Published by: IUCN The World Conservation Union; iisd International Institute for Sustainable Development / Institut international du développement durable

Cover design by: HAKI, Hanoi

Report title: Expanding Shrimp Aquaculture on Sandy Land in Vietnam: Challenges and Opportunities

Cover photos: Mikkel Kallesøe, IUCN Vietnam

Printed by: HAKI, Hanoi

Available from: IUCN – The World Conservation Union
Environmental Economics Programme for Vietnam
13A Tran Hung Dao Street
I.P.O Box 60
Hanoi, Vietnam

IUCN Vietnam (The World Conservation Union)

IUCN began work in Vietnam as far back as 1984, assisting in the preparation of a draft National Conservation Strategy and a National Plan for the Environment and Sustainable Development, which was approved by the government of Vietnam in 1991.

The government of the Socialist Republic of Vietnam joined IUCN as a State Member in 1993 and, since then, two local Vietnamese NGOs have become members: The Institute of Ecological Economy (Eco-Eco) and the Centre for Natural Resources and Environmental Studies (CRES) of the Hanoi National University. The international members of IUCN working in Vietnam are: The World Wide Fund for Nature (WWF); Fauna and Flora International (FFI); Birdlife International; Association for Research and Environmental Aid (AREA); Frankfurt Zoological Society (FZS); Canadian Centre for International Studies and Cooperation (CECI); Counterpart International; GTZ; and Frontier.

The programme in Vietnam is focussed on the key environmental issues within the country's developmental priorities. This programme is built upon the historical interventions of the Union, relates to the global priorities of IUCN, is coordinated with our international conservation partners, and is implemented in close cooperation with the government of Vietnam. Today, the main focus areas are biodiversity conservation, especially of wetland and marine resources; sustainable use of natural resources and forest conservation; pollution prevention, in particular for small and medium enterprises; environmental economics; environmental awareness and integrated environmental planning.

The International Institute for Sustainable Development (IISD)

The International Institute for Sustainable Development contributes to sustainable development by advancing policy recommendations on international trade and investment, economic policy, climate change, measurement and indicators, and natural resource management. By using Internet communications, we report on international negotiations and broker knowledge gained through collaborative projects with global partners, resulting in more rigorous research, capacity building in developing countries and better dialogue between North and South.

IISD's vision is better living for all—sustainably; its mission is to champion innovation, enabling societies to live sustainably. IISD receives operating grant support from the Government of Canada, provided through the Canadian International Development Agency (CIDA) and Environment Canada, and from the Province of Manitoba. The institute receives project funding from the Government of Canada, the Province of Manitoba, other national governments, United Nations agencies, foundations and the private sector. IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States.

The International Centre for Trade and Sustainable Development (ICTSD)

ICTSD aims to contribute to a better understanding of developmental and environmental concerns in the context of international trade. It fosters sustainable development as the objective of international trade policy-making and participatory decision-making in the design of trade policy. ICTSD promotes the interests and activities of the non-governmental community in trade and sustainable development, and endeavours to make international policy-makers and trade officials aware of the NGO community's work on trade, development and environment.

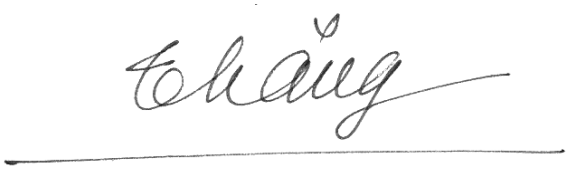
FOREWORD

The praxis of aquaculture has, over recent years, proven to be an important source of livelihood diversification for a large portion of Vietnam's rural population. The ability of aquaculture to generate income and thereby serve as means of poverty alleviation has been recognised and acknowledged by the Ministry of Fisheries (MoFI) and the government of Vietnam. Several decisions, directives and resolutions concerning aquaculture development have already been signed and adopted by the State within the Aquaculture Development Program.

The future development of aquaculture in Vietnam is expected to consolidate Vietnam's position as one of the world's leading producers and exporters of aquaculture products, especially tiger shrimp. The recently discovered potential for converting sandy land into highly productive aquaculture areas is an important step in this direction. However, MoFI has recognised that the development of aquaculture, especially in the tidal prone coastal areas of the country, has to proceed in a regulated and carefully planned manner if negative environmental and trade impacts are to be avoided and the industry is to be sustainable.

Given the present speed of aquaculture development in Vietnam the current publication and the workshop in Ninh Thuan province from which some contributions arose, is both timely and relevant in its address of challenges and opportunities involved in expanding shrimp aquaculture on sandy land. The Ninh Thuan workshop served as a national conference and drew participants from relevant departments within MoFI, research institutions and numerous neighbouring provinces.

The research and recommendations put forward in the following document represent important contributions to the future success of Vietnam's aquaculture industry. Therefore, it gives me great pleasure to convey the full support of the Ministry of Fisheries for this publication and to thank the World Conservation Union (IUCN) for their invaluable technical assistance in its preparation and the International Institute for Sustainable Development (IISD) for providing the necessary funds.



Dr. Nguyen Viet Thang
Vice Minister
Ministry of Fisheries (MoFI)

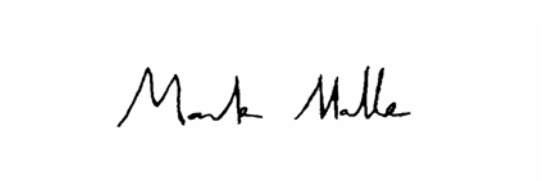
The Trade Knowledge Network (TKN) was established in 1997 by the International Institute for Sustainable Development (IISD) and the International Centre for Trade and Sustainable Development (ICTSD), in an attempt to build capacity on the issues of trade and sustainable development in six developing countries/regions: Argentina, Central America, China, Pakistan, South Africa and Vietnam. It particularly aims to increase awareness, knowledge and understanding of the trade and environment issues among developing country research institutions, non-governmental organizations and governments. The first phases of this project included country-specific case studies and workshops, as well as research on cross-cutting international themes and was concluded in May 2000. For details of Phase I, including project research and workshop reports, see www.tradeknowledgenetwork.net

In Vietnam, the work was conducted in partnership with IUCN and included a conference on international trade and environment, presenting papers from ministries, research institutes and corporate associations and discussing issues of particular concern for Vietnam. The workshop was organized in April 1999. The National Environmental Agency (NEA) and IUCN published the proceedings and summary report of this meeting.

The second phase of the TKN project has now been initiated. In Vietnam the threats related to sustainable development of the fisheries export sector were identified as important. In early 2002, in collaboration with IISD and ICTSD, this led to the formulation of the research project: Expanding Shrimp Aquaculture on Sandy Land in Vietnam: Challenges and Opportunities.

The main objectives of this project have been to examine the potential challenges and opportunities of sandy land aquaculture in Vietnam in three areas: achieving economic growth, contributing to environmental integrity and fostering development in poor areas of the country. In achieving these objectives, the project, with assistance from the Ministry of Fisheries and the Ministry of Trade, has carried out research in five provinces identified as suitable for aquaculture development on sandy land. The research was subsequently presented at a workshop in Ninh Thuan province on July 22-23, 2002, along with presentations from other ministries, departments and research institutes dealing with aquaculture issues.

It is hoped that the issues addressed in this publication, along with the long list of recommendations set forward by government agencies, will act as a positive contribution to ensure that the development of aquaculture on sandy land will be sustainable.



Mr. Mark Halle
Director
Trade and Investment
IISD

Mr. Nguyen Minh Thong
Country Representative
IUCN Vietnam

ACKNOWLEDGEMENTS

This work was carried out in collaboration with the International Institute for Sustainable Development (IISD) and the International Centre for Trade and Sustainable Development (ICTSD), with aid from The Rockefeller Foundation; The Norwegian Ministry of Foreign Affairs; International Development Research Centre (IDRC); Swiss Agency for Development and Cooperation (SDC); and the Canadian International Development Agency (CIDA).

Research reports from departments and institutes within the Ministry of Fisheries (MoFI) are highly appreciated. A special thank you to Dr. Vu Van Trieu, Deputy Director of the International Cooperation Department (ICD), MoFI, for acting as a governmental focal point and facilitating the work done by Mr. Nguyen Hai Duong from the Economic & Planning Institute (EPI); Ms. Nguyen Thi Phoung Lan from the Department of Science & Technology (DST); Mr. Nguyen Quang Dang from the Fisheries Information Centre (FIC); and Mr. Tran Van Quynh from the Department of Fisheries Extension (DFE). Also the valuable input provided by Dr. Tran Cong Sach, head of the Science and Training Department, Institute for Trade Study, Ministry of Trade, is acknowledged.

Invaluable efforts were made by the people's committee of Ninh Thuan Province, the Ministry of Fisheries and other involved parties in organizing and hosting a successful workshop in Ninh Thuan on July 22-23, 2002. Moreover, thanks are due to all the people who prepared presentations and handouts for the workshop. These include: Dr. Nguyen Van Thanh, Mr. Luu Xuan Vinh, Mr Tran Ngoc Hien, Mr. Do Van Ngo, Dr. Nguyen Van Truong, Dr. Ha Xuan Thong, Dr. Enamul Haque, Mr. Aaron Cosbey, Mr. Phan Phu Rong, Mr. Mai Xuan Thu, Dr. Nguyen Tu Cuong, MSc. Nguyen Khac Lam, Mr. Nguyen Quoc Hung, Mr. Pham Minh Tien, MSc. Dao Van Tri, Dr. Vu Huy Thu, Mr. Nguyen Van Trong, Ms. Ly Thi Thanh Loan and Mr. Nguyen Quoc Khanh.

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

ACRONONYMS AND ABBREVIATIONS

AFTA	ASEAN Free Trade Agreement
AREA	Association for Research and Environmental Aid
CECI	Canadian Centre for International Studies and Cooperation
CIDA	Canadian International Development Agency
CRES	Centre for Natural Resources and Environmental Studies
DFE	Department of Fisheries Extension (Ministry of Fisheries)
DST	Department of Science and Technology (Ministry of Fisheries)
Eco-Eco	The Institute of Ecological Economy
EPI	Economic and Planning Institute (Ministry of Fisheries)
FFI	Fauna and Flora International
FIC	Fisheries Information Centre (Ministry of Fisheries)
FZS	Frankfurt Zoological Society
GDP	Gross Domestic Product
GHP	Good Hygiene Practices
GMP	Good Management Practices
HACCP	Hazard Analysis and Critical Control Point
ICD	International Cooperation Department (Ministry of Fisheries)
ICTS	The International Centre for Trade and Sustainable Development
IDRC	International Development Research Centre
IISD	The International Institute for Sustainable Development
IUCN	The World Conservation Union
MARD	Ministry of Agriculture and Rural Development
MoF	Ministry of Finance
MoFI	Ministry of Fisheries
MoSTE	Ministry of Science, Technology and Environment
MPI	Ministry of Planning and Investment
NEA	National Environment Agency
PPC	Provincial People's Committee
RCA	Revealed Comparative Advantages Indices
SDC	Swiss Agency for Development and Cooperation
SSOP	Standard Sanitary Operation Practice
TKN	The Trade Knowledge Network
VND	Vietnamese Dong (*VND 15,500 = US$1 at time of study)*
WWF	The World Wide Fund for Nature

EXECUTIVE SUMMARY

Recently, aquaculture—especially the culture of tiger shrimp—has brought about much higher profits in comparison to agricultural activities, and has thus attracted farmers eager to earn money. The unplanned and spontaneous expansion of this culture in many parts of Vietnam is accompanied by the dangerous potential of severe negative impacts both in terms of economical and environmental losses. "Explosion" of the shrimp culture area was reported in the Lower Mekong River Delta, and Central Provinces are already running out of potential inland areas. As a result of an ongoing search for new solutions to the problem of limited land resources, Ninh Thuan province, among others, has experimented with cultivating shrimp on sandy soil. The sandy land shrimp culture currently prevalent in Ninh Thuan province is based on a semi-intensive model that has no major differences when compared to the culture of similar species in ponds on soil or in lakes and paddies. Its only distinctive characteristic is that the pond is constructed on sandy land.

Until now, wastewater from the culture ponds has been discharged directly into the surrounding environment without being treated or filtered. High pollution risks therefore threaten adjacent land areas and water sources, leading to an increased risk of shrimp diseases. In addition to considering these environmental concerns, the expansion of the tiger shrimp cultivating industry must also be examined in light of price-influence. As has been seen with coffee, a massive increase in supply can reduce prices, which can be fatal for the industry in the long run.

