the past 20 years to reach 4.65 million metric tonnes in 2003. Capture fisheries account for 3 million tonnes and are unlikely to increase, while aquaculture has seen a 10% per annum increase over the last decade<sup>5</sup>. Shrimp farming is practiced throughout the world in tropical and sub-tropical regions. The EC, Japan and the United States are the world's major importers of shrimp at around 1 million metric tonnes.

#### GENERAL WORLD SHRIMP MARKET STATISTICS

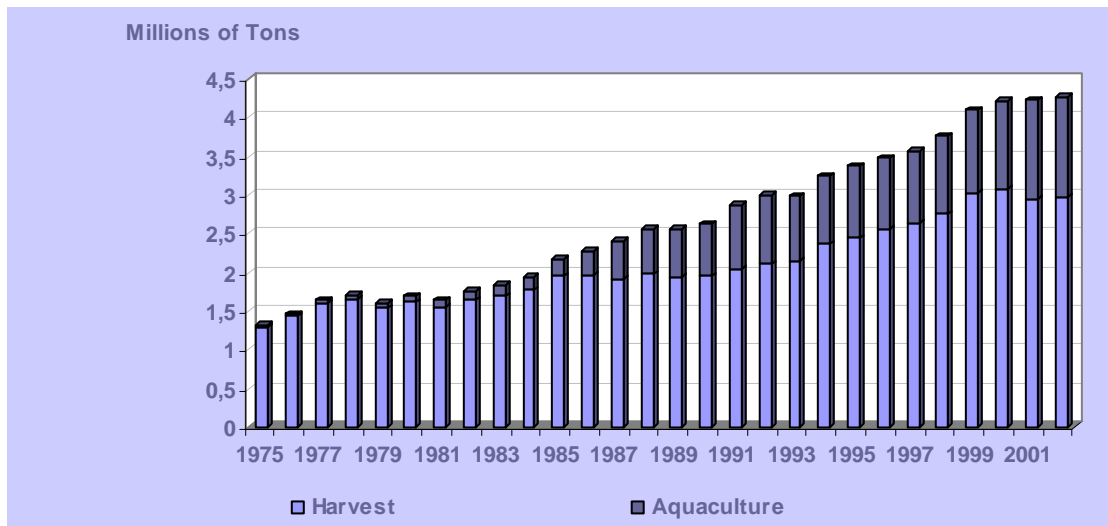
- *World shrimp production has risen by over 1 million Metric Tonnes in the last 10 years to 4,655,000Mt in 2003*
- *Wild fishing capture is now stable at around 3 million Metric Tonnes and unlikely to increase as most stocks are fully exploited*
- *Aquaculture production provides now 1,655,000 Metric Tonnes*
- *Predictions for aquaculture production from major producing countries are bullish – Madrid conference October 2004 saw Brazil, China, Indonesia, and Vietnam all suggest significant increases planned over the next 5 to 10 years: It was conservatively calculated that an additional 1 million tonnes could become available over this period*
- *Disease issues which seriously affected the expansion of the aquaculture sector in the 90s seem to be largely under control with the development of better husbandry techniques*
- *Aquaculture has seen a big increase in white shrimp production for culture reasons – especially in SE Asian countries – the home of the Black Tiger Shrimp*
- *Market prices have responded negatively to the increase of production – falling by 100% over the last ten years. For normal white shrimp prices are currently under US\$4.00 per kg*
- *It is considered likely that shrimp prices will continue to fall – probably reaching US\$3.00 – US\$3.50 before becoming more stable*
- *Many producers are now facing difficulties with rising feed costs and operation costs, against falling market prices – it is suggested that target production prices for white shrimp species (ex-farm) need to be in the region of US\$2,50/kg for profitability in this competitive market*
- *Shrimp is still perceived as a luxury product, and as such is not immediately bought as an everyday meal, more normally for special occasions or at restaurants*
- *Alternative marketing strategies (Fair Trade labels; organic; size differentiation; product development) could show better returns and incur lower market risks with better project sustainability*
- *The main shrimp consumers are aged 35-55 and new initiatives are needed to bring younger consumers into the market by offering alternative products*
- *There are strong indications for niche market demand e.g. “shrimp from Madagascar” which now attracts significantly higher prices, and that any project needs to consider opportunities to develop specialist products with specific identities which can improve profitability*
- *With prices falling, emerging markets are being found in the booming economies of SE Asia and China*

The largest exporters of farmed shrimp are China, Thailand, Ecuador, Indonesia, India, Mexico, Bangladesh, Brazil and Vietnam. The key component for these countries' success is geographical, with tropical climates and extensive areas of suitable land for shrimp pond development.

<sup>5</sup> Most export/import statistics do not differentiate between farmed and capture product, making the differentiation difficult. However, for the European market new EU labelling requirements for place of origin on seafood products will lead to differentiation between farmed and wild caught product and may lead to greater clarity with regard to production region than simply the exporting country.

However successful their current figures suggest, failure from disease or severe climatic conditions can halve production in a subsequent year – like Ecuadorian results from the 90s to the present day. In Ecuador, in 2002, over 80,000 ha of ponds were inactive, 200 hatcheries were idle and almost 200,000 people had lost their jobs. The principle cause was an outbreak of white-spot virus and Taura Virus, which was aggravated by lower than normal water temperatures. However, the introduction of greenhouse technology – where temperatures were maintained over 30°C has almost eliminated the problem in juvenile shrimp (World Shrimp Farming, 2003).

Diagram 1: World production from fisheries and aquaculture for shrimp (FAO 2002)



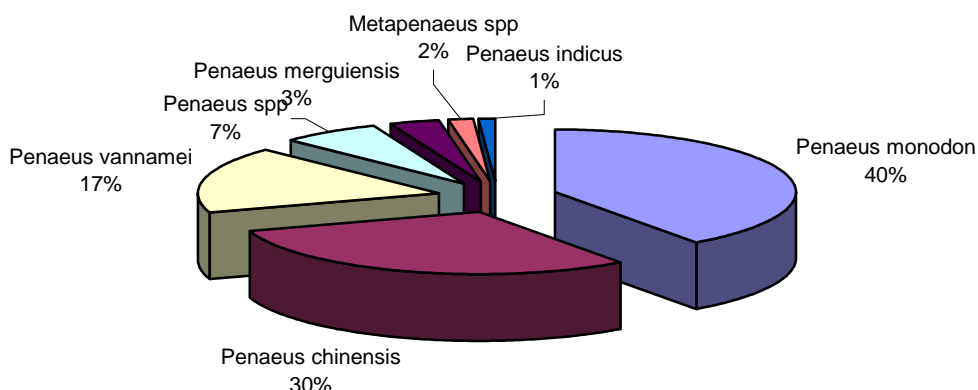
Tropical and warm water shrimp species are fully exploited, and have shown signs of decline. In the West African waters, shrimp catches are showing similar trends. Nigeria, which has approximately 250 shrimp vessels has seen catches fall in the Gulf of Guinea from 8,000 tonnes per year in 2002, to catches of 6,500 in 2004.

The main species caught worldwide are *P. notialis* (white shrimp), *Parapenaeopsis atlantica* (brown shrimp), *P. kerathurus* (tiger) and *P. monodon* (wild tiger). *P. atlantica* and *P. kerathurus* are both deeper water species and currently do not have the technology to make them available for aquaculture, while *P. notialis* and *P. monodon* are both candidates for farming.

*P. monodon* is now estimated to account for 10% of the trawl caught shrimp in the Gulf of Guinea (West Africa), even though it has only a recent introduction to the region. It is not clear where the original stock came from, but this species is now apparently naturalized throughout West Africa from Mauritius to Gabon. Specimens up to 150g have been caught indicating that brood-stock for aquaculture are available to the region.

Diagram 2: Major species under cultivation 2002

Production by species (Source : FAO, 2002)



### 3.1 Potential commercial aquaculture species for West Africa

The study has identified the following shrimp and prawn species as potentially suitable for aquaculture production in the region:

#### Marine Species

***P. monodon***: Exotic species of significance to aquaculture with existing technology available and good market potential. A fast growing, large species with good specialty market product niches and generally higher prices – species used in Madagascar.

***P. notialis***: Local West African species which form the bulk of fishery catches, but there is currently no known culture technology except trial ponds using fresh feeds and post larvae supplied from the wild. Market potential good, but will compete with other white shrimp products e.g. *P. vannamei*, *P. chinensis*, *P. indicus*, etc. Market conditions less attractive than for *P. monodon* and does not grow as fast or as large.

***P. kerathurus***: Local West African species also extensively fished and of high quality and good taste. Can grow to large sizes but no known technology available or tried for use in aquaculture though potential for similar markets as that of *P. monodon*.

***Parapenaeopsis atlantica***: Local West Africa species also part of trawl fishery catch – referred to as a brown shrimp which would mean different marketing strategies required due to taste being stronger. No known aquaculture development – generally growing to a smaller size than other species so potentially lower market prices.

***P. vannamei***: Apparently introduced and caught in Guinea and other adjoining States though not specifically identified. Is a major candidate for aquaculture and has complete technology available for culture. The market is currently paying low prices and it is anticipated to remain so with additional production arriving from Central America and South East Asian producers.

Extensive research is needed to understand whether and how to adapt local species such as *P. notialis* and *P. kerathurus* to aquaculture systems.

## Fresh Water Species

***M. rosenbergii***: An exotic species apparently available in West Africa (Senegal) – complete culture systems available and could be utilized as a commercial fresh water shrimp. Market prices normally 50% of those associated for marine species – market also less well developed. Potential for polyculture production with other fish (e.g. tilapia) normally forms part of subsistence and local market developments.

***M. vollehovenii***: An indigenous species that appears to have the technology available for aquaculture established. Is available throughout the region, though does not grow to the sizes achievable by *M. rosenbergii*. Will face similar and to a degree poorer marketing capabilities than *M. rosenbergii*, but could have potential for local in-country marketing. Exports again limited by lack of consumer knowledge and lower prices.

**Serious consideration should be given to the feasibility of extensive culture of local freshwater prawns (*M. vollehovenii*) or semi-intensive culture of the exotic species *M. rosenbergii*.**

In the West African context the most likely scenario is to introduce freshwater prawns alongside fish culture as an additional cash crop. Extensive culture of the local species is a possible option along with hatchery production which, although nascent, is deemed commercially feasible. In addition, investment costs for extensive farms are far lower than for semi-intensive farms. If stocking densities are less than 5 m<sup>2</sup> then no additional feed is required and the prawns can utilize waste from the fish.

### 3.2 Principle characteristics that meet world shrimp market specifications

For any new, unique shrimp product to enter the world market today, it has to be seen as a product of quality with outstanding taste and texture if it is to support commercial investment. In the study region of West Africa, the wild caught shrimp have this image on the major markets, and as such are commanding high prices. In considering the development of shrimp farming in West Africa, it is important to compare the issues of production in Africa with the criteria and quality of shrimp produced for world markets.

- **Quality:** To assure quality, especially in the tropical conditions found in Africa, catch to processing time is a major factor – This must not exceed 2 hours and all project development must consider distances from existing processing facilities or the need to construct on-site processing capability. **Firmness:** Another issue of quality, and controlled by speed of handling and minimum transportation, especially where roads are not sealed or in bad repair. Transporting shrimp from the production site to the processing facility can seriously affect firmness which is directly related to quality and market price **Taste:** This is a unique quality of African shrimp and although not analyzed or quantified, is an important factor for traders and consumers to pay more for these products from the region. It is normally associated with water quality though no technical correlation is available to identify causing agents.
- **Reputation:** Existing traders and exporters have created a “name” for shrimp products from the region, and as long as future aquaculture producers respect the quality issues and maintain them, there is no reason to suppose that the regional “brand” will not help the sale and prices for shrimp products from the region.
- **Product types:** Will be frozen shrimp – whole head-on for quality shrimp and frozen tails for lower quality or damaged shrimp. Local fishing companies estimate that they currently trade 90% of head on and 10% of lower quality product. Any aquaculture project must seek to emulate or better these ratios to be successful.



- **Native Species:** Local species may also meet the criteria of higher quality and prices obtained in the international markets. For example, Madagascar is producing *P. monodon* and as such is in direct competition with the major S.E. Asian producers of the same species, yet receives significantly higher prices, so this cannot be the only factor. Other issues are at work which give Madagascar an advantage – all of the above contribute to this
- **Processing Skills:** An experienced workforce, used to handling and controlling quality is essential. Throughout West Africa there are companies able to meet and sustain these levels, as is demonstrated by the market prices received for the locally produced products. Careful grading and selection is essential to maintain the best quality for all products.
- **Hygiene Standards:** Although limited in number, local health and veterinary staff in some countries have the necessary skills, training and equipment to ensure all processors and producers meet the international standards required for HACCP and traceability legislation pertaining to the chosen export markets.
- **Export facilities:** Throughout the region there are ports for exportation of shrimp products to world markets with regular shipments to international destinations. Infrastructure from the hinterlands and project location will be limiting factors not only for exporting the finished product, but also for servicing the project with raw materials
- **Infrastructure and services:** All shrimp farming projects will need to be based as self contained units with their own backup generating capacity and access to potable water which is suitable for hygienic processing to international standards
- **Management:** All shrimp farming projects need qualified and experienced managers to ensure compliance of processing to international standards
- **Marketing:** It has been successfully demonstrated by Madagascan producers and West African fishing companies that a direct marketing organization in the receiving countries is essential. In the current world markets, the removal of wholesalers and other elements of the distribution chain is essential for the commercial success of any shrimp project to maximize the profits retained within the company
- **Foreign-exchange (For-ex) Accounts:** It will be essential that any shrimp project is able to establish and maintain For-ex account facilities as many of the inputs will need to be imported and all income will be generated in foreign currency. Payment for inputs can be protracted if local banks have to be used

*It is important to remember that shrimp is traded as a commodity and, as such, is a very generic product. Achieving product identity in a cluttered market, therefore, is difficult and requires time, investment and commitment.*

## **4. How to Produce Shrimp in West Africa for High-return Markets**

---

In the development of any business or sector strategy where technology is required, it is essential to evaluate all existing conditions and the potential for sales before committing capital investments and labour. For shrimp farming in West Africa, cross-sector analysis for market-led development is needed before embarking on a sector development strategy. To begin, a clear understanding of the worldwide industry is needed (see previous table), along with good knowledge of the marketing opportunities and constraints and the ecological environment, the basic criteria for shrimp farming.

*Critical data for establishing the appropriate requirements for shrimp farming project development:*

### **Production and operating costs:**

- Producers in SE Asia and other major producing countries have been able to lower production costs to under US\$2.00 per kg by being highly efficient in management and use of inputs (feed, fuel, pumping etc)
- A recent feasibility study in Africa using the best culture systems available and transfers of new technologies concluded that operational costs would be in the region of US\$4.50 per kg due to higher development, infrastructure and labour costs, and having to import many consumables – notably feed

### **Food safety legislation for producers and processors:**

- With new EU (as of 1<sup>st</sup> January 2006) legislation and legislation passed in the last 4 years all producers and processors are legally liable for the production of safe food. They have to fully record all aspects of the culture system and inputs (feeds, medicaments) - traceability; all products have to be tested and certified, processors have to meet HACCP standards, the storage and transportation systems must meet accepted standards.

### **Retailer and consumer demands:**

- Retailers and consumers are placing more pressure on shrimp producers to farm shrimp using sustainable methods, and this is being supported by the EU's CONSENSUS initiative. The Darden restaurant group in the USA now require all shrimp supplies to meet the Global Aquaculture Alliance standards as defined in their Best Aquaculture Practices – other major retailers are also pursuing these standards for quality and sustainability.

### **West African perspectives – Challenges:**

- There is limited local shrimp farming technology for culture without major financial assistance and long-term investment on all levels.
- There are limited resources to establish and ensure food safety criterion which will qualify products in the major markets. Although under the EU's program for ACP countries, specialists continue to work in West African countries to train and support local institutions to ensure hygiene and food safety standards are being met.
- Infrastructure needed to establish production and processing facilities away from main population centres is weak.
- Production costs are potentially significantly higher than in other major production regions in the world. Products will have to be exceptional and must be aimed at specific niche markets if projects are to be commercially viable.
- Political instability, and corresponding negative perceptions of the West African region could impact negatively on marketing.

#### **West African perspectives – Opportunities:**

- **There are potentially valuable commercial species which could be developed for shrimp farming.**
- **Extensive areas could be developed which are environmentally and socially acceptable for sustainable shrimp farming and which meet the criteria set by the major markets.**
- **Well developed processing industry already supplying high value shrimp products to the major markets.**
- **Potential to utilize existing good trade links with major markets to create brand of excellence for farmed shrimp products.**
- **Potential exists to create alternative brands that are organically certified, Free Trade labeled, etc. Marketing potential identified for these products is good, with limited risks of competition. Market prices for quality up to 50% above normal market prices.**
- **Due to limited shrimp farming activities, risks of disease are reduced significantly which will assist the industry to by-pass the failures of other regions around the world. To maintain this status will require pro-active interventions by government and industry.**

#### **4.1 Value chain analysis**

There are significant niche markets which can be entered by a shrimp producer but to do so the producer must meet the standards required by these markets in terms of quality, size, freshness etc. as were outlined in this report.

The main purpose of the value chain analysis is to consider all aspects which make up the total production costs, and relate these to the target market. Such analysis allows an assessment of the gaps and the levels of intervention for different stakeholders in order to develop a sustainable shrimp farming project.

In the table below is a sample analysis of data obtained for Ghana of detailed costs (in nominal value) for production, processing and shipping of a West Africa shrimp product, although it is likely that these costs will be similar for all of the countries in the region to some extent.

| Items to be considered in value chain analysis  | <i>Apparent costs for items for production and export of shrimp from West Africa</i> |
|---|--|
| <p><b>Construction &amp; Capital costs:</b></p> <ul style="list-style-type: none"> <li>• Hatchery buildings and self contained power supply, filters, tanks, pumps, laboratory, etc.</li> <li>• Ponds, inlets and outlets including reservoirs and settlement tanks</li> <li>• Pumping facilities and control systems</li> <li>• Potential for aeration with generating capacity for complete backup</li> <li>• Infrastructure for access and harvesting</li> <li>• Processing facility, admin buildings cold stores &amp; other storage</li> <li>• Security for main compound</li> <li>• Vehicles</li> <li>• Specialist equipment for feeding, harvesting, etc.</li> <li>• <b>Depreciation on all of above assumed at annual rate of 15%</b></li> </ul> <p><b>Operational costs:</b></p> <ul style="list-style-type: none"> <li>• Feeds</li> <li>• Post larvae supply from hatchery</li> <li>• Labour (in hatchery, on-growing, harvesting and processing)</li> <li>• Packaging used in processing for shipment</li> <li>• Fuels and oils</li> <li>• Fertilisers</li> <li>• Maintenance</li> <li>• Other consumables – medicines, office, etc.</li> <li>• Technology transfer and specialist input / management</li> </ul> <p><b>Calculated costs per tonne based on all of the above:</b></p> | <p style="text-align: right;"><b>€ 4500.00</b></p>                                   |
| <p>Processing assumptions are based on 90% of all harvested shrimp being of high quality suitable for whole shrimp product at best market price, and 10% being soft shelled or damaged – suitable for peeled un-de-veined products with lower market value. Shrimp products have different tail weight extraction values e.g. Tiger species 55%; white shrimp species 65% of total weight</p>   |  |
| <p><b>Finance charges are estimated at 10% of production costs on per tonne</b></p>   | <p style="text-align: right;"><b>€ 450.00</b></p>                                    |
| <p><b>EX FARM COST PER TONNE (subtotal)</b></p>   | <p style="text-align: right;"><b>€4950.00</b></p>                                    |
| <p><b>Costs of movement of shrimp from farm/processing facility to quayside ready for export including: costs per tonne</b></p> <ul style="list-style-type: none"> <li>• Transportation of reefer container</li> <li>• Rental of reefer container (using containers as cold storage at farm)</li> <li>• Port charges for reefer container handling and maintaining</li> <li>• Veterinary inspection and clearance</li> <li>• Customs clearance</li> <li>• Shipping documentation and agents fees</li> </ul>   | <p style="text-align: right;"><b>€700.00</b></p>                                     |
| <p><b>Estimated shipping costs for reefer container from West African ports to ports in EU, USA or Japan. Costs per tonne.</b> Principle costs for containers are incurred for loading and unloading, not for actual time onboard the shipping vessel, hence costs can be average for all markets</p>   | <p style="text-align: right;"><b>€300.00</b></p>                                     |

|  |           |
|--|-----------|
| Delivery of container from receiving port to customer in EU, USA or Japan. Costs per tonne. <ul style="list-style-type: none"> <li>• Customs clearance</li> <li>• Veterinary inspection and clearance</li> <li>• Shipping agents documentation and clearance</li> <li>• Transport with truck to cold storage facilities</li> <li>• Rental of space at cold storage facility</li> <li>• Logistic transport and breaking of container to consumer</li> </ul> | €1 000.00 |
| Costs per tonne for shrimp products produced in West Africa when delivered to wholesale customer based in EU, USA or Japan assuming all carriage and insurance costs borne by producer.  | €6 950.00 |
| <i>Note: The above costs are at the point of entry into the existing distribution chain</i>  |           |

Marketing operations of quality products with identifiable brands in the EU, USA or selected markets which enable the producer to deliver higher up the distribution chain will significantly improve returns to the producer.

Accurate development of these costs is only possible by undertaking a **detailed feasibility study** but estimates have been used to apply realistic costs to the value chain analysis and provide a minimum market price required for shrimp products entering major markets. Many standard shrimp products are currently sold below this level. However, quality products similar to those produced by aquaculture in Madagascar and shrimp from wild sources in West Africa realize considerably more than the above base price.

#### 4.2 Prospects for most suitable operational formats

Shrimp farming can be categorised as **super-intensive, intensive, semi-intensive and extensive** (detailed descriptions of each system are available in the shrimp farming specialist report). The terms, intensive, semi-intensive and extensive, however, are not absolute terms. For example, recent developments reported from China and Indonesia (where exotic shrimp species *P. vannamei* are being farmed at intensities of 450m<sup>-2</sup>) stretches the term “intensive” beyond anything understood until now. An alternative way to look at the terms is to say that super-intensive and intensive shrimp farming means that all aspects of the shrimp culture has to be managed, their oxygen requirements, their total diet and their health. Technologies for managing the first two factors are relatively straightforward but costly. It is the latter aspect, that of health management that is not straightforward. Once shrimp are overcrowded, their stress levels rise and they become more susceptible to disease. Thus, the five different operational systems below should be thought of in terms of stock intensity which directly affects the health, and therefore the viability, of the shrimp being farmed.

**Super-intensive** – High risk systems that rely on advanced technology but are still extremely vulnerable to disease problems. The term can be understood very literally as “beyond intensive”. It has been introduced recently to refer to intensive systems with stocking intensities far beyond anything common until now. This is the case for developments reported from China and Indonesia where exotic shrimp species *P. vannamei* are being farmed at very high intensities (450 m<sup>2</sup>).

**Intensive** – High density monoculture system that requires high level of expertise to run successfully and to avoid environmental impacts. It has high fixed costs so is more sensitive to product price drops. All aspects of the culture system are provided for in this system. This may have a hatchery supply for shrimp seed, high stocking density of the ponds, very little reliance on algae for feeding growing shrimp, complete diets, and high levels of water exchange (pumping) where aeration is extensively used, etc. This is a potential system where land space is limited or costly, energy is cheap and trained staff supports the technology. Production levels are normally in excess of 10 tons (per hectare, per year), but risks of failure and environmental problems are high.

Intensive shrimp farming is also a technology-dependant system and requires high levels of investment that can produce huge returns but is very sensitive to price drops in the product. To operate successfully intensive farms requires a significant level of expertise in management and high inputs of good quality feed and technical equipment which in turn require reliable energy sources to operate. Intensive farming cannot usually be done without some risks to the local environment from effluent discharge, unless it is done in a totally controlled manner by well-trained staff.

**Semi-intensive** – Low density and relatively low risk system that can still produce large shrimp, and if well managed, with little waste production. It has fixed costs and variable costs such that the system has greater flexibility to respond to shrimp prices. This system requires inputs, but the shrimp also utilise the natural productivity of the pond ecosystem. Inputs include fertilisation of the pond pre-stocking, some feeding and limited pumping and aeration. At this level, it is possible to achieve organic certification. Technical requirements from staff are also lower, and the system is not very mechanically reliant. Production levels are much lower, from 1.5 – 3 tons (per hectare, per harvest) but risks are also much lower. These systems are proven in many parts of the world and would be suitable for West Africa.