In all of the Central Provinces combined, the total sandy land area is approximately 100,000 ha. Provinces covering particularly large areas include Quang Binh (39,000 ha), Phu Yen (14,000 ha), Quang Tri (13,000 ha) and Quang Ngai (10,000 ha). Within the five surveyed provinces of Quang Binh, Quang Tri, Quang Ngai, Ninh Thuan and Thua Thien Hue, the sandy land area suitable for shrimp cultivation is roughly 15,000 ha, distributed as 4,500 ha in Quang Binh, 4,000 ha in Quang Tri, 4,000 ha in Quang Ngai, 1,500 ha in Ninh Thuan and 600 ha in Thua Thien Hue. According to survey data collected during the preparation of this report, the areas already cultivated include 200 ha in Ninh Thuan, 60 ha in Quang Ngai, 16 ha in Thua Thien Hue, 14 ha in Quang Binh and 6 ha in Quang Tri. Average yields per crop range from three tonnes/ha (in Quang Tri and Thua Thien Hue) to six tonnes/ha (in Ninh Thuan). The highest yields fluctuate between four tonnes/ha (in Thua Thien Hue) and ten tonnes/ha (in Ninh Thuan) and the average lowest between 1.72 tonnes/ha (in Binh Dinh) and 3.6 tonnes/ha (in Ninh Thuan).

In considering the advantages and disadvantages of developing sandy land shrimp aquaculture, a list of recommendations, with the objective to secure sustainability, has been put forward by the ministerial research institutes and provincial departments engaged in this study. The list of recommendations complies with the existing legal framework and overall policy of the government, but may in itself also include suggestions on the design of new rules and plans when these are believed to be necessary. A list of the main findings is presented below, but is by no mean exhaustive.

Legal framework for aquaculture development

Main Decisions, Directives and Resolutions that are important when focusing on the expansion of aquaculture include:

- Decision No. 18/2002/QD-BTS dated 3/6/2002. The decision, with the attached regulations, is an ideal legal framework for shrimp culture on sandy land.
- Decision No. 01/2002/QD-BTS dated 22/1/2002 prohibiting the use of selected antibiotics and chemicals used in the production of fish and fisheries products.
- Decision 224/1999/QD-TTg dated 8/12/1999. Here the orientation of aquaculture development in the period 1999–2010 is outlined. Within direction principles, the decision implies that sustainable aquaculture should be developed. The development should occur while protecting the ecological

environment, ensuring production and stabilizing people's livelihoods, and should strongly focus on brackish and marine aquaculture in line with freshwater aquaculture.

- Directive No. 07/2002/CT-TTg dated 25/2/2002 concerning the management and use of antibiotics and chemicals in the production of animal feed.
- Directive No. 36 CT/TW dated 25/6/1998. The directive deals with the strengthening of environmental protection in the period of industrialization and modernization. This document also refers to overfishing leading to resource depletion and groundwater contamination.
- Resolution No. 03/2000/NQ-CP dated 15/6/2000, which addresses the issue of structural transition. Aquaculture, in particular the cultivation of shrimp, is identified as one of the investment priorities.
- Resolution No. 09/2000/NQ-CP dated 15/6/2000 where utilization of un-reclaimed land for aquaculture purposes is approved.

Main advantages of developing aquaculture on sandy land

- Waste and unproductive land is utilized in an economically efficient way.
- Job opportunities are created and contribute to improved local livelihoods and reduced poverty.
- A productivity that is higher than that of conventional aquaculture on soil is possible since the production cycle can be repeated twice and, in some provinces, even three times a year.
- The construction is quite easy and possible at relatively small costs.
- Clean water is available and reduces the risk of diseases and limits the outbreak of pathogens.
- Pressure is drawn away from in-shore fishing.
- Spin-off effects such as the development of other fields/sectors supplying input to the aquaculture industry.

Main disadvantages of developing aquaculture on sandy land

- The cultivation of shrimp on sandy land involves the use of fresh and groundwater, which in the coastal areas are limited in supply.
- Insufficient considerations have been given to the planning of culture areas.
- Waste handling and processing methods are limited, and environmental protection receives little attention.
- Frequent strong winds, storms and moving sand dunes create difficulties for the transportation and production of products.
- Poor infrastructure.
- The local population in the coastal areas is very poor and lacks capital.
- The diversification of cultivable species is still limited.

Overall conclusion

The practice of aquaculture on sandy land has its own advantages and offers opportunities for development. By undergoing a good start it has brought about promising socio-economic results. But, concerns, especially regarding the environment and production techniques, have arisen and need to be resolved shortly. However, the enthusiasm, creativity and confidence of people in the project areas are factors that will positively assist the development process.

General recommendations

- A master plan for aquaculture development, applicable to the provinces, should be developed. The master plan should address the issues of cultivable species diversification, technology, investment and line of research.
- When contemplating technical solutions suitable for the prevailing conditions of an area in regard to infrastructure, ecology, investment capacity and expertise, concerned agencies should draw on past lessons and methodological studies.
- Overall planning should be given more attention and should be based on considerations involving areas of cultural heritage, environmental protection and tourism.
- Technologies for waste processing, disease diagnosis and treatment, post-harvest product maintenance, etc. should be developed, and low-cost solutions for bottom cover should be made available.
- Aquaculture should be combined with reforestation to prevent sand-movement and to protect against strong winds.
- The quarantine of shrimp seeds from hatcheries should be reinforced and the timely availability of these seeds should be assured.
- Extension officers should provide technical guidance and act as marketing agents to facilitate farmers' access to manufacturers and exporters, and to secure good prices from the retailers.
- There should generally be a close cooperation between extension and research institutions, and organizations and individuals inside and outside the country, in order to adjust new and appropriate technologies and quickly share them with the shrimp farmers.

Specific recommendations for the government

- The government should set up directives for the agricultural and aquacultural sectors facilitating a master plan for the development of aquaculture on sandy land, and ensure policies/regulations on land use, finance and technology.
- The government should financially support infrastructure development in regions with potential for intensive aquaculture development. The government should provide financial assistance to set up "pilot" culture models, organize training and facilitate communication.
- The Ministry of Fisheries should compile and submit draft policies on taxation, land contractual terms and low-interest lending to create favorable conditions for aquaculture farmers.

1 INTRODUCTION

Fishery is the fastest growing economic sector in Vietnam and its contribution to the GDP is increasing (3.1 per cent in 1999). Seafood constitutes the principal source of animal protein for the Vietnamese population and is a pillar in governmental food security policy. In 1992, it was estimated that 60–70 per cent of the fishery's products were derived from near-shore fishing, while aquaculture contributed 30 per cent of the total fishery's production. However, it has become increasingly difficult for the offshore fishing industry of Vietnam to obtain satisfactory catches. The near-shore fish stocks have been heavily depleted by over-fishing, use of destructive fishing methods and pollution from agricultural runoff of pesticides and fertilizers.

Over the last two decades, the Ministry of Fisheries (MoFI), with the assistance of foreign organizations, has made substantial efforts to promote aquaculture as an alternative source of income in the poorest rural areas relying on agriculture production, particularly rice. MoFI has recently also been encouraging offshore fishing through preferential taxation in an attempt to reduce the pressure on near-shore marine resources, but constraints have arisen since the Vietnamese fishing fleet is unsuited for offshore fishing.

Under the economic reforms, or *Doi Moi*, the economic activities of the fishery sector started to be regulated with the adoption of a fisheries master plan that fixed the annual fisheries output to 3.5 million tonnes per year, enabling Vietnam to meet domestic needs and become a major seafood exporter in Asia. The government of Vietnam is keen to expand its exports of fish products, but, as mentioned, faces capacity constraints imposed by the productivity of wild stocks. One route for expansion is marine aquaculture. The government estimated that the current marine aquaculture capacity of the country is only reaching half of its potential for development. However, expansion by traditional methods might face constraints caused by environmental concerns. Also, the expansion possibilities of inland aquaculture are limited given the scarce availability of land. Therefore, new potential areas have been identified in the form of sandy lands.

Before allocating large resources towards developing these areas for aquaculture production, certain questions need answering. First of all, can it be environmentally sustainable and at the same time foster rural development? If the environmental impacts of this new technology are recognized up front, and appropriate measures are taken, sandy land aquaculture can potentially become a force for sustainable development through international trade.

In line with developing aquaculture, the government has issued Decision No. 224/199/QD-TTg in which the Prime Minister approves a program for developing the aquaculture industry in the period 1999–2010. The program allows the conversion of the low land area's salt-intruded land, salt-producing land and unsustainable rice fields into ponds for shrimp cultivation. The Decision is supplemented by Resolution No. 09/2000/NQ-CP (outlining some guidelines and policies encouraging structural changes in the production and consumption of agricultural products), in which the government authorizes the use of low lands and land located in the coastal areas for aquaculture development purposes.

In compliance with the implementation of Decision No. 224/199/QD-TTg and Resolution No. 09/2000/NQ-CP, many provinces have initiated a planning stage focusing on developing aquaculture on salt-intruded land, salt-producing land and unsustainable rice fields in the low land area. In Vietnam, according to primary statistics, nearly 236,500 ha were converted for aquaculture development in 2001 alone. 230,000 ha have been converted from unsustainable rice production, nearly 1,700 ha from salt-producing land and the remaining 4,800 ha from unused sandy land and wasteland. The converted sandy land is mainly concentrated in the provinces of Ninh Thuan, Phu Yen, Binh Thuan, Quang Tri and Quang Ngai. In Ninh Thuan province, 200 ha of sandy land were converted for aquaculture purposes in 2002.

Furthermore, as part of its efforts to improve the quality of the fisheries products and gain market access, MoFI has adopted internationally - recognized monitoring systems, such as Good Management Practices

(GMP), Good Hygiene Practices (GHP), Standard Sanitary Operation Practice (SSOP) and the Hazard Analysis and Critical Control Point (HACCP).

The progressive integration of Vietnam into the regional and global economy will affect the fisheries sector. For instance, ASEAN Free Trade Agreement (AFTA) will become effective in 2003 and will revoke tariff preference on aquatic products, forcing local enterprises to compete with foreign enterprises, even in local markets. In order to harmonize national import regulations among the ASEAN members, general regulations on fish product quality and hygiene, and aquaculture product hygiene, will be drafted. Hygiene testing methods will be harmonized and finally ASEAN HACCP will be set up. The ratification of the bilateral trade agreement with the U.S. is expected to provide new opportunities for exporting high quality aquatic products to the U.S.

The output of the research project: *Expanding Shrimp Aquaculture on Sandy Land in Vietnam: Challenges and Opportunities* will be presented in the following, and will deal with many of the above-mentioned issues.

The first section of this publication will present the research papers produced by various departments within MoFI. The research is partly based on data collected during two field trips to the provinces of Quang Binh, Quang Tri, Thua Thien-Hue, Quang Ngai and Ninh Thuan. A research paper produced by the Science and Training Department, Ministry of Trade on International Export Implications of Expanding Shrimp Aquaculture in Vietnam, is also presented here. Following these research papers is a summary of the workshop held in Ninh Thuan July 22–23, 2002. The final section of this publication will be an appendix containing the workshop agenda, the participation list and a broad selection of presentations and handouts from the workshop.

2 SOME ISSUES ON THE PLANNING OF AQUACULTURE ON SANDY LAND IN CENTRAL PROVINCES

By

Mr. Nguyen Hai Duong, senior expert
Economics and Planning Institute, MoFI

2.1 Background

Recently, aquaculture, especially the culture of tiger shrimp, brought about much higher profits in comparison to other agricultural activities and thus attracted farmers eager to earn money. The spontaneous expansion of this culture area without planning, in turn, has led to serious losses. "An explosion" in the shrimp culture area was reported in the Mekong River Delta, while Central Provinces nearly ran out of product under the circumstance of increasing numbers of people taking up the career. After a long search for new solutions, for the first time in Ninh Thuan province and all over the country as well, people started cultivating shrimp on sandy soil. Accordingly, trials of tiger shrimp culture on sandy soil using liquid insulating materials, funded and assisted by the Institute of Fisheries Economics and Planning, proved to be successful in 2000. The triumph marks a watershed in aquaculture development, uses new potential, creates new employment chances and helps diversify the choices of livelihood. Nevertheless, planning has now become a pressing and urgent task in order to sustain the development trend and avoid spontaneously mushrooming phenomenon. An expert team, supported by the International Institute for Sustainable Development (IISD) and the World Conservation Union (IUCN), was formed within the Ministry of Fisheries to evaluate the state of shrimp culture on sandy soil and make necessary recommendations for appropriate planning and for the sustainable development of aquaculture activities on Central Vietnam sandy lands.

Initial survey data collected by the team show that in Quang Binh, Thua Thien Hue, Quang Ngai, Ninh Thuan and some other typical provinces, most of the beach in the central region is endowed with sand-dunes. Sand fields stretch along the coastline for hundreds of kilometers, with a width ranging from hundreds to thousands of meters and totaling approximately 100,000 ha. Once the potential is directed towards aquaculture purposes, surely the culture area, production and job opportunities will be generated, contributing to poverty alleviation and economic structure innovation in our country. Due consideration should be given to planning in order to make this development sustainable and help conserve the ecological environment.

2.2 Aquaculture development in central provinces

2.2.1 Potential and area capacity of coastal zones

The survey data collected from a number of important provinces, despite inadequacies, show that the sandy land area in the central provinces is enormous (some 100,000 ha), especially in Quang Binh (39,000 ha), Phu Yen (14,000 ha), Quang Tri (13,000 ha) and Quang Ngai (10,000 ha). Cultivable land accounts for nearly 15,000 ha and concentrates in Quang Binh (4,500 ha), Quang Tri (4,000 ha), and Quang Ngai (4,000 ha).

2.2.2 Aquaculture development status in 2002

Area

At present, there are 571.4 ha of aquaculture on sandy land, of which 541.4 ha are for shrimp culture. Top provinces include Phu Yen (250 ha), Ninh Thuan (200 ha) and Quang Ngai (40 ha), (see Table 1).

Productivity

Average yields per crop range from three tonnes/ha (in Quang Tri and Thua Thien Hue) to six tonnes/ha (Ninh Thuan). Meanwhile, average highest yields fluctuate from four tonnes/ha (Thua Thien Hue) to ten tonnes/ha (Ninh Thuan), and lowest average productivity from 1.72 tonnes/ha (Binh Dinh) to 3.6 tonnes/ha (Ninh Thuan), (see Table 1). Apparently, Ninh Thuan is the top producing province.

Table 1 Potential area capacity and status of aquaculture development in several central provinces

Province	Coastline length (km)	Sandy soil area (ha)	Cultivable sandy soil area (ha)	Production status in 2002			
				Area (ha)	Yield (tonnes/ha/crop)		
					Average	Highest	Lowest
Total	*930*	*85,100*	*14,600*	*571.4*			
Ha Tinh	137	1,300					
Quang Binh	116	39,000	4,500	total 36.8 shrimp 6.8 freshwater 30	 4 0.8	5	4
Quang Tri		13,000	4,000	6	3	5	3
T.T. Hue	126	1,300	600	16.2	3	4	2
Quang Ngai	130	10,000	4,000	40	3.7	4.5	2.9
Binh Dinh	134	5,000	1,300	2.42		5.5	1.72
Phu Yen	182	14,000	1,300	250			
Ninh Thuan	105	1,500	1,500	200	6	10	3.6

Culture seasons

As the coastal sandy land in the central provinces is not flood-prone, the culture cycle can be applied all year round, and normally split into two crops: first crop from February–April to June–August; and second crop from June–August to October–December. In Ninh Thuan a third crop (from October to next February) can be carried out.

Stocking species and rate

The most common species stocked is tiger shrimp, but in Thua Thien Hue, cockle grow very well. In Quang Binh, the freshwater species are stocked in places near freshwater sources, and reportedly 0.5–1 tonne/ha/crop productivity has been achieved.

Stocking rate: 30–40 shrimp/m^2 is the most prevalent. In Ninh Thuan some households stock at the rate of 50 shrimp/m^2, while in Quang Ngai, a lower rate (15–20 shrimp/m^2) is widely accepted. However, in Ninh Thuan, the rate of the third cycle is decreased by 50 per cent (compared to main crops).

2.2.2.1 Infrastructure construction

Construction investment depends on scale and capital mobilization capacity in each area. Average amount per hectare to build a pond is VND 350–400 million (US$ 22,580–25,806) in Quang Binh and Thua Thien Hue, VND 200–250 million (US$ 12,903–16,129) in Ninh Thuan (at most VND 390 million–US$ 25,161), VND 188 million (US$ 12,129) in Binh Dinh and VND 28 million (US$ 1,806) in Quang Ngai.

2.3 Advantages and disadvantages

2.3.1 Advantages

Developing aquaculture on sandy land begins to utilize an enormous land-area considered unproductive for a long time, and to generate production of aquaculture products for export. It contributes a new livelihood option to rearrange labours and relieves the pressure on in-shore fishing. More employment chances and more income will contribute significantly to poverty alleviation causes, improve the material and cultural life of the people, and improve environmental and climate conditions of the beach. Most of the people living in the coastal sandy areas are extremely poor, which explains why aquaculture

development is anticipated as a means of contributing to poverty alleviation. Thanks to aquaculture development (on-sand shrimp culture) some people have already improved their livelihood and some have even become well-off. Preliminary surveys conducted in some provinces have shown that on-sand shrimp culture has been highly effective. In the following list some estimated profit perspectives for on-sand shrimp culture, after meeting all production costs, are identified along with other advantages:

- In the central province of Thua Thien Hue, some profit-making farms gain as much as VND 20–30 million/ha/crop (US$ 1,290–1,935/ha/crop).
- In the southern province of Ninh Thuan, the lowest recorded profit is VND 20 million/ha/crop (US$ 1,290/ha/crop), the average profit is VND 50–60 million/ha/crop (US$ 3,225–3,870/ha/crop), and the highest obtained profit is VND 80–100 million/ha/crop (US$ 5,161–6,451/ha/crop).
- Since the majority of dunes and fields are adjacent or close to the sea and far away from industrial/agricultural zones or residential quarters, the saline water source is rather clear of toxic wastes. This is a good environment for aquaculture.
- Through interviews, we have learned that the stability of dune and field positions is rather high. Hence, there are no remarkable dangers to the existence of construction work during a long period.
- Although the model has been applied since as early as 1999, average productivity of three–six tonnes/ha/crop are equivalent to earthen ponds (maximum figure may reach ten tonnes/ha).
- Various species can be cultivated in the model. Where salinity is under control through a freshwater canal system, shrimp is recommended. Otherwise, saline or freshwater animals should be raised instead, depending on the distance between the culture site and water sources.
- It is possible to establish ecological aquaculture villages in collaboration and cooperation with other sectors like forestry, tourism, sports, etc.
- The model of establishing aquaculture on sandy land helps lower the cost for resettlement of displaced households compared to resettlement schemes on normal soil. Establishing aquaculture on soil would normally call for high compensation, as selected areas would include rice fields and land where cash crops are grown. Furthermore, people who have land use certificates own most of this land, and in some instances the land even has tombs and houses on it. This makes it difficult and costly to set up aquaculture projects in these areas. However, setting up aquaculture development on sandy land involves mainly fallow land without tombs and houses or any established production associated with land use rights.
- This practice also fosters the development in other fields/sectors like techniques of liquid insulating materials, construction, ecological tourism, etc. Surveys show that on-sand aquaculture has attracted lots of labour especially in Thua Thien Hue (ten persons/ha, four persons/0.4ha), Quang Ngai (eight persons/ha, two persons/0.25ha) and Ninh Thuan (more than four persons/ha, thirty persons/seven ha).

2.3.2 Disadvantages

- People are not yet ready in terms of infrastructure, technologies and finance to take up the new model, since most farmers are still living in poverty.
- Lack of freshwater source or canal system. Ground supply is now at risk when people drill more wells to get clean water for daily use.
- Most of the current pond systems do not contain waste processing ponds but water is drained directly to sluices. This may cause serious pollution problems when the culture area soars up and wastes are drained out frequently.
- The high stocking density of 30–40 even 50 shrimp/m^2 leads to small size of harvested products (50–55 shrimp/kg), low market price and seed demand tension at the beginning of the culture cycle.
- In areas without forests, gusty winds and sands storms create major obstacles for the construction of culture systems. There has not been a good technique of pump installation for the system.

- Cultivable species are not yet diversified (marine fin fish, molluscs, seaweed, etc.)
- Few considerations have been paid to environment protection and multi-disciplinary planning actions for sustainable development of geological conditions and groundwater resources.

2.4 Planning viewpoints and orientations

2.4.1 Viewpoints

- To fully make use of the sandy soil potential by transforming unreclaimed or unproductive sandy land into aquaculture sites for marine, brackish and freshwater species will increase production, provide raw products for the export processing industry, generate job opportunities, improve living standards and reduce poverty for coastal inhabitants, help effectively diversify livelihood activities, and conserve the beauty of the coast's ecological landscape.
- To utilize this huge potential in a sustainable way, people have to acquire good socio-economical and ecological knowledge as well as sound professional expertise.
- Priorities should be given to cultivation of high value and competitive quality species for export, focusing on using technological advances in species selection, seed production and culture techniques appropriate for specific ecosystems and market demands.
- To reinforce infrastructure conditions, modernize and industrialize the practice of aquaculture on sandy soil.
- From the failed lessons in earthen pond aquaculture, it is recommended that to ensure sustainability, and limit spontaneous development of the practice, planning has to be done on the basis of clear identification of potential/capacity and demarcation of seed production and culture areas, protection of forest areas, tourism areas, etc.
- There should be certain allocations from the state budget to innovate infrastructure circumstances including upper-basin pumping stations, canal system, main transportation and basic power supply networks. Research actions should be backed firmly, especially in the realm of culture models, import of exotic species, transfer of advanced technologies to make positive abrupt changes in aquaculture in general, and aquaculture on sandy soil in particular.
- Due to natural conditions, the southern provinces of Binh Thuan and Ninh Thuan are characterized by a very low average rainfall. In fact, they have some of the lowest levels in the country (>700mm). Therefore, it is possible in these provinces to culture an additional third crop of shrimp (September–December). Since 1992–1993 it has been possible to grow three crops of shrimp a year in these provinces. In practice, only a few households have conducted the third crop. For instance, Mr. Nguyen Thanh conducted the third crop and produced three tonnes/ha. However this is only half what he produced on average during the other two crops. In turn, provinces that experience higher rainfall levels than Binh Thuan and Ninh Thuan should reject culturing this third crop.

As a personal opinion, it might be wise to leave out the third crop as the land and water system needs time for refreshing.

2.4.2 Planning orientations

Although the career has not yet matured since its recent birth, lots of opportunities are now in our reach. Numerous lessons and experiences were learned from earthen pond aquaculture, and the Aquaculture Development Program for the period of 2000–2010 (Program 224) was endorsed by the government in December 1999. Policies on land use and credit loans in aquaculture, and detailed circulars by the Ministry of Fisheries on guidance of various aquaculture practices, have been issued. Since then, the success of many demonstration sites has been observed. Moreover, the central region is the centre for artificial breeding of tiger shrimp larvae, so development trends of those provinces should consider the following:

General orientations

- Make use of unreclaimed sandy land area with appropriate ratio (30–40 per cent), or unproductive land for aquaculture practices in all environments of marine, brackish and freshwater. Ensure ecological balance and a stable environment by applying polyculture instead of monoculture, making seeds available in a timely fashion, cultivating demand-based species, using effective feeds and improving pond environment.
- Step by step, limit the use of groundwater (since this is the inhabitants' vital source) for aquaculture, but utilize surface water from rivers/reservoirs as a replacement.
- Central and local authorities should arrange financial and infrastructure/logistic preparations to support aquaculture practice on sandy soil.

Specific orientations

- Urgently develop a master plan (until 2010) for aquaculture development for the whole central coastline, identifying suitably cultivable species.
- Set up demonstration sites in different ecological areas of marine, brackish and freshwater environments. Develop appropriate techniques and disseminate them to farmers/fishermen though training courses.
- Invest in infrastructure innovation: Construction of irrigation, transportation and power networks, and reforestation to protect culture sites from sand and winds.
- Train technicians to be qualified enough for management of seeds, feeds, water and environment. Procure equipment/facilities needed for the above-mentioned fields of tasks.
- By 2005: An increase in the cultivation area of about 30 per cent of the potential area.
- By 2010: Full utilization of the potential area (15,000 ha) for aquaculture farming.