**Extensive** – Traditional systems as operated in SE Asia for centuries based on wild caught shrimp often cultured with milkfish. Systems often rotated with rice culture or salt production. If land is plentiful in coastal areas can provide low risk system for shrimp culture. Low fixed cost but usually due to traditional nature of its use or due to its dual use nature. This system that is often adopted where large areas of land are available but where necessary technology is not. Very little water exchange is used (possibly tidal) and no feeds are added, with shrimp growth based on natural productivity. Production levels rarely exceed 1 ton (per ha per year).

A fifth culture system, known as **Polyculture**, is considered in the extensive system family though it is an integrated aquaculture system. Integrated shrimp aquaculture systems are culture operations in which shrimp (normally fresh water species) are grown in conjunction with fish species (tilapia) and in some cases integrated with rice farming or mangrove-based farming. As many countries in the region have significant river systems and local freshwater shrimp species, this culture technique has merit. However, hatchery technology for culture of juvenile shrimp is required if the production volume is set to increase. Hatchery technology would be available from South-East Asia but this may open the region to exotic species importation, which is clearly a non-preferred option because of the associated risks for disease (not clear what is being referred to here. you can import the technology but not the species). Shrimp hatchery technology is available in Madagascar.

*West Africa represents almost the last opportunity in the world to establish low intensity farms that can also reliably produce local shrimp species at large sizes that will command high prices at no or very little environmental cost. This is the Unique Selling Point (USP) for West African farms.*

In the current situation in West Africa, the needs for supporting infrastructure and skills for super-intensive or intensive shrimp farming would be difficult to meet. This leaves the production systems of choice as **either semi intensive or extensive** (including polyculture). Market information indicates that prices are likely to remain highest for the largest shrimp and these systems are the most likely systems to produce large, healthy, good quality shrimp.

One option to ensure intensity levels are kept at sustainable levels of semi-intensive or extensive culture might be to advocate the use of **organic farming methods**. The most stringent of conditions for such labelling is to restrict stocking density to less than 15 post larvae m<sup>-2</sup> (Naturland 2004). Organic farming also insists on the use of native species, although in West Africa it may be difficult to get certification for *P. monodon* culture which is not an endogenous species but has localized in recent years.

### 4.3 Environmental suitability in West Africa

Successful shrimp production requires a satisfactory level of environmental suitability and above all, finding the right site, as both are fundamental criteria for sustainable shrimp farming.

#### Site suitability

In general terms, the countries of West Africa from Senegal to Cameroon have many characteristics that make them environmentally suitable for shrimp farming (the countries are also on the same latitude as shrimp producing countries in Asia growing *P.monodon*, and in South America, on the other side of the Atlantic, where white shrimp are cultured). Countries to the north – Cape Verde islands and Mauritania, are considered to be too cold for *P.monodon* farming, even though there are reports that *P.monodon* is found in Mauritanian shrimp fisheries.

From Senegal to Cameroon, there are coastal land areas that (superficially at least) are physically suitable for shrimp farming in all countries. Extensive areas of flat land behind mangrove areas can be seen in several countries, as well as more open coastal flats where ponds might be constructed. However, detailed feasibility studies at potential sites are essential to make decisions on suitability of different areas.

#### Coastal mangroves and other coastal habitats

An important development issue will be to minimize impacts on mangrove forests that are extensively found through the region. Mangroves are found discontinuously from Senegal to Cameroon, with important areas in Guinea Bissau, Guinea, the Niger delta and Cameroon. Other countries have smaller areas of mangroves. This region contains mangroves of the Niger Delta, which is the single most extensive mangrove system in Africa, and third worldwide after India and Indonesia. In some countries in West Africa, mangrove communities also contain species of particular biodiversity value, such as the white mangrove (*Laguncularia racemosa*) in Guinea Bissau<sup>6</sup>. These mangroves play an important role as nursery areas for fishes and shrimp; moreover, important factors in stabilizing the shoreline and provide an important coastal buffer that helps reduce vulnerabilities of coastal people to natural disasters.

Mangroves throughout the region are threatened, with over-cutting for firewood for cooking, building and salt drying, having affected natural habitats. A marine protected areas strategy for the northern part of the region has been prepared<sup>7</sup> that includes mangrove habitats. A feature of the mangroves in the region is the relatively low percentage of mangrove habitats under protection or management. Clearly, careful attention will be needed to development of shrimp farming in the region, and particularly in areas where there are significant coastal mangrove resources (Guinea Bissau, Guinea, the Niger delta and Cameroon), to ensure that aquaculture does not impact on mangroves adding to the existing damage. The need for protection of critical habitats is increasingly being recognized in West Africa, and there are a number of Global Environment Facility (GEF) projects in the region supporting identification and building of institutions and policy frameworks for conservation and management of these critical habitats. Ideally, shrimp aquaculture development should proceed alongside such initiatives, where suitable areas for shrimp and other forms of aquaculture are identified and properly zoned in ecologically less sensitive areas, within coastal management plans, and shrimp farming is restricted in ecologically sensitive areas.

As the livelihoods of many people living in coastal areas of West Africa are also be dependant on mangroves and other coastal resources, it will be important to be aware of potential conflicts with other coastal habitat users when selecting sites. Apart from the rice and mangrove areas, are so-called “tannes” or the non-exploited zones that are widely recognized as having scope for aquaculture development, making use of areas that cannot be used for agriculture. Further descriptions of “tannes” can be found in the socio-economics report.

---

<sup>6</sup> Guinea Coastal Biodiversity Management Program. World Bank.

<sup>7</sup> Regional strategy for Marine Protected Areas in West Africa.

## Climate

The lowland climates of West Africa are characterized by uniformly high sunshine and high temperatures throughout the year; mean annual temperatures are usually above 18°C. In the Gulf of Guinea temperatures are much more stable throughout the year, and most favourable for shrimp farming. North of the gulf, while generally suitable for shrimp farming, lower temperatures during winter months will limit scope for shrimp aquaculture during the cooler months.

The West Africa region is also being affected by, and is highly vulnerable to climate change, that is expected to increase average temperatures and make rainfall more erratic<sup>8</sup>. In parts of the region, notably Senegal, severe drought has already led an influx of people into the coastal area, creating significant new pressures on coastal habitats and fisheries. Aquaculture has a potentially important role to play in such conditions, as a source of food and employment, but careful integration into coastal zone management planning will be essential, even though complex.

## Coastal water quality

In general, the coastal areas of the West African region have water suitable for farming of *P.monodon*, and other shrimp species. Water salinity can be found within acceptable limits throughout the region, although the large delta areas are subject to wide fluctuations on salinity that have an influence on shrimp farming. In such cases, stocking practice and timing will need to be modified to take account of periods of high water salinity fluctuation.

Water temperatures are generally suited for *P.monodon* shrimp farming, although low water temperatures in the northern part of the region will limit possibilities during winter months.

Water pollution is a concern around urban developments in the region. In several parts of the region, Cameroon, Côte d'Ivoire, Ghana and Nigeria for example rapid increases in population, industrialization and urbanization has resulted in a population density of 250-300 persons per square kilometre along the Atlantic coast. The fast growing cities have been unable to provide the requisite sanitation which has contributed to significant degradation of the natural resources and biodiversity of the coastal and international waters of the Gulf of Guinea and adjacent freshwater catchment areas. These have an influence on water quality, and will make locations close to large cities risky and less suitable for shrimp farm development.

Shrimp hatcheries require good quality full strength seawater (28-35 ppt) that can be found along several coastal areas, and there are a number of islands in the region (e.g. Guinea, Guinea Bissau) where hatcheries could be located with suitable uncontaminated water supplies.

## Soil conditions

Lowland coastal soils in the region include several types, including acid sulphate soils and sandy soils. Acid sulphate soils are common throughout the West African region, particularly near mangrove areas Senegal, the Gambia, Guinea Bissau, Sierra Leone and Liberia<sup>9</sup>. Shrimp farming developments in Guinea were already affected by low pH caused by acid sulphate. Whilst suitable soils exist, careful site selection is required to properly assess soil conditions, and site farms in areas with suitable soils.

## Operational features

### Shrimp seed

*P.monodon*, being a non-indigenous species, is widely found in the wild along the west coast of Africa, probably the result of an earlier introduction (see also shrimp technical expert report). This resource provides the potential for development of a *P.monodon* hatchery system based on local resources, avoiding the need to introduce shrimp from other regions, and risks of import of disease.

---

<sup>8</sup> The Africa Region Environment Strategy. Environment Matters, 2001, page 24-27. World Bank, Washington DC.

<sup>9</sup> FAO/AGL problem soils database. <http://www.fao.org/ag/agl/agll/prosoil/acids.htm>.



Further assessment of the available resources would be useful to determine the extent of stocks available for shrimp farming and assist in business planning.

#### Feeds and feed supply

Shrimp feeds are not available in the region, except through imports. Development of feeds based on imports is unlikely to be sustainable, and in any event will involve additional costs and problems associated with customs and import procedures.

In some countries, local fish feeds are being produced, such as in Senegal. Some research, or perhaps cooperation with an Asian business with experience in shrimp feed, is recommended to develop locally suitable feeds, ideally based on local resources.

#### Shrimp disease

Shrimp disease is one of the major risks to shrimp farming worldwide. Serious outbreaks of major shrimp viral diseases – white spot syndrome virus (WSSV), Taura syndrome virus (TSV) and others<sup>10</sup> - have caused significant economic losses to shrimp farms in Latin America and Asia. There is no information on the status of shrimp disease in West Africa, but there is a high probability that the region is – so far – free of major known shrimp viral diseases. The lack of serious shrimp disease in Madagascar for example is one of the key factors contributing to success in this leading shrimp market in Africa. If proven to be free of major shrimp viral diseases<sup>11</sup>, then this is a major comparative advantage for shrimp farming in the West Africa region.

The major challenge for future developments in shrimp farming is to keep the region free of major diseases that afflict shrimp farming elsewhere (in Asia and Latin America). There is, to date, however very limited capacity for shrimp disease control and management in the region. It would require a very strict control on the introduction of new species to the region, or bringing in new stocks of existing species.

*Cooperation between countries in the region will be needed to agree on joint policies that mitigate the disease risk, and to develop the capacity for effective surveillance and diagnosis of shrimp disease once aquaculture is well established.*

---

<sup>10</sup> The OIE/NACA lists can be consulted for the most significant shrimp diseases affecting shrimp farming in Asia and Latin America – [www.oie.int](http://www.oie.int) and [www.enaca.org/health](http://www.enaca.org/health).

<sup>11</sup> A preliminary survey of wild shrimp stocks to determine the status of wild shrimps with respect to major shrimp viral pathogens would be useful.

## 5. Positioning West African Shrimp Products in the Target Market

---

Products from West African shrimp production will be targeted to three different markets:

- International markets for frozen shrimp,
- African markets for fresh shrimp,
- African markets for frozen shrimp.

In terms of product lines, in-depth cost benefit analysis is needed to assess the returns to the investor in the following determinant areas:

- Initial capital costs of production lines – machinery, packaging equipment, storage and handling equipment
- Ability to implement and control HACCP<sup>12</sup> and traceability systems for production
- Staff costs for manual labour required for processing different shrimp product forms
- Management costs to organize and maintain the proposed production lines
- Costs involved for the technology needed to maintain and operate production lines
- Efficiencies that can be created in transportation and distribution
- Costs needed to service specific customers requirements (packaging/delivery schedules/quantities, etc.)
- Revenues received for various product forms which can be translated in to profit margins available to the company

Due to the current weakness of the world shrimp markets, which is expected to continue, it is essential to carefully consider many different ways of not only producing the shrimp, but in the presentation and continuity of the products. This will require extensive business contacts between the buyers and traders to ensure the products satisfy their demands, and they can generate sufficient returns to the investor.

### 5.1 Accessing International markets for West African shrimp products

Any producer seeking to deliver aquaculture products to the international markets of the EU, ASIA or US must comply with strict internal and external procedures which guarantee the quality and safety of the product.

**Internally** the company must have the following in place;

- Full HACCP systems – including building specifications, work/person flow management systems and reporting systems
- Full traceability program – This will be a legal requirement for the EU from the beginning of 2005, and the USA is also following this development.
- Be able to meet all veterinary inspection requirements for local and international authorities
- Be able to provide labelling of all products to meet EU and USA label legislation

The complexity of these systems and ability for the project to meet these standards should form a separate business activity throughout the design and construction of the farming project.

---

<sup>12</sup> Hazard Analysis and Critical Control Point, International Seafood Regulation

**External requirements:** All West African veterinary inspection services must have the necessary capability to inspect and control products from their respective countries and trained personnel who are licensed by the EU, or FDA in the USA. The EU has a program currently in operation for the training and certification of all African, Caribbean and Pacific (ACP) member state's veterinary staff, including laboratory and analysis techniques equivalent to EU standards. It is not known if all West African countries have veterinary services are currently approved by the EU, but in those visited this appears the case.

**Tariffs on West African shrimp products:** Aside from the above legal requirements, tariffs also apply to the importation of shrimp products to the EU and the US.

## 5.2 Accessing Alternative Markets

Disease results in the use of medicines and antibiotics. Modern detection methods are now able to detect the use of prophylactics and results indicate that on average 2 – 3 containers per week are destroyed because of the use of chemo-theraputants by producers supplying the EU. Apart from the actual financial losses incurred, the image of the industry is severely damaged by these incidents, further depressing main stream markets.

As a result, all efforts should be made to identify and operate in niche or “alternative” markets. The following criteria could be used for alternative product marketing:

- A site that has not been used for agriculture or aquaculture – it is in pristine condition
- Minimising impacts on mangroves and other sensitive coastal wetland ecosystems
- There is no agricultural activity in the vicinity to introduce pesticides etc. which could affect the projects water quality
- By careful design and management, environmental impact will be negligible – by using biological-type filters developed in SE Asia to eliminate waste outputs from the project
- Introduction of fair management and working conditions, supported by infrastructure development – schools, clinic, housing, etc. counters ethical arguments

There is a growing appreciation of these efforts in the main markets and this has led to the development of accepted standards that are becoming “labels/brands” such as Fair Trade and Organic labels.

### Fair Trade and Organic Certification or Labelling

The principle organisation behind the idea of a “Fair Trade Label” is based in Europe. **Fair trade or Ethical labelling** is a certification or labelling scheme designed for products that meet more social and economic (rather than environmental) principles of fair and ethical trade. Fair trade is, however, linked to environmental aspects of resource management as it affects local communities, and other social issues associated with environmental certification. Currently there is no fair trade label for shrimp production but the label exists for other commodities from the agricultural sector e.g. bananas, coffee, cocoa, etc. There is no reason why a label for shrimp farming could not also be established. A fair trade label in itself does not immediately benefit the price, but it has been seen in the major retailer chains that products with fair trade status become products of choice, benefiting the producers with more stable trading conditions. Buyer preference for fair trade products such as coffee for instance can result in prices being 3-5% higher in extreme trading conditions.

**Organic labeling** signifies that the product has been produced following standards for organic production (biologically untreated, produced within its natural environment) and usually shows a seal or label which shows that a certified organic or eco-label product has been designed to do less harm to the environment than similar but un-labelled products. Although organic shrimp operations would initially give lower returns than normal shrimp farming methods, this must be weighed against the current expectation that organic shrimp fetches 20-30% more than normal shrimp prices. The organic product markets may never take over the main markets, but their existing 3 – 4% share of the food market is growing, and in the developed markets where most shrimp products are sold, this will provide a niche for a few producers. However it must not be missed, that the better prices are of course linked to the normal markets – so 20% of US\$10 per kg versus 20% of US\$4 per kg.

Organic shrimp production already exists in Vietnam and Ecuador, Thailand and Indonesia. The quantity currently available on the world markets is unknown, however the leader in certification in Europe, Naturland has stated that it currently sells in excess of 1 000 MT of shrimp per year, and estimates for the world market show growth of 30% per year.

Currently, work is in progress to create international standards for Fair Trade and for organic labelled shrimp.

## 6. Identifying Knowledge Gaps to Meet Market Potential

---

➤ **West Africa has the potential to capitalise on the existing good market perceptions** of its locally caught shrimp by developing a shrimp aquaculture sector for both a “mainstream” product and a product that meets the criteria of niche (organic, fair trade) markets. Certain areas in the region are in a unique position to develop a sustainable shrimp aquaculture sector in part due to its very favourable climatic conditions and geographic location (all but 3 countries are on the coast). At the same time, adverse impacts on the ecosystem must be kept to a minimum with appropriate planning of the construction and operation of farms whose production methods and impacts respect local community livelihoods. However, **shrimp produced under these conditions are likely to attract high niche market prices** and can present potentially high returns.

➤ **Any investment in shrimp farming must assume very conservative market projections**, and look at all methods to minimize operating costs – in particular, juveniles, feed inputs and pumping operations. Products from a project need to be exceptional - not just good, and have a clear image and status. The ability of the project to deal directly with major retailers, shortening the supply chain to a minimum will be crucial. It has been seen that from both the wild fisheries on both coasts of Africa, and from aquaculture production in Madagascar that there are clear opportunities to develop brand leaders. This must be the aim of any project in West Africa, and it will be necessary to develop the project in conjunction with the proposed main markets for niche products in Europe and the USA. Although the Japanese market will remain interesting, in the short-term it is not likely that West African shrimp production will be able to benefit from this market due to issues of proximity. Alternative markets, therefore, need to be targeted.

**West Africa is in a unique position to develop a sustainable shrimp Aquaculture sector...  
...it has the potential to capitalise on existing good market perceptions**

➤ **In addition, the export trade of aquaculture shrimp should not be understood as an end in itself.** While economic action is certainly undertaken to reach profitability, the definition of shrimp products for export may also serve to adapt existing domestic structures to meet general criteria of export market demand.

By assessing the missing links and necessary interventions for the successful export of shrimp to niche world markets, ways of refining the structure of production in the sector to include not only export markets but also targeted local markets becomes more feasible.

### 6.1 Requirements for West Africa culture systems and shrimp species

- The species should grow in semi-intensive systems to sizes large enough for export markets, in which quality makes the margin, not quantity
- Culture techniques for the species should be sufficiently understood to produce consistently high quality shrimp for which the target market (alternative market) will bear a high price
- The species should be native to West Africa to keep the region free from disease

While *P. monodon* could be used for culture in a short-term strategy, research should be undertaken in a long-term strategy to determine the as yet poorly understood conditions of successful culture of local species: *P. notialis* above all, but also *P. kerathurus*, which is comparable in size and market potential to *P. monodon*. Both West African species are recognised on the world markets and while data on culture trials are scarce, there is general agreement that they represent

good potential. The development of freshwater prawn culture could rely on native *Macrobrachium vollenhovenii*. However, the culture techniques for this species are not readily available at present. A second choice could be *M. rosenbergii* which is not originally native to West Africa. Since larval rearing of *M. rosenbergii* requires brackish water, there is little evidence that introductions of this species will interact with native populations.

All things considered, the most competitive of the widely cultured marine species seems to be the Black Tiger Prawn (*P. monodon*). Its status of a naturalised exotic species, however, should be considered as a possibility for producing post-larvae and broodstock. At present, it is unclear how established and how large the population of *P. monodon* is in West Africa. If post-larvae or broodstock are sourced from the wild, the stock needs to be carefully monitored in order to determine if it can sustain this practice. As a general guideline, it should be sourced from a hatchery to gradually phase out wild-sourced raw materials. Shrimp aquaculture development should therefore aim to bring investment not only to shrimp farms (grow-out ponds), but also to hatcheries.

### **Sourcing Stock from a Hatchery**

In West Africa, hatchery rearing of aquaculture shrimp initially requires access to wild-caught broodstock. Ideally, over time shrimp seed supply should come from a local hatchery or possibly a regional hatchery in West Africa, to avoid importation of disease and potential negative impacts on wild populations from collection of wild seed. An advantage of *P. monodon* is that hatchery technology is available and sufficiently well understood to say that it is amenable to adaptation for aquaculture.

### **Freshwater shrimp culture experiences from Asia**

Interest in *M. rosenbergii* culture has grown rapidly in recent years in Asia. The production of *M. rosenbergii* in China has recently been reported as 128,338mt (FAO 2003) while Vietnam is up to 38,000mt and Bangladesh 7,000mt. Exports of *M. rosenbergii* from Bangladesh in 2001-2002 were worth US\$ 58million with net profits around 68% (Banks 2002). Disease problems are associated with intensive marine shrimp culture or excessive development of lower intensity cultures. This has encouraged examination of the alternatives to marine shrimp culture. There are significant positive impacts being made on the quality of life of the rural poor through prawn culture and this is illustrated particularly by the methods used in Vietnam and Bangladesh which may be of great significance to West Africa. Socio-economic and geographical conditions may be very different but the systems may well be amenable to adaptation to the West African context.

In both Bangladesh and Vietnam the system is based on rice culture; growing prawns as a valuable cash crop sometimes also with fish as an additional product. Williams, Alam & Noble (2004) reported that more than 100,000 households in Bangladesh practised integrated freshwater rice cum prawn culture and fish farming, known as "Gher farming". Gher farming generates an average income 4 times higher than any other agricultural practice there and has had a significant impact on food security, education levels (due to increased household income) and better medical care and improved housing (Williams et al 2004).

Both systems have relied initially on wild caught post larvae of *M. rosenbergii*. As the farming activity has developed this has caused some problems with shortage of post larvae to stock ponds. At the same time the over collection of post larvae in Bangladesh has been cited as having an adverse effect on biodiversity. In Bangladesh wild collection of post larvae was banned in 2002 but there has been difficulties implementing this because of the impact on the poorest people supported by this activity (Williams 2005). Development of hatcheries has however been successful in Bangladesh and well on the way in Vietnam.

One of the most crucial features of the development of the rice-prawn culture in Bangladesh is how it has been able to help the poorest people who are often difficult to access via aquaculture development through the use of participatory methods (Demaine 2004, Haque, Alam & Demaine 2004). There is considerable scope for South-South cooperation in implementing such developments for artisanal aquaculture in West Africa.

## 6.2 Attracting Investment into Shrimp Farming

Despite the very favourable geographic situation of West Africa, shrimp aquaculture will develop only if West Africa closes a number of gaps—or perceived gaps—in its investment environment.

Generally, FDI interest is determined by a combination of so-called “push” and “pull” factors. The macroeconomic situation in the potential investor’s country can “push” him to invest outside the home country. These factors include availability of surplus funds, opportunity cost associated with held capital, and the situation and returns on the home capital market. Capital that is made available through existing “push” factors can be attracted to one country rather than to another by the “pull” factors that exist in that country, such as expected returns, investment risks, trade regime, and growth of the domestic economy. When gaps are perceived in the business environment of an investment-seeking country, they reduce the strength with which the country can “pull in” foreign direct investment.

### Perceived and real gaps related to shrimp aquaculture investment inflow to West Africa

- **Legal framework** – At present, nearly no legal framework or coastal zoning schemes exist that are dedicated to aquaculture. In the absence of clear guidelines and regulations, medium- and long-term investment will be slow in coming, especially when questions of the right of land use are not settled because purchase or lease follows traditional patterns that are incompatible with continued presence of a foreign investor.
- **Infrastructure** – In many areas that are suitable for shrimp farming, communications and electricity coverage is poor or inexistent. If an investment project can only be considered as a self-contained unit, this is a comparative disadvantage.
- **Lack of technical competence** – Although trained staff can be recruited at the labour level, at the management level, qualifications and competence in the fields of aquaculture and shrimp farming are lacking in most cases. If an investment project relies too heavily on expatriate staff, it may be both less enticing for the investor and less responsive to local communities’ needs.
- **Lack of political stability and unfriendly investment environment** – West Africa, rightly or wrongly, has a reputation that investments are risky. There is a perception that socio-political conditions are unpredictable, that authorities are wilful and corrupt, and that procedures to establish a business are too slow. In addition, real problems of political unrest or civil war in one part of West Africa may be perceived indiscriminately as applying to all West African countries. Therefore, West Africa should be prepared to attract investment interest before it endeavours to attract investment.
- **Lack of regional co-operation** – Many aspects related to the development of a shrimp farming sector are best handled on the regional level for all West African countries. As there are Rules of Origin and “*de facto*” tariffs despite the existence of ECOWAS, foreign investors may be dissuaded from investing in West Africa unless there are proper incentives put into place.