2.5 Conclusion and recommendations

2.5.1 Conclusion

The practice of aquaculture on sandy soil has its own advantages and opportunities for development. Undergoing a good start, it has brought about promising socio-economic efficiency. However, certain problems regarding environment, techniques, ecological environment security, etc., have arisen and require resolving. However, the consistency of authorities, and the enthusiasm, creativity and confidence of the people in project areas are factors that will help the practice proceed steadily and produce much more output for export. People's living standards improved remarkably, the socio-economy grew quickly, and livelihood alternatives diversified positively—all signs of progress in the poverty reduction cause.

2.5.2 Recommendations

- Aquaculture on sandy soil has great potential, but at the same time it contains several risks and faces some challenges. This fact requires due consideration and serious research by local governments and the fisheries sector, as well as central agencies such as the Ministry of Planning and Investment, the Ministry of Finance, the Ministry of Agriculture and Rural Development, the Ministry of Science, Technology and Environment, the banks, and the Administration of Tourism, etc.
- Sand/wind protection forests must be maintained and conserved better, and not exploited for aquaculture. Appropriate logging should be calculated carefully by scientific studies if trees are harvested for other purposes.
- Planning exercises have to be done first on the basis of clear identification of potential/capacity and demarcation of seed production and culture areas, protection of forest areas, tourism areas, etc. (Ideally, investment projects for two deadlines of 2005 and 2010 should be set forth by the institute according to an assignment mechanism.)

- Local agencies should appraise potential and cultivable areas as soon as possible, and accordingly issue detailed plans for production sub-regions and suitable culture species. If the job is delayed, there will be risks of dangerous losses due to spontaneous expansion, as already observed in the development of earthen pond aquaculture.

2.5.3 Policies and mechanisms

- There should be certain allocations from the state budget to innovate infrastructure circumstances, including upper-basin pumping stations, canal system, main transportation and basic power supply networks.
- There should be government investment in development of technologies for species selection, seed management, culture techniques for particular ecosystems, wastewater processing, prevention of groundwater destruction, etc.
- There should be treatment policies for the poor and job-changing farmers. Before adopting new livelihood alternatives, farmers are normally not ready in terms of facilities, technical skills and finance. As most farmers living on the beach are poor or short of investment capital, zero-interest loans of VND 30–50 million (US$ 1,935–3,225) each should be provided to them in three–five years.

3 REPORT ON STATUS APPRAISAL AND DEVELOPMENT TREND OF TIGER SHRIMP CULTURE ON SANDY SOIL

By

Mr. Tran Van Quynh, Director
Department of Fisheries Extension, MoFI

3.1 Status and development perspective

In line with Resolution No. 09/2000/NQ-CP issued by the government on June 15, 2000, promulgating directions and policies on the transformation of economic components and agro-product consumption and the approval of turning unreclaimed land to aquaculture purposes, several localities have planned schemes to bring unproductive rice fields and unreclaimed land, including sandy soil regions, into aquaculture activities, especially for shrimp culture.

Along the coast of the central part is a land-belt hundreds of meters wide. This land has potential for aquaculture development, which will lead to various advantages like bringing unreclaimed sandy areas into full play, poverty reduction, job opportunity creation, income generation, reduction of pressure on in-shore fishing and contributions to national defence. As a result, development of shrimp culture on sandy soil is a priority option for investment, as specified in Communist Party resolutions of many provinces.

Additionally, shrimp culture on sandy soil is a motivation for development in other fields and technologies, such as production of liquid insulating material, production of seed, processing of export products and services for tourism, especially for ecological tourism, etc.

In the year 2001, provincial reports showed that the total area of transformed land was 220,818 ha, of which *terra incognito* and sandy land made up 4,535 ha. Several localities in intensive progress include Ninh Thuan (120 ha), Quang Ngai (50 ha), Thua Thien Hue (16.2 ha), Kien Giang (7 ha) and Binh Dinh (2.42 ha).

Culture of tiger shrimp on sandy soil in both intensive and semi-intensive modes, under limited water exchange mechanisms, is progressing vigorously in Ninh Thuan, Binh Dinh, Quang Ngai, Quang Binh, Quang Tri and Kien Giang. In 2001 productivity ranged from 1.7 to 5.5 tonnes/ha, and 8 to 10 tonnes/ha were reported in some cases. Production in Ninh Thuan was 500 tonnes.

According to local statistics, the coastal sandy land is enormous. 39,000 ha in Quang Binh, 14,000 ha in Phu Yen, 13,000 ha in Quang Tri, 10,000 ha in Quang Ngai, 5,000 ha in Binh Dinh, 1,500 ha in Ninh Thuan, 1,300 ha in Ha Tinh and 1,300 ha in Thua Thien Hue.

Ninh Thuan is among the most dynamic provinces in shrimp culture development. Since the very beginning, with only one shrimp pond of 5,000 m^2, for which the method of water retention was to cover the bottom and dikes with nylon sheets, the shrimp area has increased up to five ha in 2000. Stocking density was 15–20 shrimp/m^2, with two crops per year, and productivity of 2–3 tonnes/ha/crop. By the end of 2001, the shrimp culture sandy area in the province was 120 ha (increased by 24 times compared with 2000) and accounted for 10.43 per cent of the total shrimp culture in the province per season. Average productivity per hectare raised up to 4.16 tonnes/crop, and maximum yield was seven–eight tonnes/ha/crop.

Following up on the past achievements, in 2001 the Provincial People's Committee of Ninh Thuan ratified a proposed project for investment in shrimp culture on sandy area of Son Hai (303 ha) and An Hai (648 ha) under the aquaculture-forestry combination practice.

Table 2 Shrimp culture production on sandy soil in Ninh Thuan (1999–2001)

Year	Area (ha)	Total production per crop (tonnes)	Productivity (tonnes/ha/crop)	Profit (million VND/ha)
1999	0.5	1	2	50
2000	5	15	3	100
2001	120	500	4.16	80

In 2001, after a study tour to neighbouring provinces, Binh Dinh started the activity in 10 ponds of 2.42 ha in total. At the end of the crop, production ranging from 1.7 to 5.5 tonnes/ha/crop in nine ponds was reported. Due to the MBV disease, the other ponds had to be drained out completely. Even though this is the first year for shrimp culture on sandy land, and high FCRs were encountered, through their promising results the trials affirmed the appropriateness of the methods to the people's investment and management capacity. A total of 300 ha have been taken into the master plan after a careful survey by the provincial agency for fisheries and aquaculture management.

After the study tours, Thua Thien Hue developed the career on an area of 16.2 ha in 2001. This first experiment was faced with many difficulties, among them problems of technique, liquid insulating materials and diseases. Average productivity, therefore, was 2 tonnes/ha/crop (4.5 tonnes/ha/crop maximum), while total production was 30 tonnes. The targeted area to be utilized in the year 2002 was 45.2 ha.

3.2 Evaluation of the techniques applied and results

In order to introduce the methods and enlarge the culture area, since 2001 the National Fisheries Extension Centre, in collaboration with local governments, has promoted the establishment of shrimp culture demonstrations in Ninh Thuan and Thua Thien Hue. It then expanded outwards to Quang Binh, Quang Tri, Thua Thien - Hue, Quang Nam, Quang Ngai and Ninh Thuan in 2002.

By applying the pond excavation on sandy land, polythene cover sheets to prevent water leakage from the bottom, and dikes for intensive tiger shrimp culture, the method of limiting water exchange differs from ordinary ponds in the following details:

3.2.1 Pond construction

- Ponds should be designed and built above the tide-mark to prevent erosion caused by waves and winds. The pond includes a nursery pond and filtering one. The pond should be 0.4–0.5 ha large, and 1.2–1.5 m deep. Water leakage could be prevented by covering the dikes and the bottom with nylon sheets stuck together with glue at connection margins. A 30–50 cm thick sand-layer is required afterwards. For better protection of nylon covers and avoidance of erosion, people normally place a two-layer tarpaulin sheet on the top of dikes (even on the bottom in some localities). HDPE can be used instead of the above material.
- The filtering pond acts as a filter for suspending substances and provides clean water into the nursery pond under stable conditions of pH, dissolved oxygen, and transparency. It is generally as large as 1/3 the nursery pond area, but excavated deeper to enlarge the volume.
- Drainage system consists of 90–200 mm diameter PVC tubes, heading to the gas compartment adjacent to the pond, whereas the supply system is made up of the filtering pond saline water well, 10–15 CV pumps, and PVC tubes 60–90 mm in diameter. In addition, one–three drilled wells are required to provide freshwater for each pond. Designs of culture ponds also usually describe aeration systems, office buildings, power installations and other devices/tools needed.

3.2.2 Pond preparation

- After construction, fill the nursery pond, flatten the bottom, and then drain all water out. Before flowing into the nursery pond, the saline water in the filtering pond is treated well with dolomite, $KMnO_4$ solution, saponin, etc. Salinity at 27–30 ‰ is the most suitable.

- Bottom of dried pond is then limed all over, at 7–10 kg/100 m^2 or more if pH is high, then exposed to the sun for 7–10 days.
- Let the water from the filtering pond in at a depth level of 0.8–1 m, then treat again with pollutant removing chemicals or 20 ppm concentration saponin solution. Wait for two–three days, add water until the level reaches 1.2–1.5 m depth then fertilize the pond two or three times a day at the rate of urea 0.5 kg + DAP 2.5 kg/ 1000 m^2 each time. Five–seven days after the fertilization, when the water colour is bright green and transparency is around 30–40 cm, farmers can begin stocking.

3.2.3 Shrimp seeds and stocking density

- Most of the shrimp seeds in Vietnam are produced in central provinces and sold at the size of P15–P22.
- In several provinces, P15–P22 fingerlings are nursed in ponds or tanks up to two–three cm in length (P45) before grow-out. A stocking of big size seeds brings in high survival rates and protects the shrimp from temperature changes.
- Stocking density is dependent on stocking size, management skills, practices and investment capital.
- In intensive mode (for four–five tonnes/ha), stocking density per metre is 15–25 shrimp of two–three cm length, or 20–35 P15s.
- In semi-intensive mode (for two–four tonnes/ha), stocking density per meter is 8–15 shrimp of two–three cm length, or 12–20 P15s.

3.2.4 Water control and care-taking

Water control

- Water control plays a significant role in ensuring parameters for a quality environment.
- In the closed circulation of the culture system, water trespasses the filtering pond and, after being treated there with chemicals such as BRF2-Aquakit, Aquabac, Bacillus 1070, etc., flows into the nursery ponds. Once the nursery pond water becomes dirty, it is returned to the filtering ponds for repeated treatment or draining. The drained volume will be compensated from the sea or a freshwater drilled well, but will not equal more than 20 per cent of the total volume in the nursery pond.
- Water depth should be from 1.2 to 1.5 m to maintain temperature range and environment, make room for shrimp's activities and limit the development of benthos plants.

Care-taking and management

- Keep track of daily water quality through eye observation of water colour, transparency and identification of pH, DO, salinity, etc.
- On a frequent basis, apply dolomite, $CaCO_3$ (two–five times weekly, 15–20 kg/100 m^2 each) to improve the water environment, adjust pH, and stabilize bottom circumstances. In the last months, dim-ethyl or zyolite can be used to ensure the availability of bottom nutrients. Use chemicals and biotechnological products to maintain water colour and the environmental conditions, and to foster the growth of effective micro-organisms.
- Increase DO amount via aeration system or water propellers. The water propellers also help form a current, which gathers waste substances to the centre for easy removal. Each propeller set contains four wheels, and each pond two–four sets along the dikes. Running time depends on the climate and shrimp action, but usually is from 3.00–5.00 to 7.00–8.00 AM, and during most of the day time on gloomy or non-windy days.
- Keep track of shrimp actions.
- Check dikes, monks and sluices everyday to identify leakage problems.

- Check the growth rate of shrimp by devising suitable measures.
- Bottom management: Treat the bottom with micro-organism enzymes, like zeolite. Regularly siphon the bottom mud out of the pond.
- Casual death of algae often makes sandy ponds short of nutrients, therefore application of manure/fertilizers is strongly recommended.

3.2.5 Disease problems and solutions

- Shrimp culture in high density demands a good environment and quality and sufficient food. Lack of good management methods will definitely lead to the contamination of the pond water and bottom, especially from the second and third months, thus enabling the fast growth of bacteria, viruses and other pathogens. Natural factors, including sunny and hot weather and heavy rains for long duration, are common reasons for shrimp shock and also decrease their disease resistance.
- Henceforth, prevention measures through responsible management and the use of chemicals and biotechnological products to stabilize the environment, strengthen disease-resistant capacity, etc., play a certain role in increasing culture production and productivity.