## 6.3 Using a Franchising System for Placing West African Shrimp Products on the Market

The two major considerations for attracting FDI into West African shrimp aquaculture will be:

- Avoiding, if possible, to go into direct competition with well-established shrimp-producing regions in the mass shrimp market;
- Stretching the margins the producer/first processor can make on the product, for instance by reducing the number of intermediaries along the supply chain.

Both can be done if the currently good image and above-average price of West African shrimp are kept and carefully developed. A strategy that has been successful in this context in the past is the sale of branded and labelled product in the form of a franchising system.

In business format franchising, one person or entity, the franchiser, grants a license to another person or entity, the franchisee, which entitles the franchisee to trade under the trademark or brand name of the franchiser. In general the franchisee, by buying the license, is also entitled to a full support package from the franchiser, comprising all elements necessary to establish a previously untrained person in the business and to run it with continual assistance. Further to the package, the franchisee is granted exclusivity in his/her area in many cases.

*Based on the results of this study, promoting the idea of a franchising system to sell West African shrimp to high-return markets under a brand or label is considered the most effective way to attract FDI from potential private investors from Asia.*

In a situation where the West African “pull” factors may be perceived as too weak in South-East Asia, in particular in competition with other potential investment destinations, a franchising system allows to enhance the following “push” factors:

- The headquarters of the franchiser can be in South-East Asia while the company is active in, and controlled from, West Africa. This allows using the South-East Asian banking and finance infrastructure.
- The franchiser can define product and production criteria that make the products and the production meet the brand or label requirements consistently. The definition occurs in a formalised manner and the franchisees are licensed to sell exclusively under the formally defined criteria. The franchiser can thereby comply with considerations of sustainability or equity that otherwise would have to be enacted by lengthy legislation and enforcement processes.
- As growth of a franchising structure takes place mainly in the form of selling licenses to more interested franchisees, growth happens as and when there is enough demand to support the growing structure. A franchising system inherently lowers the investment risk for the franchiser and can support FDI to a region where the business environment is perceived as difficult.



## **7.** Managing Sustainability and Risks: Closing the gaps

---

### **7.1** *Technical sustainability*

#### **Shrimp farm location**

Finding the right location for investing in shrimp farming is critical and site selection for an individual shrimp farm project requires careful individual examination as every site has different potential and risks. It requires ensuring that the potential shrimp farm site, and the associated infrastructure, will be located in areas that make efficient use of land and water suitable for shrimp production and in ways that conserve biodiversity, ecologically sensitive habitats and ecosystem functions.

Although it appears from this study that most countries in West Africa, from Senegal to Cameroon, have locations that are biologically and physically suited for shrimp, actual availability of sites for farming, and designation of suitable sites is, in reality, more limited.

Shrimp farm sites visited in Senegal and Guinea had been located on generally physically suitable sites. One of the reported causes of failure of the shrimp farm in Cote D'Ivoire, however, was its distance from the coast, and high costs associated with pumping over several km of pipeline. In Guinea, where detailed surveys had been conducted, it appears that the existing farm suffers from acidity problems due to acid-sulphate soils, with ongoing attempts to relocate some of the ponds in the farm to less acidic areas.

Only in Guinea has the government taken actions to officially designate suitable site areas. At present, no other countries in West Africa have designated sites or incorporated shrimp farming, or indeed other forms of aquaculture, within coastal zone management plans, although concerted efforts seem to be underway.

Such experiences indicate the need for government assistance to help in the identification and legal designation of suitable shrimp farming sites, as well as to help raise awareness on the criteria for site suitability.

### **7.2** *Institutional sustainability*

There is a need for a regulatory framework for development of shrimp (and other forms of) coastal aquaculture in West Africa. Although the present policies in the region and legal frameworks do cover some key issues, under existing fisheries or environment laws, the longer-term development of the sector will require more specific legislation on both the national and regional level focused on aquaculture.

The capacity to regulate aquaculture through legislation appears to be very limited at the moment in all countries in West Africa. Strengthening of the legal framework for aquaculture, therefore, must be accompanied by capacity building for regional institutions and local government, in order to create the environment for a responsible business investment. For example, private investors in shrimp farming in Madagascar have recently worked closely with the government to establish legislation for shrimp farm development, recognising the importance of a legal framework to protect business investment in the sector.

The considerations of how and where to establish a commercial shrimp farm cannot be a single country or single site approach. Issues related to the promotion of this sector affect all countries in the West African region, as natural resources especially along coastlines are shared. Coastal and river waters are to a large degree a commonly shared resource, and shrimp stocks move freely throughout. Mitigating risks and ensuring sustainable development of the sector cannot be done unless all stakeholders are involved in developing a common concerted action plan and management system whereby all countries can enjoy the full development benefits of a sustainable shrimp-farming sector.

**To ensure sustainability and minimize medium and long-term risks, multi-stakeholder partnerships involving national and regional institutions, civil society, private investors and local communities would have the following objectives:**

- Develop the sector so that it has little or no adverse impacts on the ecosystems from either establishment or operation of shrimp farms.
- Develop the sector as smoothly as possible alongside the livelihoods of local communities, providing income opportunities and a reliable food base, and adding value to their local knowledge
- Start developing the sector with the existing skill base and infrastructure; both skills and infrastructure will develop as the sector develops, but this should be seen as a medium- to long-term process
- Identify roles and responsibilities for interested stakeholders in an initial start-up project, which seeks to develop using the existing skill base and infrastructure, and identify corresponding short-term and medium-term activities in a transparent manner

**The need to involve all concerned stakeholders:**

- West African policy-makers in agro-food/seafood, private sector development, and macro-economy,
- West African business associations and/or shrimp aquaculture business operators in the region who work in import-export, particularly in Asia
- Asian and other business associations and/or shrimp aquaculture business operators who work in the West African region
- West African private sector in artisanal or industrial seafood production
- regional economic and political organisations (e.g., ECOWAS, NEPAD, UNECA) and international organisations (e.g. SWAC/OECD, World Bank, AfDB, UNCTAD)
- Interested or potentially interested marketers (retail chains, import wholesalers) and internationally active labelling organisations that could have a role in bringing the branded products to the final consumer in the target markets,
- Local communities whose environment could be affected by the establishment of a shrimp aquaculture project
- International donor community working in West Africa
- Research institutes and universities who have worked on issues of sustainable aquaculture and shrimp farming

### **7.3 Social sustainability**

One of the fundamental points raised by the communities during the field interviews is the obvious lack of information on shrimp farming in general. Differences between types of operations (intensive, semi-intensive, extensive, organic, etc.) and the environmental, economic and social consequences of their respective establishment are largely ignored by the communities, except for those that were affected by the establishment of a shrimp farm (Katakalouse in Casamance and Piran in Gambia). Lack of information is also an issue for administrations and to a lesser degree for national research centres.

A sub-regional collaboration between research institutions, administrations and NGO's, can mitigate this knowledge gap, especially if it was fed by an international research network in the field of shrimp farming and of its induced effects. At the community level, NGO's dedicated to rural development can play an important role in the diffusion of information given their proximity with communities in the littoral zones.

### **7.4 Environmental sustainability**

#### ***Implementation of Ethic Principles: the FAO Code of Conduct on sustainable shrimp farming***

FAO worked out in 1995, following the international conference relating to sustainability of fisheries of Cancun in 1992, a Code of Conduct for Responsible Fisheries. Article 9 of the Code covers the development of aquaculture. The role of the State is particularly put forward as being responsible for:

- the installation of an institutional and legal framework appropriate to the development of aquaculture;
- the encouragement of responsible aquaculture practices which are neutral in relation to the environment and which do not affect the living conditions of the communities;
- the control and the respect of the application of the sustainable development principles;

Other codes of conduct, or guides, have been developed<sup>13</sup> since the creation of the FAO Code developed primarily for the shrimp farming; these codes of conduct constitute a reaction to the damage caused by the development of shrimp farming in Asia and South America. They all insist on the need for reconciling economic development, improvement of living conditions of local populations and absence of environmental damage. Their diffusion, just as that of the FAO Code, remains however, confined within a very restricted circle of researchers and administrators and some pro-environmental NGO's. To remedy this, new relays must be developed in order to reach the civil society and mangrove communities concerned with the development of aquaculture and help develop a dialogue between promoters, the state and communities.

Another issue of sustainability includes the short life cycle of intensive shrimp farming operations (see figure 3). Past experiences of local communities on the short lifespan of a shrimp farm and subsequent abandonment of sites leaving behind a disfigured landscape difficult to rehabilitate have caused scepticism as to the sustainable benefits for the population. This can be avoided by involving the communities as early as possible in the information and project design cycles, and introduction of improved planning and operational management.

---

<sup>13</sup> For a presentation of the Codes and guides of control and other principles for responsible aquaculture, see Environmental aspects and sustainable development individual expert report.

The application of the FAO Code is directly linked to the scale of intensity of the system used to develop the shrimp farm. Evidence has shown that the more the farm functions according to more intensive methods the more difficult the conciliation between economic, environmental and social elements is to guarantee. The FAO Code of conduct, although incomplete because it only conceives sustainability of the exploitation before and during operation, is thus necessary to take into account when measuring the level of sustainability of a potential project. Nevertheless, an operator's internal measure of project sustainability should cover the duration of the exploitation, as well as those issues linked to the longer-term impacts of potential abandonment of the shrimp farming activity.

### **Orientation of shrimp farming projects towards community needs and well-being:**

Development of intensive, semi-intensive and extensive projects could all potentially contribute to the improvement of living conditions of the communities pursuant to the level of participation in the shrimp farming operation, including the identification of possibilities to develop the community's own initiative to create additional shrimp ponds. The complementary activities of shrimp farming and rice culture, also known as polyculture (observed in Casamance and Guinea Bissau), could represent a real potential for the development of sustainable community shrimp farming. A crucial question on the viability of the polyculture approach would be the product and marketing components given that it is reliant on existing farm operations for many of its inputs and for the marketing of the product.

Sustainable shrimp farm development has to take into account the long-term needs of the populations. The orientation of shrimp farm projects towards the participation of local communities and towards creating new employment opportunities that promote local livelihoods constitutes a basic condition for measurement of a shrimp farming operation's level of "sustainability".

## **7.5 Financial sustainability**

A major obstacle for attracting investments from South-East Asia or Europe to West Africa is the perceived high investment risk. Therefore, **investment and development partnerships** (joint ventures, PPPs, FDI) should be set up to involve both West African and South-East Asian stakeholders, and would have a twofold task: on the one hand, develop long-term investment promotion mechanisms, in order to eventually attract funding for individual projects; on the other hand, a continuous "information campaign" directed toward potentially interested South-East Asian investors, in order to give them specific information on real versus perceived investment risks and short, medium and long-term opportunities. Investment promotion agencies, government ministries and local private sector investors need to demonstrate that the different mechanisms are in place and funding is committed for implementing necessary coastal management plans, site zoning, and legal frameworks to facilitate partnership ventures.

Investment opportunities should be presented to the South-East Asian business community that are smaller, perceived as more controllable and likely to diversify the investment risk. The most likely candidates at present for short-term investments are the construction of a **feed mill** that would serve shrimp aquaculture but also other livestock and aquaculture operations. Raw materials for feed are available throughout West Africa and when a market for the feed is there, a potential investor need not rely exclusively on the export success of a shrimp farm when calculating the investment risk/return ratio. The baseline for investment promotion is to avoid the impression that investment is sought exclusively for an export trade venture and/or exclusively for a product that does not have a local market.

**Franchising schemes** may be a format for keeping initial investment for the marketing of the shrimp brand low. By selling to franchisees in the target market, the producer-franchiser need not establish a full-blown import and sales network in the target market and can still bypass to a fair extent the wholesale trade, which would reduce the producer's margin substantially.