Technical notes

- To avoid sand storms and maintain groundwater level, forests should surround the shrimp pond. Water used should be circulated within the system to protect the environment from pollutants and to reduce investment costs.
- The covers should be kept away from direct sunlight during the construction work. Water should be drained quickly when necessary.
- Since sandy ponds usually absorb lots of solar radiation energy, water depth should be 1.2–1.3 meters.
- To supplement nutrients for the pond, the bottom must be fertilized with composted animal manure (from chicken, goat, cattle, etc.), mixed with 20 kg of phosphate and 60 kg of lime per ton. To control the phenomenon of algae accidental death in the first two months, the following fertilizers are recommended:
    - Inorganic fertilizer: Urea 0.5 kg + NPK 1.5 kg per 1000 m^2, applied at 9.00–10.00 PM.
    - Chicken manure: 8–10 kg/1000 m^2.
    - Biological leave fertilizer: There is a variety of this fertilizer, producers' usage directions are shown on packs.
    - Environment parameters change continuously, especially among temperature, oxygen, salinity, transparency, etc., and should be checked daily for timely resolutions.
    - Freshwater is generally supplied through drilling wells of 5–40 m depth. Before filling, ion tests of heavy metals (Cu, Zn, Fe, etc.) and toxic gases (H_2S, NH_3, SO_2, CH_4, etc.) should be carried out for treatment in the filtering pond.

Necessary facilities

- Fresh and saline water irrigation systems.
- Processing system for discharged water.
- Transport systems.
- Shrimp culture systems.
- Protective forests surrounding the shrimp ponds.
- Integrated ecosystems.

Disease problems

Thanks to the application of new techniques, careful advice of technical staff and clean water sources, there are only a few cases of poor-management-led diseases, including yellow gill, black gill, slow growth, etc. Symptoms of serious epidemics of red body, white spot, yellow head, etc. have not been reported. However, once the culture of tiger shrimp reaches its intensive peak, the above dangerous problems may arise.

Productivity and efficiency

In the north, shrimp culture activities are not yet in full swing despite their enormous potential. The development of the career in the central provinces like Ninh Thuan, Binh Dinh, Quang Binh, etc. started bringing about efficiency in economic life and a transformation for the coastal disadvantaged people. However, the system is not applied uniformly for every region, and no waste processing mechanism has been developed.

The results in 2001 were promising for the central provinces:

- In Thua Thien Hue, shrimp culture area was 16.2 ha, productivity two tonnes/ha/crop (4.5 tonnes/ha at maximum); total production was 30 tonnes.
- In Quang Ngai, productivity was 3 tonnes/ha.
- In Ninh Thuan, productivity was 4.16 tonnes/ha on a total of 120 ha area; profit was VND 80 million/ha (US$ 5,161/ha).
- In Binh Dinh, there were 10 ponds totalling 2.42 ha, yields 1.7 to 5.5 tonnes/ha. High FCR caused by clumsy food management led to losses for certain households. However, in some ponds VND 40 million (US$ 2,580) was generated from one crop.

The results indicated that if techniques are applied properly, and shrimp are fed adequately and correctly, the practice may result in a 36–48 per cent expense rate and a 52–64 per cent profit rate. Average profit will be VND 30–50 million/ha/crop (US$ 2,580/ha/crop). Mr. Nguyen Van Manh in Vinh Tuong village, Phuoc Dinh commune, Ninh Phuoc district, earned VND 102,200,000 (US$ 6,593) from 0.8 ha after a four-month culture (productivity 3.9 tonnes/ha), corresponding to a profit rate of 64 per cent.

3.3 Advantages and disadvantages in the development of shrimp culture on sandy soil

3.3.1 Advantages

- The culture practice is appropriate to an industrial mode circulating cycle, bringing about a good yield. During the culture process, the outbreak of pathogens is limited and clean water sources help prevent the onset of diseases normally occurring in culture environments.
- While building the pond system, it is economical to cover the bottom and dikes with nylon and tarpaulin to reduce costs, remove acidity and facilitate the drainage.
- On unproductive soil or unreclaimed land, the practice helps to fully utilize the land potential, increase and diversify the number of job opportunities, lower the pressure on in-shore fishing, improve living standards, and upgrade the ecological landscape of the coastal areas. The practice adapts to the state and sector's directives, and assists local authorities in making plans for infrastructure innovation from the beginning.
- Compared to conventional aquaculture on soil, sandy land cultivation has the advantage of a clean environment and increased productivity on a yearly basis. For farmed species like shrimp, fish, shellfish, etc. it is possible to repeat the production cycle twice and, in some provinces, even three times within a year, thereby increasing productivity. Moreover, clean products are generated regardless of rain, floods, storms or gusty winds, which results in pro rata economic efficiency. For

instance, the current average yield of shrimp is five tonnes/ha (for all two–three crops a year). In some cases, 8–10 tonnes/ha have been reported.

- Shrimp culture on sandy land generates income two–four times higher than that from brackish or marine environments; and a one-and-a-half–two-time increase in productivity.
- Producing on sandy land is associated with lower risks compared to wet land or sea production.
- Products are clean enough for foreign market demands.

3.3.2 Disadvantages

- Lack of fresh and groundwater makes the system unsuitable for large-scale aquaculture. Therefore, state investment in culture infrastructure, irrigation canals, and waste processing techniques is needed for sustainable development.
- There has been little consideration given to the planning of culture areas. The practice is applied spontaneously, almost without waste processing methods.
- Gusty wind storms and the moving of sand dunes activated by seasonal monsoons are major obstacles to transportation and culture systems.
- Poor transportation, power supply difficulties and farmers' low income.
- Poorly nutritious benthos organisms make the bottom manuring ineffective for the first period. Biotechnological products and fertilizers, hence, are required for development of algae and active micro-organisms in the culture environment.
- A large capital amount is needed for both pond construction and care-taking production, while the fishermen and coastal farmers are normally poor.

3.4 Recommendations

- Intensive and semi-intensive methods under limited water exchange are appropriate for the purpose of increasing production and productivity in combination with environment conservation.
- A master plan and specific plans have to be developed for provinces and the country as a whole, in which cultivable species, technologies, investment solutions and research directions must be identified for particular periods.
- Local concerned agencies should incorporate experience with methodological studies to complete step by step technical packages suitable for the conditions of infrastructure, ecology, investment capacity and expertise.
- Modern technologies for waste processing, disease diagnosis and treatment, post-harvest product maintenance, etc. should be developed. Lower-cost methods for bottom covers should be made available.
- To protect the culture system, aquaculture should be combined with reforestation of coastal prevention woods to block winds and prevent sand from moving in. Planning of the culture areas should include improvement of transportation, irrigation and power status to standardize cultures, filtering, waste processing ponds and supply/drainage channels.
- To reinforce the quarantine of shrimp seeds from hatcheries, and ensure timely availability of seeds when the crop comes.
- Extension officers should act as technical advance disseminators and also as marketing agents to facilitate farmers' access to manufacturers and exporters, and to limit the disadvantageous settlement of price with middle men during the harvest.
- Ministry of Fisheries should compile and submit draft policies on taxation, land contractual terms and low-interest lending, to create favourable conditions for farmers to take up the practice.

- There should be close cooperation among extension and research institutions, organizations and individuals inside and outside the country, and vocational societies, etc. to fine-tune technologies and quickly impart them to shrimp farmers.

3.4.1 Recommendations to the government

- The government should set up directions for the agricultural and aquacultural sectors by facilitating a master plan for the development of aquaculture on sandy land, and to insure policies/regulations on land use, finance and technology.
- To financially support infrastructure developments in intensive aquaculture regions.
- To provide financial assistance to set up "pilot" culture models, organize training and facilitate communications.

4 STATUS OF ON-SAND TIGER SHRIMP CULTURE IN THE CENTRAL PROVINCES AND SUSTAINABLE MANAGEMENT OF THE ENVIRONMENT

By

Ms. Nguyen Thi Phuong Lan, senior expert
Department of Science and Technology, MoFI

4.1 Introduction

The fisheries sector is considered a spearhead economic sector in Vietnam with the vital role of aquaculture. In 2001, total fisheries export revenue was US$ 1.7 billion. Aquaculture products alone accounted for 50 per cent. Aquaculture development is limited compared with marine fisheries. The Vietnamese state has issued comprehensive investment policies regarding aquaculture based on production status, via the following documents:

- Decision 224/1999/QD-TTg dated 8/12/1999 regarding orientation of aquaculture development for the period of 1999–2010. Within the direction's principles, it states that "To develop sustainable aquaculture in relation to protection of eco-environment, ensuring production and stabilizing people's livelihoods. To strongly focus on brackish and marine aquaculture in line with freshwater aquaculture development";
- Resolution No. 03/2000/NQ-CP dated 15/6/2000 regarding structural transition in which aquaculture is identified as an investment priority, in particular the cultivation of shrimp.
- Directive No. 36 CT/TW dated 25/6/1998 issued by the Politburo Unit regarding the strengthening of environmental protection in the period of industrialization and modernization. This document also refers to over-fishing leading to depletion and groundwater contamination.

The fisheries sector has to draft policy on marine and coastal aquaculture development that should be submitted to the Prime Minister for approval and issuance.

In a bid to meet the increasing demand of domestic markets and exports regarding both quantity and quality, the Ministry of Fisheries has to develop the diversity of watershed fish species, modalities and culture methods, as well as strictly monitor the management of food hygiene and safety, post-harvest preservation and final products.

The development of on-sand shrimp culture has contributed to the diversity of culture methods, paving the new way for aquaculture of poor provinces, which possess land richness, especially in the central provinces. However, in order to invest in development of this new method, sustainable development should be given thorough consideration.

No matter where aquaculture is practised, the waste that is produced is the same. In marine aquaculture, the appropriate planning of a cultivation site involves site layouts and cage settings. If contamination occurs in marine cultures, the spreading of infectious diseases cannot be stopped, but will eventually be minimized naturally by aquatic organisms and the impact of marine aquaculture on the environment will be reduced.

On-sand shrimp culture is faced with limitations. The poor treatment of waste from culture ponds can cause the spread of disease and economic losses. The amount and on-site existence of groundwater should also be taken into consideration. However, on-sand shrimp culture has significant importance to the contribution of hunger reduction, where the average income of local people is below the standard. The control and management of the environment at the culture sites can be influenced by humans, and is therefore important. If the awareness and education is improved and the planning is given due attention,

on-sand shrimp culture is expected to bring high profits along with a sustainable environmental protection.

On-land shrimp culture has operated in several regional countries, namely Malaysia, Indonesia and China. Some Chinese units have developed concrete ponds for on-land shrimp culture. The pond is designed with the sand bottom covering an area of one ha for culturing white-leg shrimp (new species). The productivity reaches eight tonnes/ha.

4.2 Status of on-sand tiger shrimp culture in the central provinces of Vietnam

4.2.1 Production

On-land tiger shrimp culture has developed since 1998 when it was practised by one household. Up to now, the model has been adopted by provinces such as Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue, Phu Yen, Khanh Hoa, Quang Ngai and Binh Thuan.

In determining the path for this model, the Ministry of Fisheries, in co ordination with IUCN, has held fieldtrips to the five central provinces of Quang Binh, Quang Tri, Thua Thien Hue, Quang Ngai and Ninh Thuan. The situation here shows that these provinces have common characteristics regarding narrow tidal and slope areas and that they are beach areas. There are a number of burned sand dunes in which trees cannot survive. Locals call this area a "desert." In beach areas, people's livelihood depends on small-scale fishing, planting and small and low-productivity agriculture. The livelihood is hard and a number of the localities are among the poorest communes in Vietnam.

In the five surveyed provinces alone, there are thousands of sandy hectares of which, 15,000 ha have the potential for shrimp culture. The area presently being used is nearly 300 ha (Table 3). Shrimp ponds are designed in square or rectangle form covering the areas of 2,000–5,000 m^3. Ponds retain water by waterproof materials. Some ponds are constructed by concrete with a sandy base. Due to different investments, in which some spend VND 300–500 million/ha (US$ 19,354/ha) and others only VND 28 million/ha (US$ 1,806/ha), and different feeding (due to awareness and money of producers), the productivity and price of shrimp is different. Some units produce five–six tonnes/ha earning hundreds of VND millions/ha. Some other units only earn tens of millions, while other units have no gain.