A franchising scheme has important advantages for the investor:

1. The initial investment into the construction of a marketing and sales network is comparatively low. As a complement, there is no need for the franchiser to get involved with the administrative “red tape” the authorities of the target market may require to set up a company. The franchisees being independent companies, it is them who will decide on their form of incorporation, fiscal status, and application for start-up funding under the applicable legislation of their country.
2. A franchising network gives the franchiser a very high flexibility to react to market developments when it comes to growth or consolidation. If the market stays level or declines, the franchiser is only partly affected as the risk is shared with the franchisees. If the market shows a consistent trend to grow, the franchiser can try to attract new franchisees. If market development justifies or even requires that the business grow, the franchiser invests as and when more cash flows in. Not only initial investment, but also continued investment has comparatively low cost.
3. Working with franchisee outlets allows serving both the export and the local market with the same type of marketing model. If the local market grows to a level that a potential franchisee considers sufficient to start an outlet, this franchisee can be supplied with the same product under the same terms as any other franchisee in the export markets.

## **8. Conclusion: Suggested Short and Long-term Strategies for Sustainable Shrimp Farming**

---

Shrimp aquaculture development in West Africa **requires both long-term and short-term strategies**. The long-term strategies will include macro-level considerations such as regionally defined policies for shrimp aquaculture management and coastal conservation plans, while the short-term strategies normally respond to more micro-level considerations, such as enlarging the skill base, improving the facilitation of executing business transactions and developing local participatory coastal management conservation criteria. The “main conditions for effectiveness” are therefore based on the existing conditions in the West African region which could facilitate investment opportunities in both the short-term and long-term for the development of sustainable shrimp farming operations.

### **8.1 Adopting a blended value approach (economic, social, environmental values)**

A sector development strategy for shrimp aquaculture in West Africa will be one that is economically viable because it is also environmentally, socially and culturally viable. It will be a strategy that promotes direct investment into existing shrimp farms and well-established species without compromising local livelihoods and the natural environment. Investment strategies adapted to the region's opportunities and constraints is a **blended value approach**, whereby local knowledge on shrimping in the natural environment and information on local markets are used to direct private investments to areas that meet the requirements for operating and sustaining a shrimp farm within the local context.

Blended value strategies are most effective for developing this sector because they seek, first, to build upon existing artisanal aquaculture operations and develop culture operations for existing local species such as *P. notialis* which, based on its characteristics, could capture as high a market value as *P. monodon*. Such an approach to investor success requires seeing the knowledge gaps that exist on culture techniques as hidden investment opportunities. For instance, the most widely caught and traded world shrimp species that is also found within West Africa is a White Shrimp, usually called Southern Pink, the *P. notialis*. Currently, very little is known on the conditions of its successful culture, but if these conditions were known, it could attract FDI that seeks to develop profit as well as sustain local species biodiversity.

New lessons on diversified production schemes using this approach could emerge. In particular, schemes could be developed using artisanal aquaculture operations and promoting producers' co-operatives to sell shrimp products into export trade, as is done in numerous parts of Asia, especially in Vietnam. Artisanal aquaculture operations in West Africa are mostly farmed freshwater prawns. At present, the world market for freshwater prawns is underdeveloped, but through targeted marketing of speciality, high quality freshwater shrimp, West Africa could be at the forefront of what can bring extremely high investment returns to both investors and local communities over time. Small-scale freshwater prawn culture can directly add to the food base of local communities as well. Finally, as freshwater prawn prices are lower than marine shrimp prices, they are affordable in local markets as an immediate income opportunity for artisanal and/or cooperative shrimp farms.

### **8.2 Readiness for Investment**

Clearly some of the proposed investment interventions, notably in the infrastructure category, would require some macro-level or “spatial” adjustments requiring concerted public-private sector involvement. A complete table of actions, actors, intervention levels and their applicability in the short, medium-, and long-term follows at the end of section 8.

**Micro-level interventions** are actions for all concerned stakeholders (public, private, civil society, local producer groups, communities) but focus primarily on local or national level conditions and consist of supporting initiatives (through funding and/or technical expertise) to either jump-start a dormant shrimp farming operation or support an existing operation with immediate investments. Two examples of micro-level interventions are 1) re-activating, or at least partially, the Sakoba farm (in Guinea), and 2) supporting the formation of producers' co-operatives in artisanal shrimp producing areas by following the example of successful associations like the shea butter artisans in Northern Ghana and the tilapia farmers in Eastern Ghana. The visible impact of micro-level interventions is high (see enclosed table for more details).

### **FDI into existing operations**

Foreign direct investments at the initial start-up phase into needed technical skills in aquaculture operations could present a valuable economic opportunity to create the conditions for building a hatchery and a processing operation from scratch. FDI such as this with long-term objectives is perhaps the most reliable way to ensure adequate staff training at both the labour and the management level, and to catalyse on the local and regional level the establishment of needed regulatory frameworks to facilitate the investor's access. Although a risky venture for just one private investor him/herself, investment partnerships would be available with government and with donors prepared to accompany the long-term process of development-for-investment activities in the shrimp farming sector. This potential opportunity would provide certain short-term strategies, such as the promotion of **FDI into existing operations** in order to present interested investors with an opportunity for returns on the investment in the short to medium term (see discussion on two potential farms below).

Standard rapid return on investment (RROI) strategies would suggest investing in the culture of *P. monodon*, a Tiger Shrimp that grows to large sizes and can fetch high prices in the target markets, and of which the conditions of successful culture are fully understood in other parts of the world. However, such short-term investment strategies could face grave risks. Although the species is historically exotic to West Africa, it has since established, or "localized" itself in the region in substantial numbers. It will be essential to determine how established the species is in West Africa. Unless there is a guarantee of continuous supply of broodstock from local sources there may be a temptation to import from outside the region and hence introduce disease risks thus losing much of the disease free advantage the region currently enjoys. Controlling such importation is vitally important

**At present, immediate short-term strategies** could include investment partnerships for two existing operations: the expansion of an operating shrimp farm in The Gambia (called West Africa Aquaculture, near Pirang); and the re-activation of an operational shrimp farm in Guinea, the operation of which was suspended (called Sakoba, near Koba).

- *West Africa Aquaculture, near Pirang, The Gambia* – The farm operates ponds and a hatchery renovated from an earlier operation that had been abandoned. It is expanding by renovating the remaining previously abandoned ponds not currently in operation, and it could benefit from training of the hatchery staff. In the medium to long-term especially, this farm has the potential to be turned into a training centre or centre of excellence for shrimp farming in West Africa.
- *Société d'aquaculture de Koba (Sakoba), near Koba, Guinea* – The farm operated from 1996 as a development aid project, although operation was discontinued after 2 years, reportedly because of problems with acid soils, and yet the exact reason or reasons remain unclear. The facilities continue to be maintained and are in a relatively good state of repair. Even if soil problems were an obstacle to investment, the hatchery, located on Île de Tamara, off the coast of Conakry, may be revived and serve as a supply hatchery for other parts of West Africa.

**Meso-level interventions** can affect groups of people on a multi-city, national or even regional scale. They are actions for public and private sector actors who have decision-making roles or the necessary resources to influence collective action or actions on a large scale, such as outside the local community, and have institutional implications. Establishing new codes of conduct or regulations, new public programs or private investments that affect a sector or sectors indiscriminately, are some examples.

### **Skill building**

If shrimp farming, or other types of aquaculture, is to impact job creation as well as offer broader economic opportunity for West Africa, then a broader skill base is going to be needed. Developing a **centre of excellence** for vocational workplace-based training will widen the potential positive impact of shrimp farming on the local, national and regional level. In addition, skill building could include **incorporating aquaculture training either in existing vocational training curricula** or in general measures of alphabetisation and primary education. Ideally, methods of sustainable production of shrimp aquaculture should make use of South-South cooperation to draw on the technical expertise available in South-East Asia.

### **Infrastructure and communications**

Any investment project is bound to fail if the selected site is not accessible at a reasonable cost by road, if the harvested shrimp cannot be brought from the pond to the processing unit fast enough, if pumping and cold storage are either so expensive (if self-contained unit) that they take the production cost above market price or so unreliable (if from mains power) that they make hygiene compliance unpredictable. Into the category “Infrastructure and communications” also fall shipping terminals, including port facilities as countries in the region with a port of international importance are in the minority. A fair amount of the West African shrimp that the European market holds in high regard never see West African land. They are caught in West African waters by foreign industrial vessels and processed on board for export to Europe. (Nigeria is currently paying an “operators bonus” to fishing companies for all shrimp that passes through its ports to try to eliminate trans-shipping at sea.) The existing farm in The Gambia, too, which is very promising in all other respects, is limited in its potential to become a major exporter by the lack of sufficient port facilities for commercial-scale reefer transshipment. (The development of Banjul’s port facilities is currently out to tender.)

### **Legal and regulatory framework**

Besides a number of general considerations on the legal situation for investors (e.g., possibility to hold for-ex accounts, to employ expatriate staff, to repatriate profits), there are considerations that are specific to shrimp aquaculture. They include above all issues of environmental and social sustainability. Governments in the region have become aware of the need to introduce mangrove protection schemes and coastal zone management programmes. In the absence to date of formally established frameworks to this effect, the conditions in which investors start a medium- or long-term investment project may no longer apply in a few years when such legislation may have come into force without regard to the respect of older rights. Governments should attempt, ideally trans-nationally in the region, to move on to either formally established legislation and regulations or to programmatic declarations that will give a potentially interested investor the chance to be reasonably sure of what such legislation may look like when it comes into force. Furthermore, to attract FDI, it is indispensable that a State, or its investment promotion agency, can present an interested investor with a clear picture of the land tenure situation in which the investment project would take place.

### **Importance of Regional Coordination**

Many aspects of shrimp farming sector development are best approached through a regional, inter-state approach, e.g. if one hatchery shall supply post-larvae to a gradually growing number of shrimp aquaculture operations throughout West Africa, *de iure* and *de facto* tariffs



should not put so heavy a strain on the cost of raw materials that a shrimp farm becomes an unprofitable enterprise. Coastal resource management plans, which are lacking in West Africa today and which should be implemented, are also best discussed and agreed on a regional level. Regional co-ordination and co-operation is also needed to negotiate the future of preferential trade agreements with the major shrimp purchasing markets.

- ***Outward marketing of West Africa as a region and an investment destination***

Regional efforts are needed to respond to the unfairly indiscriminate perception of West Africa as a region with poor investment opportunities and high risk. The main thrust of this approach is to perform outward-oriented marketing of West Africa, ideally with the support of international organisations, and to get potentially interested investors to invest in West Africa. It is paramount that West Africa presents itself as a united region mobilising all available forces capable of moving forward on a shrimp aquaculture project, maybe nationally at different paces but maintaining a regionally united approach. An expressed investment interest may later be specifically focused on a given area or country.

- ***Outward marketing of a West African shrimp product***

If West African shrimp are to become a high-quality product of choice in the major markets, they have not only to be produced to high quality criteria but they have to be recognisable also as shrimp from West Africa, a region producing a high quality product that fetches high prices. The criteria for quality, which West African shrimp should consistently meet, should be jointly agreed on because they should be marketed under a West African shrimp brand. As the shrimp are marketed under a brand, it does not matter whether they come from a marine culture or fresh water culture shrimp operation, as long as they are produced to the regional West Africa brand characteristics. Sold under a regional brand name, their marketing presents a promotional opportunity for the branded product to be sold under a business franchise format which allows returns at a relatively early stage of the investment cycle through the selling of franchise licenses to the franchisees (refer to point 6.3 for details).

### ***8.3 Opportunities for South-South Business Cooperation***

The study identified several specific opportunities where Asian partners can realize their expressed interest in south-south cooperation partnerships, covering areas for direct investment and technical cooperation in skills development and sharing of experiences.

1. **Disseminate the results of the study in Asia and West Africa.** It is recommended to prepare concise publicity material providing an overview of the study findings for wider circulation in Asia. In Asia, the information could be circulated through various channels to entrepreneurs and governments, some of whom (such as Thailand and Malaysia) have policies increasingly positive towards cooperation with Africa.
2. **Prepare an investment guide for shrimp farming in West Africa** that would include relevant information on comparative advantage, technical, economic, environmental and social issues and the investment processes required for interested entrepreneurs. The guide could be prepared with inputs from Asian aquaculture entrepreneurs and expertise, and in a participatory way involving inputs as much as possible from all West African countries.
3. **Hold a workshop in West Africa to bring relevant actors together (entrepreneurs, key policy actors) from West Africa and Asia**, to share experiences in shrimp farming and the contents of the study, identifying interested stakeholders for short, medium and long-term cooperation opportunities.