Table 3 On-land shrimp culture conducted in five surveyed provinces, 2002

No	Provinces	Potential area (ha)	Cultured area (ha)	Productivity (tonnes/ha/crop)
1	Quang Binh	4,500	14	0.8–1.2 (old areas)
2	Quang Tri	4,000	6	2–3
3	Thua Thien-Hue	<600	16.2	2–4
4	Quang Ngai	4,000	40	2.9–3.3
5	Ninh Thuan	1,500	200	3–6

In the five surveyed provinces, on-sand shrimp culture has been strongly developed, especially in Ninh Thuan and Quang Ngai provinces. In such provinces, several households possess from 20 to 30 completed pond constructions (with water intake and outlet system). Ninh Thuan province alone is establishing an investment project of 700 ha of on-land shrimp culture development in combination with afforestation (400 ha for shrimp culture and 300 ha for afforestation).

On-land shrimp culture in the central provinces has been widely developed. In general, it has been conducted in scattered areas in a small-scale and unplanned manner, so that the farmers are coping with difficulties in infrastructure, and especially with the water supply system. Production facilities are simple in some units. Farmers' lack of knowledge and experience leads to productivity limitations.

Some provinces have piloted on-sand shrimp culture experiments through the costs allocated by fisheries extension services or scientific funds. In Ninh Thuan province, the provincial Fisheries Department and Department of Science, Technology and Environment jointly piloted the model of an advanced

technology transfer of on-sand shrimp culture within an area of 10 ha, by combining the shrimp culture with afforestation aimed at securing a sustainable environment. For example, the benefits of planting Casuarine trees in the coastal areas is that the living environment is protected and strong winds are prevented from blowing sand into inland areas. Casuarine trees are also used for timber and firewood.

4.2.2 On-sand tiger shrimp culture technology process

Presently, on-sand tiger shrimp culture shows unstable productivity. Some gain five–six tonnes/ha/crop; others only gain one or two tonnes/ha/crop due to difference in farmers' expertise and experiences, land quality and investment.

The on-sand tiger shrimp culture process is the same as pond shrimp culture in tidal areas, and includes the following considerations:

- Pond site selection: far from contaminated areas resulting from industrial, agricultural and residential activities.
- Settlement ponds have appropriate position and areas.
- Treatment of water in settlement ponds (cleaning and salty adjustment as required).
- Drainage system is located and regulated so as to limit the spread of disease.
- Cleaning, upgrading pond base before releasing shrimp fry (pH level adjustment).
- Fertilizer usage, remove trash fish before releasing shrimp fry.
- Density and time of releasing fry should be considered.
- Feeding methods (aerating, water revolving, feed time, environmental elements, health, medicine).
- Time for releasing shrimp and time for harvest.
- Harvest methods and preservation.

However, due to water-retaining characteristics from using waterproof materials, on-sand shrimp culture is to some extent different from land-based ponds as follows:

- By retaining the water by using waterproof materials like PE nylon, tarpaulin or high quality and expensive HDPE pellicle imported from Malaysia, the water level will reach the top of the pond-bank and since the sandy bank and waterproof material absorb thermal energy fluctuations in the water temperature will occur. Fluctuations in the temperature cause the shrimp to lose their appetite as well as the sudden death of algae.
- Pond base is covered by sand with 30–50 cm. Some units do not use sand base so that the water colour is different than it is in land-based ponds.
- It is easy to treat the pond base before releasing shrimp, minimizing the water contamination due to dissolution of waste.
- It is easier to harvest shrimp on sand compared to on land (pond bank does not have cave or hole).

4.3 Environmental issues of on-sand shrimp culture

4.3.1 On-sand shrimp culture bears environmental interests because:

- On-sand shrimp culture is different from land-based shrimp culture, as water is not absorbed by the surrounding land. This type of culture actually contributes to land erosion protection, which improves the solidity of coastal areas.

- To develop on-sand shrimp culture is to exploit and to reclaim the deserted areas into useful areas. Shrimp ponds increase the air humidity. The planting of trees, the development of forestry in combination with the shrimp model will improve livelihoods and national defence protection.
- Within the technical issue:
    - On-sand shrimp culture makes it easy to reclaim the pond base (drain the water, remove organic sludge left on the pond base, sun dry the sandy base and treat pH level with powdered lime).
    - Cleaning the pond during the culturing (by siphoning the base, minimizing disease spread).
    - Restricting the use of medicine and antibiotic in the culture period in order to promote the hygiene and safety of harvested products.
    - Socio-economic significance: On-sand shrimp culture will take full use of deserted lands, create jobs, increase income, reduce the pressure on inshore fishing and bolster the development of waterproof material production, which contributes to poverty reduction and the boosting of socio-economic development in the region.

4.3.2 Challenges to the environment from on-sand shrimp culture

For any cultured species, it is important to realize the sustainable management of the environment as the basis of production orientation. With on-sand shrimp culture alone, the environmental issues that should be taken into consideration are:

Use of groundwater for shrimp culture

The freshwater used for one ha of pond should be based on:

- Water level in the pond before releasing the fry is 0.8 to 1.0 m. This increases gradually and ensures the water level of above 1.4 to 1.5.
- Salt concentration for each development period of commercial shrimp culture is different: the first month: 25–30 ‰, the second month: 18–25 ‰, the third month: 15–18 ‰, the fourth month: 20–30 ‰. This will be used as basis for salt adjustment and calculating the appropriate freshwater volume for the pond.
- General estimation of freshwater for pond (water level depth is on average 1.4m)
    - Water for pond: 10,000 m^2 x 1.4 = 14,000 m^3
    - Water supplemented (every two weeks supplement 20 per cent water – 16 weeks) (14,000 m^3 x 20 per cent) x 8 = 22,400 m^3
    - Change water as any incidence happens: 50 per cent of water supplied (14,000 m^3 + 22,400 m^3) x 50 per cent = 18,200 m^3
    - Total water volume for one ha for one crop is: (14,000 m^3 + 22,400 m^3 + 18,200 m^3) = 54,600 m^3
    - Of which: 30–50 per cent freshwater: from 16,380 to 27,300 m^3
    - Fresh water used in two crops per year: from 32,460 to 54,600 m^3

If the groundwater in the well is overused, the collapse or intrusion of salt will occur inland. Groundwater is an utmost important element, and needs to be considered when expanding areas of shrimp culture on sand.

Water discharge from shrimp ponds

Presently, on-sand shrimp culture is conducted in an unplanned manner. People lack capital for infrastructure development, especially in terms of water supply and drainage systems and farmers lack culture experience regarding environmental management in aquaculture. Therefore the water discharge from shrimp ponds has been spontaneous. Some units have discharged wastewater directly into the sea, which is near the water supply source and the pond. Other units have discharged wastewater from the ponds onto the surrounding land. This contributes to the contamination of groundwater.

If shrimp ponds are infected, the wastewater discharged from these ponds, if left untreated, will spread the disease to surrounding ponds and water supply systems. The damage is unpredictable, but could result in high economic losses, especially in high pond-density areas.

After being drained, soil ponds are traditionally cleaned by spraying lime powder on the bottom and then letting it dry for five–seven days. Removing the sludge will clean ponds that hold a thick layer of sludge, but this method is not advisable, since the sludge contains acid that can flow back into the pond during heavy rains.

Formulated regulations on the management of concentrated shrimp culture sites, decided upon by MoFI, require that settlement ponds be separated from the culture ponds. MoFI is presently also researching the treatment of sludge in shrimp culture ponds, and suggests that sludge be used as a fertilizer for salt-resistant trees. (The research will be completed in 2003, and the outcome will be recommended as the best practice.)

Antibiotics currently used in shrimp culture

The Prime Minister has issued Directive No. 07/2002/CT-TTg, dated 25/2/2002, concerning the management and use of antibiotics and chemicals in the production of animal feed in order to ensure hygiene, safe feed and the well being of consumers, as well as to meet the requirements of export trade. At the same time, the Minister of Fisheries has issued Decision No. 01/2002/QD-BTS, dated 22/1/2002, prohibiting the use of some antibiotics and chemicals in the production of fish and fisheries products.

The use of industrialized products for cleaning the cultivation ponds after harvest is a necessity. However, during the cultivation period antibiotics are only used when diseases are detected, and overall, shrimp farmers are allowed to use any kind of drugs that are not on the prohibited list issued by MoFI.

The drugs and chemicals used in shrimp farming include: $CaCO_3$, CaO, Dolomite, $Ca(OCL)_2$, Chlorine, Benzalkonium Chloride (BKC), bio-products like FASC, BRF-2-PP99, BIO Wast, MAZAL (MZ-1), other herbal chemicals like Retanon, Derris pp, Sapindus mukorossi Gaertn, Milletia ichthyochtona Drake and antibiotics like Aureomycin, Erythrocin and Published by Vitamin C.

Presently, most of the shrimp farmers are aware of the negative impacts caused by the use of antibiotics and chemicals. As a consequence, they are following the recommended technical proceedings regarding the site layout and the treatment of the pond's bottom after harvest (by letting them dry out). Furthermore, the farmers, when possible, only use bio-products as a means of disease control, thereby protecting the environment.

Antibiotics are only effective against bacterial infections, so for small-sized shrimp the only effective method of treatment is to drain the pond and destroy the shrimp (if the infection rate exceeds the allowable limit of about 5–10 per cent).

Risk with the on-sand shrimp culture

Presently, people in some places actively pour capital into pond development on sand. If ponds are strongly developed without a master plan or the necessary knowledge, the following risks are expected to exist:

- Protective forests will be narrowed, having direct impact on peoples' livelihoods (sand storm).
- Overexploitation of groundwater will lead to the collapse of strata (layers), increasing the salt intrusion that affects the development of agricultural crops.
- Wastewater from the ponds is unregulated and discharged into the surrounding environment, causing contamination and the spread of disease.
- Some units establish unregulated ponds.

- Some beach areas have complicated geography, and the installation of a water supply system is difficult. This leads to unused constructions or a usage period that is too short given the investment cost.

Measures for mitigating environmental issues and improving productivity

- Careful planning is of utmost importance as a basis for the establishment of investment projects on shrimp culture.
- Provinces should gradually pilot the management models on behalf of communities for effective and sustainable exploitation of sandy areas.
- Shrimp culture development should be given priority in "desert" areas in order to develop economics and environmental improvements (increase the air humidity and afforestation).
- EIA (environmental impact assessment) is needed (with assessment of groundwater volume) as a basis for expanding the areas and zoning the culturing areas with appropriate species.
- For concentrated tiger shrimp culture development (several ha and more), the pre-requisite is to have freshwater supplied from reservoirs, lakes, rivers or springs.
- If there is only an groundwater source in the area, the project should include a plan to zone the production areas with appropriate species. Some parts are dedicated to shrimp culture (balanced with groundwater volume), the remaining parts are used for other species culture (marine fish, mollusc).
- Within storm-hit areas, the position of ponds and water supply systems should be taken into careful account and protective measures should be applied (Casuarina tree planting).
    - Coastal areas are often suffering under the influence of strong winds, which carry a lot of sand with them. If shrimp culture ponds are set up in these areas without any mitigation measures, the ponds risk being filled with sand, thereby resulting in production problems. When selecting sandy areas for aquaculture, it is therefore important that the shrimp culture ponds are placed in the high tidal areas and that afforestation is included as part of the development process.
- Within technique:
    - The pond-depth should be at least 1.5–1.6 m, ensuring the durability of the pond structure.
    - The base of the pond should be covered with 50 cm of sand.
    - Water should not be changed too often to prevent disease spread (water is often added before any incidence).
    - Elements such as a clean pond base, good quality water, and shrimp fry size of (PL 15) should be ensured (the immediate period of two–three cm should be avoided).
    - Fry density (size PL 15) should be 30–40 shrimps/m^2 (40 individuals at maximum).

In brief, for high productivity, the farmers should strictly and properly follow the technical guidance issued by the Ministry of Fisheries (site selection, water supply and drainage system, feeding and harvest periods).

- Via funds from the fisheries extension service, training courses on on-sand shrimp culture and sustainable management of the environment should be conducted. Visits to successful models in the local area or in adjacent provinces should be conducted so the farmers have better access to the best feeding methods.
- Information on policies, and relevant regulations regarding environmental protection and sustainable development of shrimp culture should be communicated to people.

4.4 Conclusion and recommendations

The production of tiger shrimp is mainly found along the coast in the central provinces. The expansion of this culture in high tidal areas is rather limited due to poor land potential.

The development of on-sand shrimp culture in the central provinces is a move in the right direction. However, for sustainable development to work, the farmers need infrastructure investment assistance, and knowledge of culture techniques and environmental protection.

- The government is kindly asked to allow the central provinces which have conditions for sustainable development of aquaculture to set up investment projects on on-sand shrimp culture in combination with afforestation, to the extent of more than 20 ha. These provinces should be given the investment policies according to Decision No. 224/1999/QD-TTg dated 8/12/1999, such as the 22 projects approved on shrimp culture in high tidal areas (irrigation channels and big reservoirs funded totally by the state).
- Potential provinces should set up specific plans for aquaculture development on sand, which should then form the basis for future project developments. In desert areas alone, provinces should design plans for encouragement and attraction of investors. Maybe companies can invest in the infrastructure and it can sell, contract or lease the ponds for fund returns.
- The undertaking of large projects on shrimp culture must have freshwater sources from lakes, rivers or springs.
- Areas to which freshwater cannot be brought in should be subject to assessment of groundwater volume in order to balance the areas and species, ensuring a sustainable environmental development.
- Setting up the plans and investment projects on shrimp culture development in provinces should include the consultation of relevant sectors (Department of Science, Technology and Environment, Department of Agriculture and Rural Development). EIAs are considered a basis for Appraisal Council consideration.

5 ISSUES ON SHRIMP PRODUCTION AND TRADE, ON-SAND SHRIMP CULTURE AND ARRISING PROBLEMS

By

Mr. Nguyen Quang Dang
Fisheries Information Centre, MoFI

5.1 Introduction

Over the past 10 years, total shrimp volume in the world has increased by 46.3 per cent, which is seen as a high rate in fisheries production. In 2000, the volume reached 3.8 million tonnes, which is the highest rate ever.

Shrimp catch from nature accounts for 77.5 per cent of total shrimp volume and increased 64 per cent in the period of 1991–2000. Remarkably, there is a consecutive and stable increase of shrimp catch from nature. This reflects that shrimp capture in nature has been paid particular attention and that nations have taken care to protect shrimp resources. There is an increasing demand for shrimp catch from nature, and the cultured shrimp are mostly used for export. The nations catching wild shrimp have built modern and large shrimp fishing vessels and also extensive processing lines. Fresh shrimp are immediately processed so that they are of high quality and meet the demands of the consumers.

China is the leading shrimp fishing country in the world. In 2000, it harvested nearly one million tonnes of shrimp. This is a result of policies on the conservation of aquatic living resources, the annual release of shrimp and good management of the shrimp capture fisheries.

Table 4 Development in the world shrimp production

Year	Capture fisheries		Aquaculture		Total catch (1,000 tonnes)
	Catch (1,000 tonnes)	% increase and decrease	Catch (1,000 tonnes)	% increase and decrease	
1991	1,820	-	810	-	2,630
1992	1,450	+7.1	840	+3.7	2,790
1993	2,081	+6.7	637	-24.0	2,718
1994	2,284	+9.7	747	+17.2	3,031
1995	2,338	+2.3	788	+5.5	3,126
1996	2,454	+5.2	718	-9.0	3,177
1997	2,601	+5.8	715	-0.5	3,316
1998	2,740	+5.3	820	+14.7	3,560
1999	2,890	+5.5	796	-3.0	3,686
2000	2,985	+3.2	865	+8.6	3,850

5.2 General situation of shrimp culture

5.2.1 Productivity and its value

Though shrimp culture fisheries have been put in an important position by nations with a number of investment projects, artificially-cultured shrimp volume has been at a standstill for 10 years (from 1991–2000). It has fluctuated annually but is difficult to predict.

In 2000, cultured shrimp volume was 865,000 tonnes, accounting for 22.5 per cent of total shrimp volume in the world. It was valued at US$ 5.1 billion with an average value of US$ 5.9 per kg of commercial shrimp.

5.2.2 Main cultured species

Though there are over 20 shrimp species being artificially cultured in fresh, brackish and marine water in the world, the species that have the highest productivity and value are the following:

Tiger shrimp (P.monodon)

The highest productivity of cultured tiger shrimp was 546,000 tonnes in 1996. In 2000, this figure was 585,000 tonnes with a value of US$ 3.7 billion, accounting for 67.6 per cent of cultured shrimp volume. It is clear that presently tiger shrimp remains the most important cultured species with the highest value (in average commercial tiger shrimp have a value of US$ 6.34/kg).

Table 5 Tiger shrimp production and associated value

Year	Volume (1,000 tonnes)	Value ($ million)
1991	288	1,874
1992	375	2,461
1993	438	2,720
1994	514	3,340
1995	576	4,028
1996	596	4,157
1997	576	4,090
1998	529	3,795
1999	564	3,475
2000	585	3,755

In 1999 the countries that had a large productivity of tiger shrimps included:

- Thailand: 225,000 tonnes.
- India: 114,000 tonnes.
- Vietnam: 99,000 tonnes.
- Indonesia: 75,000 tonnes.
- Philippines: 34,000 tonnes.
- Malaysia: 12,000 tonnes.

Chinese shrimp (P.chinensis)

Only China has this shrimp species, and after the shrimp disease epidemics during 1993–1994, its productivity was reduced by 64,000 tonnes. However, recently the productivity increased rapidly and caught up with the initial level of 1991, which was the most productive year.

Table 6 Chinese shrimp production

Year	Productivity (1,000 tonnes)
1991	220
1992	207
1993	88
1994	64
1995	79
1996	90
1997	104
1998	143
1999	172
2000	210

White-leg shrimp of South America (P.Vannamei)

In 2000 this species suffered from white-spot disease epidemics, which caused a loss of about 100,000 tonnes at a value of US$ 600–700 million. The countries that were hit hardest where Ecuador, Mexico, Peru and Venezuela.

Table 7 White-leg shrimp production in South America

Year	Productivity (1,000 tonnes)
1991	88
1992	135
1993	109
1994	120
1995	142
1996	140
1997	172
1998	148
1999	187
2000	95

China has imported this species and managed successfully to culture it in both marine and freshwater. The volume has therefore increased rapidly but the price has been low. Chinese products exported to the U.S. have been in strong competition with those exported from Latin America. The value of commercially cultured white-leg shrimp is US$ 5.67/kg (lower than tiger shrimp, which is US$ 6.34/kg). It is said that it is not logical to say that white-leg shrimp have a higher value than tiger shrimp.

Prawn (Macrobrachinm rosembergii)

Prawns are another high value species, and in 2000 China cultured nearly 100,000 tonnes of prawns. Following China is Vietnam, Thailand and Taiwan.

Table 8 Prawn production

Year	Productivity (1,000 tonnes)
1991	26
1995	18
1996	55
1997	61
1998	74
1999	102
2000	150

Shrimp (Penaeus spp)

Bangladesh, is the main cultivator of this species with a predominant production of 90,000 tonnes in 2000.

Table 9 Shrimp production

Year	Productivity (1,000 tonnes)
1991	25
1995	47
1996	64
1997	71
1998	80
1999	95
2000	110

5.2.3 Main shrimp culture regions and countries

At present, shrimp culture is mainly conducted in Asian countries, accounting for 87 per cent of products around the world. Following is Latin America. In general, shrimp culture fisheries have now been concentrated in the Asia-Pacific region. The tables below summarize the leading shrimp culture countries together with their productivity, cultivation method, technical parameters and the shrimp value.

Table 10 Shrimp productivity over years (1,000 tonnes)

No	Countries	1995	1996	1997	1998	1999
1	China	78	126	146	205	251
2	Thailand	278	259	233	250	230
3	Vietnam	53	58	105	115	128
4	Indonesia	121	125	126	148	118
5	India	97	95	65	81	114
6	Ecuador	96	48	114	130	108
7	Bangladesh	34	49	56	66	82
8	Philippines	90	76	40	36	34

Table 11 Methods mainly used in the Asian region (1996)

Countries	Extensive culture (%)	Semi-intensive culture (%)	Intensive culture (%)
China	10	85	5
Thailand	5	10	85
Vietnam	80	15	5
Indonesia	45	45	10
India	70	25	5
Bangladesh	90	10	0
Philippines	35	50	15

Table 12 Technical parameters on shrimp culture in Asian region

System/countries	Production cost (US$/ha)	Labour (person, day/ha)	Feed (kg/ha)	Fry released (1,000/ha)
Extensive				
Bangladesh	1,393	166	162	17
India	6,039	642	1,027	47
Indonesia	3,430	175	397	57
Myanmar	409	147	98	29
Philippines	1,901	90	107	14
Sri Lanka	13,707	789	2,745	160
Vietnam	1,989	492	367	26
Average	4,210	357	700	50
Semi-intensive				
Bangladesh	12,527	661	4,503	317
India	14,609	472	3,994	172
Indonesia	12,155	478	2,483	196
Malaysia	36,485	534	9,687	446
Philippines	17,576	531	6,456	197
Vietnam	7,222	771	984	124
Average	19,295	702	5,234	243
Intensive				
Thailand	75,350	946	20,475	1,240
Malaysia	62,224	428	14,122	766
Sri Lanka	71,707	1,334	13,747	502
Taiwan	38,430	221	4,807	693
Indonesia	34,914	809	8,269	749
Philippines	19,286	631	7,578	252
Average	47,595	685	11,340	691

Table 13 Shrimp culture establishments, shrimp productivity in Asian countries (1996)

	China	Vietnam	India	Bangladesh	Philippines
Extensive					
Establishments	2,681	22,374	45,040	6,500	3,029
Average area of farm (ha)	34.5	10.3	3.7	16.6	10.8
Productivity (kg/ha/year)	421	79	646	216	260
Semi-intensive					
Establishments	1,666	6,014	4,193	64	2,447
Average area of farm (ha)	19.7	1.4	6.4	12.7	7.5
Productivity (kg/ha/year)	848	662	2,374	1,633	2,701
	Thailand	**Indonesia**	**China**	**Taiwan**	**Philippines**
Intensive					
Establishments	521	10,000	731	521	782
Farm areas (ha)	68.7	2.1	6.4	2.6	8.4
Productivity (kg/ha/year)	10,724	4,392	1,229	2,808	3,057

Table 14 Production cost and product price of shrimp in Asia (1996)

	Production value (US$/kg)	Sale price (US$/kg)
Extensive		
Thailand	1.74	3.63
Vietnam	3.04	2.73
Indonesia	3.86	6.84
China	1.62	3.05
India	4.42	7.19
Semi-intensive		
Indonesia	3.78	6.83
Vietnam	3.34	5.63
India	5.96	7.27
China	2.27	3.21
Intensive		
Thailand	4.26	6.89
Taiwan	7.33	12.46
Indonesia	4.59	6.48
Philippines	6.81	7.10
China	4.90	4.91
Malaysia	4.83	7.57

In general, China and Thailand are two countries producing shrimp with an agreed product price in the Asian region. In a semi-intensive culture system, one kg of commercial shrimp is valued at US$ 2.27. Recently, the Chinese white-leg shrimp culture reached a production cost of US$ 2/kg. This is an advantage that China has in a competitive market.

5.2.4 Disease epidemics of cultured shrimp

- In 1988, disease epidemics of tiger shrimp caused great damage to this developed industry in Taiwan. The production for auction in the world at that time was 75,000 tonnes. In 1990 it dropped to 8,500 tonnes and in 1999 to 4,400 tonnes. The Taiwanese tiger shrimp culture industry, which was seen as a giant, had collapsed. Taiwan had shifted from being an exporter to being an importer of tiger shrimp products.
- A three-week long epidemic of cultured shrimp in 1993 led to huge losses in the Chinese industry. China was a leading shrimp culture country (220,000 tonnes in 1991). This figure was reduced by 64,000 tonnes in 1994, causing China to be ranked sixth in the world. It took China five–six years to regain its position as leader. The epidemic has also been in the Philippines since 1996, causing huge losses for the country. Tiger shrimp production reached 90,000 tonnes in 1994 but was reduced to 34,000 tonnes in 1999, and to 29,000 tonnes in early 2000 (a reduction of 2/3).

- In 1997, this epidemic also reduced the Indonesian production by 1/3.
- During 1996–1997, tiger shrimp in Thailand were infected with a serious disease. The production of 260,000 tonnes was reduced to 223,000 tonnes in 1997.
- White-spot disease attacked the South American white-leg shrimp in 2000, causing damages of about 100,000 tonnes in Latin American countries. For the first time ever, the President of Ecuador issued an urgent order nation-wide due to the epidemics (with the aim of helping farmers by relieving them of paying taxes).

5.3 Shrimp trade

5.3.1 General background

Though total shrimp volume reached nearly four million tonnes/year, shrimp is still a commercially-valuable product. Of the annual shrimp volume, about one half has been used for domestic consumption while the remaining half has been used for foreign trade on the international markets.