4. **Develop the skill base.** The skills base (education, technical and management) among entrepreneurs and government management/policy makers for management of the sector's development is poor in most countries. A south-south program of skills development in aquaculture, sharing experiences among Asia and Africa through short and long term training/educational programs has potential to raise skill levels in West Africa, as well as creating more awareness of West African aquaculture potential among interested Asian partners. International development partners might consider supporting a south-south cooperation program for skills development in aquaculture.
5. **Provide direct technical assistance/investments.** In some countries there appear to be areas where immediate technical assistance from Asia might provide early benefits for aquaculture development. In Senegal, for example, expertise from Vietnam may be useful to improve economic returns from the existing small scale extensive/traditional aquaculture farming systems in the Casamance. In several countries (Cameroon, Ghana, and perhaps Nigeria) interest in breeding and culture on local freshwater prawns might be stimulated by sharing knowledge of prawn breeding and farming from several countries in Southeast Asia. A south-south technical cooperation exchange program between Asia and West Africa could be constructed to capitalize on such opportunities.
6. **Regional organizations in Asia, such as NACA,** would be well placed to highlight the outcomes of the study in Asia, and to assist in organizing training and south-south technical cooperation, finding Asian experts to work together with colleagues from West Africa, and more generally exploring ways to encourage aquaculture cooperation between Asia and West Africa. There are also aquaculture research centres and training agencies in Asia, including WFC, SEAFDEC, AIT and other that could provide useful training opportunities for West Africa.

#### 8.4 Opportunities for Public and Private Sector interventions

| TYPE OF ACTION <sup>14</sup>  | ACTION   | ACTOR(S)   |
|---|--|--|
| <p><i>Micro-level interventions</i><sup>15</sup> are actions for all concerned stakeholders (public, private, civil society, local producer groups, communities) but focus primarily on local or national level conditions and consist of supporting initiatives (through funding or technical expertise) to either jump-start a dormant operation or to support an existing operation with targeted investments.</p> |  |  |
| SHORT-TERM  | Re-activation of the only existing hatchery, qualified as a potentially operational farm in Guinea (called <i>Société d'aquaculture de Koba (Sakoba)</i> )                 | Private investors, local entrepreneurs, other donors   |
| SHORT-TERM  | Support the formation of producers' co-operatives in artisanal shrimp producing areas  | Local producers, Asian shrimp farming experts, private investors, public sector agencies and public financing mechanisms, international development partners                           |
| SHORT-TERM  | Disseminate and discuss these and other related study results dealing with shrimp farming development in West Africa with Asian partners                                   | NACA, ENDA, Asian and West African private sector, Asian (Thailand and Malaysia) and West Africa Government Rep's, Shrimp farming technical experts, SWAC/ECOWAS, development partners |
| SHORT-TERM  | Establish or reinforce an existing feed mill that would use locally available raw materials to produce shrimp feed, but also feed for other livestock and cultured seafood | Shrimp farming entrepreneurs, Asian and West African private investors, local community development organisations, joint public-private ventures                                       |
| SHORT-TERM  | Immediate technical assistance (Cameroon, Ghana, and Nigeria) in breeding and culture of local freshwater prawns   | Vietnamese shrimp farming expertise, local entrepreneurs and producers, Asian and West African private investors, development partners   |

<sup>14</sup> Short-Term: 6months-1 year; Medium-Term: 1-2 years; Long-Term: 2 years-on

<sup>15</sup> Macro/spatial, meso and micro-level interventions.

| TYPE OF ACTION <sup>14</sup>  | ACTION  | ACTOR(S)   |
|---|---|--|
| SHORT-TERM//MEDIUM TERM   | Establish a training centre or centre of excellence in shrimp aquaculture at an operating shrimp farm, notably using the existing farm in The Gambia  | Shrimp farm operators, government representatives, local private sector, South-South cooperation partners, development agencies, World Bank, NACA  |
| SHORT-TERM/<br>MEDIUM-TERM  | Prepare an investment guide for shrimp farming in West Africa (relevant information on comparative advantage, technical, economic, environmental and social issues) and investment processes required for interested entrepreneurs. | Inputs from Asian aquaculture entrepreneurs and experts, involving inputs as much as possible from all West African countries' export promotion agencies, and development partners, including SWAC |
| SHORT-TERM  | Hold a regional information and investment workshop in West Africa to bring relevant actors together (entrepreneurs, key policy actors) from West Africa and Asia   | SWAC/OECD, ECOWAS, FAO, InfoPêche, NACA, others; West Africa public and private sector representatives, Asian-West African technical experts, investors and local producers                        |
| SHORT-TERM//MEDIUM TERM   | Aquaculture research and training agencies in Asia to provide useful training opportunities for West Africa   | WFC, SEAFDEC, AIT, NACA  |
| SHORT-TERM//MEDIUM TERM   | Assist in organizing training, south-south technical cooperation in West Africa   | NACA, West African shrimp farming experts and private entrepreneurs  |
| SHORT-TERM//MEDIUM TERM   | Evaluation of wild shrimp resources with respect to sourcing broodstock and post-larvae supplies  | ENDA, West African technical experts, Government Rep's, Asian and West African entrepreneurs, FAO and World Bank   |
| <p><i>Meso-level interventions</i> can affect groups of people on a multi-city or national or regional scale. They are actions for public and private sector actors who have decision-making roles or the necessary resources to influence collective action or actions on a large scale, such as outside the local community, and have institutional implications.</p> |   |  |

| TYPE OF ACTION <sup>14</sup>  | ACTION  | ACTOR(S)  |
|---|---|---|
| MEDIUM-TERM/<br>LONG-TERM   | Implement coastal resource management plans that adhere to International Guidelines on Sustainable Shrimp Farming   | ECOWAS, FAO, World Bank, Ministries of Fisheries and Environment, local community organizations, local fishers, civil society   |
| MEDIUM-TERM   | Produce criteria for shrimp from West Africa of high quality to be marketed under a West African shrimp brand (organic, fair trade, other niche markets)  | Asian and West African shrimp producers, export promotion agencies, EU-US-Asian marketing specialists, consumers in niche markets   |
| MEDIUM-TERM/<br>LONG-TERM   | Develop South-South cooperation-based short and long term training/educational programs for skills (education, technical and management) development in shrimp aquaculture, and sharing experiences | NACA, Asian and West African shrimp farming entrepreneurs, local shrimp and fish producers, public management/policy makers; international development and international aquaculture partners |
| <i>Macro-level or spatial interventions</i> are actions which require concerted private and public sector efforts on the national, region and international levels as well as coordination, in some cases, with the international community |   |   |
| LONG-TERM   | Establishment of a franchise network in the target markets selling branded high-quality West African Shrimp   | Private sector partners in target markets, local shrimp farming producers in country of origin, Asian investors, other venture capital partners   |
| LONG-TERM   | Training for West Africans going overseas to target markets to promote the brand—if not sold in a franchise scheme—as one-man sales offices   | Shrimp farming entrepreneurs, export promotion agencies, private sector organisations, local business schools   |

## Works cited

---

- Alam, R. & Demaine, H. 2004. GNAEP's promotion of integrated rice-prawn systems in the Greater Noakhali area. <http://www.gnaec.org/pdf/GADPaper2.pdf>
- Andrew R.G. Price, Rebecca Klaus, Charles R.C. Sheppard, Mark A. Abbiss, M. Kofani, Graham Webster, 2003. Environmental and bioeconomic characterisation of coastal and marine systems of Cameroon, including risk implications of the Chad-Cameroon pipeline project. *Aquatic Ecosystem Health and Management*: 3(1); 137-162
- Anon, 2004. "To feed itself Africa must capture more rainwater." *New Scientist* 183 issue 2462 – 28 August 2004, p8
- Asia-Africa Trade and Investment Conference, 2004: Doing Business in 2005: Sub-Saharan Africa. AATIC, Tokyo.
- Banks, 2002. Brackish and marine Water Aquaculture. Fisheries Sector review. Bangladesh May 2002. Funded by World Bank, Danida, USAID, FAO, DFID, with the cooperation of the Bangladesh Ministry of Fisheries and Livestock and the Department of Fisheries
- Bergerat, H., 2002: L'EUREGIO : organisation de coopération régionale entre les Pays-Bas et l'Allemagne. Étude d'un moteur du développement local illustrée par l'exemple particulier du projet « Neuro-Fuzzy-Center » dans le cadre d'INTERREG II. Mémoire de fin d'études, Institut d'études politiques de Lyon, Université Lumière Lyon 2
- Brown, J.H. 1989. A "franchising" scheme for shrimp farmers. *Fish Farming International* October 1989.
- Brown, J.H. 1991. Freshwater Prawns. Chapter 3 in *Production of Aquatic Animals*. Editor C.E. Nash, Elsevier Science Publishers, Amsterdam. pp 31-43.
- Brown, J.H., Wickins J.F. & Maclean M.H. 1991. The effect of water hardness on growth and carapace mineralization in juvenile freshwater prawns *Macrobrachium rosenbergii* de Man. *Aquaculture*. 95: 329-345.
- Campbell, M.C., 2002: Building brand equity. in *International Journal of Medical Marketing* 2, issue 3, p. 208-218.
- CDE, 2003, *Shrimp Farming in Tropical Zones*. Centre for the Development of Enterprise, Belgium. 92pp.
- Chakraborty, A.; Otta, S. K.; Joseph, B.; Kumar, S.; Hossain, M. S.; Karunasagar Indrani; Venugopal, M.N., and Karunasagar, I. 2002; Prevalence of white spot syndrome virus in wild crustaceans along the coast of India. *Current Science*. 82(11): 1392-1397.
- Chemonics International Inc, 2002. Sub-sector Assessment of the Nigerian Shrimp and Prawn Industry. Report prepared for USAID/Nigeria Raise IQC contract no PCE-I-00-99-00003-00 Agricultural Development Assistance in Nigeria Task Order no 812. 85pp.
- Christiansen, H., 2004: ODA and Investment for Development: What Guidance Can Be Drawn from Investment Guidance Scoreboards? *OECD Working Papers on International Investment* 2004/5. OECD, Paris.

- Clotilde-Ba FL, Toguebaye BS. Occurrence of microsporidia and gregarines in the shrimp *Penaeus notialis* from Senegal (West Africa). Bull Eur Ass Fish Pathol. 1995;15:122-124.
- Clotilde-Ba, F.-L.; Toguebaye, B.S., 2001. Infection of *Penaeus monodon* (Fabricius 1798)(Crustacea, Decapoda, Penaeidae) by *Agmasoma penaei* (Microspora, Thelohaniidae) in Senegal, West Africa. Bulletin of the European Association of Fish Pathologists. Weymouth, 21, 157-159.
- Clotilde-Ba, F-L; Niamadio, I; Diatta, Y; & Capape, C 1997. First records of the giant tiger prawn *Penaeus monodon* (Fabricius, 1798) (Crustacea: Penaeidae) in the marine waters of Senegal (eastern tropical Atlantic). Bocagiana no. 185, 7 pp.
- Coche, A.G., B. Haight and M. Vincke, Aquaculture development and research in sub-Saharan Africa. Synthesis of national reviews and indicative action plan for research. CIFA Technical Paper. No. 23. Rome, FAO. 1994. 151 p.
- Cormie Salem, Marie-Christine (1999) Rivières du Sud : Sociétés et mangroves ouest africaines. Institute de Recherche pour le developement. Paris 1999.
- Demaine, H. 2004. **GNAEC's Growing concentration on Pro-poor Aquaculture: A Review Paper.** Paper prepared for GNEC Mid term review. <http://www.gnaec.org/publications1.htm>
- Development Bank of Southern Africa and New Partnership for Africa's Development, 2003: Development Report: Financing Africa's Development, Enhancing the role of private finance. The Librarian, Halfway House RSA.
- Diallo, A., 1998: Integrated farming: a new approach in Basse Casamance, Senegal. *in* Mathias et al. (eds.), 1998; p. 257-264.
- EJF 2004. Farming the Sea, Costing the Earth. Why We Must Green The Blue Revolution. Environmental Justice Foundation, London, UK 77pp
- Elias L.O., 2000. Status report of grow-out demonstration trials of freshwater culture of African river prawn (*M. vollehovenii*) (Mv) in Lagos State (1989-1998) Lagos State Agricultural development Authority, Oka-Oba, Agege. 13pp
- Environmental impacts of dredging in the Niger delta.  
[http://www.iadc-dredging.com/downloads/terra/terra-et-aqua\\_nr97\\_06.pdf](http://www.iadc-dredging.com/downloads/terra/terra-et-aqua_nr97_06.pdf)
- FAO (1987) Marine fishery resources of Cameroon.  
<http://www.fao.org/DOCREP/003/S4639E/S4639E00.htm#TOC>
- FAO 1999. Report of Regional Workshop in Africa, Lagos, Nigeria. 15-17 December 1999. FAO Fisheries report no 627. (<http://www.fao.org/DOCREP/005/X8691E/x8691e04.htm> ) viewed October 2004
- FAO (2003) Strategic framework for sustainable aquaculture development in Cameroon, December 2003.
- FAO 2003. Fisheries Statistics, Fishstat Plus v.30 © FAO 2003
- FAO/AGL problem soils database. <http://www.fao.org/ag/agl/agll/prosoil/acids.htm>
- Food and Agriculture Organisation of the UN, 1995: Report of the Mid-Term Review of the International Centre for Living Aquatic Resources Management (ICLARM). FAO, Rome
- Food and Agriculture Organisation of the UN, 2002: The State of World Fisheries and Aquaculture 2002. FAO, Rome.

- Food and Agriculture Organisation of the UN, 2004: Fishery, Aquaculture, and Commodity Statistics for 2003. FAO, Rome
- Foodwatch and Institut für ökologische Wirtschaftsforschung, 2004: Was kostet ein Schnitzel wirklich? foodwatch, Berlin.
- Globefish, 2004. Shrimp Commodity Update. FAO, 83pp. www.globefish.org
- GPA Clearing House Mechanism. West and Central African Region.  
**<http://www.gpa.unep.org/seas/workshop/wacaf.htm>**
- Guinée, République de, Ministère de la Pêche et de l'Élevage, 1996. Rapport sur un « Schéma directeur de la Crevetticulture en Guinée ».
- Gupta, M.V., 1998: Social and policy issues involved in adoption of integrated agriculture-aquaculture-livestock production systems in Bangladesh *in* Mathias et al. (eds.); p. 231-244.
- Hambrey, J., M.J. Phillips, Kabir Chowdhury and Shivappa (1999). Guidelines for the Environmental Assessment of Coastal Aquaculture.
- Haque, A. Alam, R. & Demaine, H. Participatory approaches to aquaculture development: the case of GNAEP's Pilot Prawn Culture Initiative. Working technical paper for GNAEP.  
**<http://www.gnaec.org/pdf/Participatory%20Approaches.pdf>**
- Hinkle, L.E. and R.S. Newfarmer, 2005: Risks and Rewards of Regional Trading Arrangements in Africa: Economic Partnership Agreements (EPAs) Between the EU and SSA. mimeo, January 2005.
- Holthuis, L.B. 1980 FAO Species catalogue Vol.1 Shrimps and prawns of the World FAO Fisheries Synopsis 125 FIR/S123 Vol.1. 271pp  
**[http://www.fao.org/documents/show\\_cdr.asp?url\\_file=/docrep/005/T3340E/T3340E00.htm](http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/005/T3340E/T3340E00.htm)**  
**<http://www.gnaec.org/pdf/Paper%20for%20Malaysia%20Workshop%202004.pdf>**
- International Monetary Fund, 2004: Regional Trade Initiatives in Africa. Paper prepared for the IMF Seminar on Trade and Regional Integration in Africa, Dakar, Senegal, December 6, 2004. IMF: Washington DC.
- Japan International Cooperation Agency, 1999 Country profile on environment: Cote D'Ivoire.  
**<http://www.jica.go.jp/english/global/env/profiles/e99cot.pdf>**
- Khan, 2002. "Review of the current knowledge on coastal shrimp fry collection and its impact on biodiversity". August 2002 Dhaka, Aquatic Resources Development, Management and Conservation Studies. Global Environment Facility/World Bank. Department of Fisheries . Govt. of People's Republic of Bangladesh.
- Marioghae, I.E. 1988. *M. vollehovenii*: Guidelines for the implementation of the proposed pilot culture programme, making use of the available infrastructure. LSADP.
- Mathias, J.A., A.T. Charles, and Hu B., 1998: Integrated Fish Farming. Proceedings of a Workshop Held in Wuxi, Jiangsu Province, P.R. of China, October 1994. CRC Press, Boca Raton and New York.
- Maybin, E. & Blundell, K. 1996. After the Prawn Rush. The Human and Environmental Costs of Commercial Prawn Farming. **<http://www.christianaid.org.uk/indepth/9605prawn/prawn.htm>** Last viewed November 2004
- Nabi, S.M.N., Sarker, G. Alim, M.A. & Islam M.T. 1999. The effect of rice cultivation on growth of freshwater prawn, *Macrobrachium rosenbergii* in a gher farming system. GOLDA project. CARE Bangladesh/DFID.



Naturland. 2004 Naturland Standards for Organic Aquaculture, 21pp.

New, M.B., 2000. Commercial freshwater prawn farming around the World. in M.B. New and W.C. Valenti (eds.): *Freshwater Prawn Culture. The Farming of *Macrobrachium rosenbergii**. Blackwell Science, Oxford; pp. 443.

Newman, D., 2004: *The Designer's Guide to Brand Strategy*. First Issue, so-called "Free Version", on-line distribution by the author via mdnpress, San Francisco. see <http://www.mdnstudio.com/t36/papers-index.html>

O'Sullivan, G., 2001: *Seafood as a Sector for Future Development*. in Eurofish, issue 5, 2001 (October), p. 57 f.

Ohimain, E. (2004) *Environmental Impacts of Dredging in the Niger Delta. Options for sediment relocation that will mitigate acidification and enhance natural mangrove restoration*. Terra et Aqua, Number 97. December 2004. pp 9-19.

Organisation for Economic Co-operation and Development, 2002, *Regional Workshop on Trade Capacity Building in Mombassa, Kenya 26-27 August 2002*. Organised by the Development Co-operation Director and the OECD Development Centre in collaboration with UNECA and UNDP.

Organisation for Economic Co-operation and Development, 2004: *OECD Glossary of FDI Terms*. OECD, Paris.

Peng, S. E.; Lo, C. F.; Ho, C. H.; Chang, C. F., and Kou, G. H. 1998 *Detection of white spot baculovirus (WSBV) in giant freshwater prawn, *Macrobrachium rosenbergii*, using polymerase chain reaction*. AQUACULTURE 164 1-4 253-262.

Pomerania, Euroregion and Deutsche Projekt Union, 1999: *Endbericht „Grenzüberschreitendes Entwicklungs- und Handlungskonzept der Euroregion Pomerania für den Zeitraum 2000 - 2006“*. DPU, Berlin und Eberswalde.

Prein, M., J.K. Ofori, and C. Lightfoot, 1996 (eds.): *Research for the Future Development of Aquaculture in Ghana*. in: C. Lightfoot (ed.): *Participatory Approach to Natural Resources Management in Agriculture*. FAO, Rome; chap. 5.

Prime Minister, Vietnam, 2004. *Prime Minister's Decision No 112/2004/QD-TTg dated June 23rd 2004 approving the Aquatic Seed Development Program to 2010*

Pullin, R.S.V., 1998: *Aquaculture, integrated resources management and the environment* in Mathias et al. (eds.), 1998; p. 19-43.

République de Guinée, Ministère de la Pêche et de l'Élevage, Septembre 1996, report "Schema Directeur de la Crevetticulture en Guinée".

Ruddle, K.R., 1996: *The potential role of integrated management of natural resources in improving the nutritional and economic status of resource-poor farm households in Ghana* in Prein et al. (eds.) 1996; p. 57-86.

Sahel and West Africa Club of the OECD, 2004: *Annual Work Plan, June 2004*, Presented by the SWAC Secretariat. OECD/SWAC, Paris.

Satia, B.P., 1998: *The integration of an aquaculture-poultry production system in Cameroon* in Mathias et al. (eds.), 1998; p. 245-255.

- Skabo, H. 1988. Shrimp farming developments in West Africa. In Shrimp '88, Conference proceedings, 26-28 January 1988, Bangkok, Thailand, pp. 95-102. Infofish, Kuala Lumpur, Malaysia.
- Smith, V.J., J.H. Brown & C Hauton (2003). Immunostimulation in crustaceans: does it really protect against infection? *Fish and Shellfish Immunology* 151, 71-90
- Sohou Z. <http://ioc3.unesco.org/oceanexpert/viewRecord.php?&memberID=8056> Viewed October 2004
- Spalding, M., F. Blasco and C. Field (1997). World Mangrove Ecosystem Atlas. The International Society for Mangrove Ecosystem (ISME), Japan.
- Sub-Saharan Africa Environmental Issues - <http://www.eia.doe.gov/emeu/cabs/subafricaenv.html>
- Tayamen, M & Brown J.H 1999. A condition index for evaluating larval quality of *M. rosenbergii* (De Man 1879). *Aquaculture Research*, 30. 917-922.
- Télégramme (le), 2003: Miscellaneous News. Issue of 19th of December 2003.
- The Africa Region Environment Strategy. Environment Matters, 2001, page 24-27. World Bank: Washington D.C.
- Thiam, P.D., 1991: Stratégies d'interface : Intégration économique et développement. P. Lang, Bern.
- Thompson, K.D. & Adams, A. 2004. Current trends in immunotherapy and vaccine development for bacterial diseases of fish. In *Molecular Aspects of Fish and Marine Biology – Vol 3. Current Trends in the Study of Bacterial and Viral Fish and Shrimp Diseases*. Ed Leung Ka Yin , World Scientific, Singapore.
- United Nations Development Programme, 2002: Country Evaluation: Assessment of Development Results – Nigeria. UNDP Evaluation Office, New York.
- United Nations Industrial Development Organisation, 2003: Africa Foreign Investor Survey. Motivations, operations, perceptions and future plans, UNIDO, Vienna.
- West Africa Rice Development Association - [http://www.riceweb.org/g\\_overwafrica.htm](http://www.riceweb.org/g_overwafrica.htm)
- Wickins J.F. & O'Lee, D.C. 2002. *Crustacean Farming Ranching and Culture*. Blackwell Science, Oxford. 446pp.
- Wilder, M.N. Yang, W-J., Huong, D.T.T. & Maeda, M. (1999) Reproductive mechanisms in the giant freshwater prawn, *Macrobrachium rosenbergii* and cooperative research to improve seed production technology in the Mekong Delta region of Vietnam. UJNR Technical Report no 28 <http://www.lib.noaa.gov/japan/aquaculture/proceedings/report28/Wilder.pdf>
- Williams, D 2005. Impact of the ban on post larvae collection on the livelihoods of fry collectors in Bangladesh. Paper prepared for CABI Aquaculture Compendium.
- Williams, D. Alam, R. & Noble, F. 2004. Integrated rice/fish/prawn systems in Bangladesh. Paper presented at the International Conference – “Sustainable Aquatic Resources are more than Managing Fish”, The Ecosystem Approach in Inland Fisheries and role of Intracountry Linkages, Penang, Malaysia January 12-16 2004, 15 pp.
- World Bank Guinea coastal marine and biodiversity management project. Project Brief – P049513 “Coastal and Biodiversity Management in Guinea Bissau.”

World Bank/NACA/WWF/FAO. Consortium Program on Shrimp Farming and the Environment. Programme Report "Can Shrimp farming be undertaken by a developing country profitably, sustainably and with limited impact on the environment?" The World Bank, Washington DC, 2000. [www.enaca.org/shrimp](http://www.enaca.org/shrimp)

World Resources Institute Data from [http://earthtrends.wri.org/country\\_profiles/index.cfm?theme=1](http://earthtrends.wri.org/country_profiles/index.cfm?theme=1)

Zimmermann, S. & New M.B. 2002 Grow-Out Systems – Polyculture and Integrated Culture in "Freshwater Prawn Culture. The Farming of *Macrobrachium rosenbergii*" Eds. M.B. New & W.C. Valenti. Blackwell Science pp. 443.