In general, at present, shrimp production has increased faster than demand so that the foreign trade of shrimp shows a slow development. It seems that supply exceeds demands. It has been said that if the world shrimp market were further developed the shrimp could be easily sold. This does not sound logical, and can be proved via total foreign trade in frozen shrimp.

Table 15 Total foreign trade in frozen shrimp ($ billion)

Year	Total foreign trade in frozen shrimp (US$ billion)
1994	15.6
1995	17.1
1996	16.3
1997	16.6
1998	16.6
1999	15.9
2000	16.2

It is clear that foreign trade in frozen shrimp has shown a standstill over the years. This characteristic is critical for policy-makers when deciding about shrimp export, as well as for producers and processors.

5.3.2 Shrimp import

At present, the main shrimp importers are the U.S., Japan and the EU, accounting for 80–85 per cent of the total shrimp import volume in the world. The developments in these three areas have great influence on shrimp markets in the world and are presented below.

Table 16 U.S.: A leading shrimp importer with the following developments

Year	Import volume (1,000 tonnes)	Value (US$ million)
1998	315	3.11
1999	331	3.13
2000	343	3.75
2001	398	3.61

The U.S. market has imported about 1/3 of the shrimp import value in the world. Though there is an increase in import volume, the value has decreased. The U.S. has implemented policies on reducing the price of imported shrimp. In the first four months of 2002, the average price of imported shrimp in U.S. was reduced by 30 per cent.

Table 17 Japan's import volume

Year	Import volume (1,000 tonnes)
1997	267
1998	239
1999	247
2000	246
2001	265

In 1995, Japan imported 305,000 tonnes of shrimp. Presently it has decreased to 246,000 tonnes. Japan was ranked the second biggest importer following America. Like the U.S., Japan has implemented a policy on reducing the shrimp import price and increasing the import of other low- and average-priced shrimp.

Table 18 Import volume of the EU

Year	Import volume (1,000 tonnes)
1995	297
1996	319
1997	301
1998	355
1999	341
2000	336

Since 1998, shrimp import markets of the EU have been balanced and stable.

5.3.3 Shrimp export

Whereas shrimp import markets are limited, the number of shrimp export countries is about 70. Big shrimp exporters are Thailand, India, Indonesia, Vietnam, China and Ecuador.

Due to high and rapid revenue, a lot of Asian Pacific countries have been running huge projects on shrimp culture, processing and export. Though the risk is well known in terms of trade and production, some countries, big groups and companies have still developed large shrimp projects. This is called the shrimp export industry.

The countries that boast huge shrimp productions cannot be big shrimp exporters. China is one example. It produces 1.3 million tonnes of shrimp per year, but mainly for local consumption, not for export. This is a remarkable characteristic. It is thought that if China uses shrimp for export, it will create difficulties for other shrimp exporters. China's strong advantage is a cheap price.

Table 19 World shrimp exports

Year	Volume (1,000 tonnes)	Value (US$ billion)
1997	1,091	8.4
1998	1,150	8.3
1999	1,090	8.1
2000	1,170	8.2

Though shrimp volume for export is increasing, the value has decreased. This is a remarkable characteristic of the situation.

5.4 On-sand shrimp culture development and arising issues

The establishment of on-sand shrimp ponds in the coastal or island areas has occurred since the 1990s. At that time, cultivating tiger shrimp for export was developed strongly in Southeast Asia, East Asia and South Asia. Countries like Malaysia, Indonesia and Thailand do not have natural tidal areas and mangrove forest for setting up the ponds, so they have to utilize the coastal sandy areas to set up small- and medium-size ponds and pump marine water into the ponds for tiger shrimp culture.

When setting up on-sand shrimp ponds, a number of important issues have been recognized, such as water supply and drainage systems, infrastructure, logistic services and waterproofing techniques used in the ponds.

Several methods have been piloted including: covering the pond's bank and bottom with concrete. These measures are expensive, cause an adverse impact on the environment and production, and lack feasibility. Using mixed plastic materials for the bank and base of the ponds instead shows good results, but is also expensive. The use of thin nylon for waterproof capability shows advantages, but is not very durable and can easily tear allowing water drainage. Shrimp farmers in Java Island, Indonesia, have initiated the establishment of on-sand shrimp ponds from bamboo-based concrete. This is a good measure, taking full use of local material and a low cost. On-sand shrimp pond models from bamboo-based concrete are available in Indonesia.

Recently, tiger shrimp culture has drawn the attention of billionaires in the Middle East, especially in countries surrounding the Persian Gulf. The idea of on-sand (desert) shrimp culture has been carried out by big investment projects in Oman, Saudi Arabia, and United Arab Emirates. Modern shrimp ponds are set up on the desert along the coast. Clean marine water supply systems and waste drainage systems, infrastructure, electrical supply and logistical services have all been planned and developed. However, these oil exporters do not culture shrimp on sand for export, so they do not care about the price of commercial shrimp. The two species chosen are tiger shrimp *(P.monodom)* and India shrimp *(P.indicus)*.

In general, on-sand shrimp culture has not been developed widely and has even been phased out in Malaysia and Indonesia. The main reason is that after operating some crops, lots of problems have arisen in this regard. The environmental issue is the most controversial. Based on incomprehensive calculations and the pursuit of immediate financial returns, people have set up the ponds in an unregulated manner in precious sandy areas. These areas should have been used for multiple-purposes such as ecological balance, erosion prevention, storm and wind control, and salt intrusion control. Wastewater discharged from the ponds causes serious contamination of the ecosystem. Remarkably, the establishment of ponds is unregulated even on the beautiful sandy beaches that are recreational areas. The natural landscape and ecological balance has been damaged turning beautiful sandy areas into contaminated ones. These problems have arisen from developing shrimp culture activities and have forced people to review their production. These are some of the reasons why the development of on-sand shrimp culture in some regional countries should be limited.

On-sand shrimp culture in Vietnam has developed strongly in the central provinces. It is reported that the setting up of shrimp ponds is conducted in an unregulated manner in some provinces and only for immediate objectives. This is an important problem. The development of shrimp culture should be in harmony with nature, based on immediate and long-term interests. On-sand shrimp culture should be reviewed considerably. All methods should be taken into comprehensive account in terms of benefits and damages. The cultivation of shrimp should not just use the sand but also protect the land, prevent erosion and the desertification of agricultural land. It should also protect Casuarina trees, which protect against storms and huge waves. Natural landscapes, especially, should be protected as recreational and tourist places.

By going to Singapore can one see how sandy areas are beloved by the people. They have to buy sand from Malaysia, Indonesia and transport it to Singapore in order to construct artificial beaches that serve millions of tourists.

Sandy areas are complicated ecosystems that are gifts of nature and not available in every country. Experience shows that the relationship between shrimp cultures and mangrove forests can result in high costs. This is the situation with sand shrimp culture in the beautiful and clean sandy areas in central provinces. Hopefully, we will find the appropriate model for both shrimp culture and reforestation, tourism and recreation, as well as activities to prevent natural disasters so that the sandy areas will co-exist with us forever.

5.5 Additional viewpoints and understanding of some terminology and new concepts, which may be used in sandy land aquaculture

"Organic aquaculture" is a rather new concept, which has not yet been referred to in any official documents. In the year 2001, for the first time, some aquatic products harvested from nature have been labelled "clean products" for sale in Switzerland. Since then, the so-called "Aquaculture Product Certificate" has also been a topic for ongoing discussions in the U.K., Germany and Sweden.

In Vietnam, the concept of organic aquaculture is only familiar to a few people. In some places, such as Ca Mau province, "ecological shrimp culture," which produces shrimps for export to the EU, is merely a method of extensive farming characterized by a very low stocking density and natural feeding. Sandy land shrimp culture currently prevalent in Ninh Thuan province is based on a semi-intensive model that has no major differences when compared to the culture of similar species in ponds on soil, lakes or paddies. Its only distinctive characteristic is that the pond is constructed on sandy land. Therefore, there are no logical reasons to claim that sandy land shrimp culture is "clean" or "organic," since seeds, feeds and production techniques are actually the same. At the same time, the water from culture ponds is discharged directly to the surrounding environment without being treated or filtered. High pollution risks therefore threaten adjacent land areas and water sources, leading to increased risk of shrimp diseases.

In order to reach sustainable targets, the development of sandy land shrimp culture has to strictly follow a scientific and realistic master plan, by which irrigation systems (including supply and drainage) are designed. Treatment of discharged water and dredged bottom mud after each culture cycle should also be based on technical packages. However, it may take quite a long time for current sandy ponds of shrimp culture to reach that goal. In addition, there are important requirements to non-pathogen quality of shrimp seeds, such as careful management of industrial feeds, strict control of water environments, etc., all of which need to be taken into account.

As mentioned earlier, the world supply of aquaculture products labelled as "clean" is too small. Even in Western Europe only some cultivated salmons and common carps are registered as "clean". For example, during the year 2000 only approximately 2,000 tonnes of "clean" salmon were sold in the EU market (out of 500,000 tonnes of salmon production throughout Western Europe in the same year). With regard to shrimp, no correct information about where and to what extent "clean" products are produced has been available. According to an overall appraisal, the market of clean aquaculture products (including clean shrimp) is continually expanding. After the outbreak of mad cow and foot-and-mouth epidemics among raised animals, clean aquatic products have attracted more interest. However, no statistics have been conducted on demands and major markets.

The Ministry of Fisheries Regulations attached to Decision No. 18/2002/QD-BTS signed by the Minister of Fisheries on June 3, 2002, is an ideal legal framework for shrimp culture on sandy land. Nevertheless, there is a long way to the stage where organic shrimp culture is the dominant production form.

As has been said, the cost of organic shrimp culture is still unclear. Hence, it is difficult to make a precise comment on the issue. Below is an example of how to farm organic/clean products based on a IFOAM drafted proposed set of standards for a clean aquatic environment reinforced impact evaluation of the environment;

1. Make use of natural flora in culture management;
2. Processing techniques are organic principle based;
3. Natural spawning without hormones or antibiotics;
4. Low stocking density;
5. Application of organic feeds;
6. Fish meal derived from clean sources;
7. No inorganic fertilizers;

8. No pesticides;
9. Limited use of energy; and,
10. Natural medicines as highest priority.

Apparently, sandy land shrimp culture in Vietnam has not yet met any of the above standards.

6 INTERNATIONAL EXPORT IMPLICATIONS OF EXPANDING SHRIMP AQUACULTURE IN VIETNAM

By

Dr. Tran Cong Sach
Head of Science and Training Department,
Institute for Trade Study, MoT

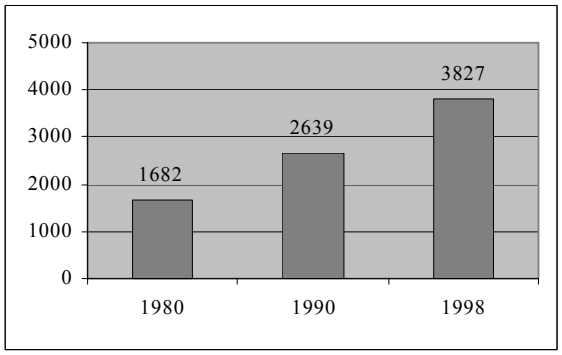
6.1 International shrimp market and facts about Vietnam's shrimp exports to some major markets from 1997 to 2002

6.1.1 Major features and general trends of the international shrimp market

In the international market, aquaculture products are classified as essential products. Aquaculture products are always in short supply globally. Over the period 1985–1995, trading of aquaculture products increased by an average rate of more than 10 per cent per year. From 1995 to 2002, though the growth rate has dropped compared to that of the previous period, the world market for aquaculture products has been expanding. The world's total export was estimated at US$ 60 billion in 2000. According to the forecast, world markets for aquaculture products will continue to be stable in the future, especially for value-added processed products, instant used products and living products that have high economic value. In recent years, 1999–2002, the trends of world market prices for aquaculture products have been increasing at an average growth rate of 5.4 per cent per year. According to the forecast by FAO, up to 2010, the growth rate of the world aquaculture products will be 3.6 per cent per year. The main reasons for this potential growth prospect are increases in the world population and per capita income (especially for citizens in developing countries), and the world food shifting movement, from cattle meat to aquaculture products.

The major feature of the world aquaculture product trading is that many countries are exporters and importers at the same time. There are seven main groups of aquaculture products. The largest group is crustacean and fresh mollusc species (mainly living fish, iced and frozen products), accounting for 41–43 per cent of the world's total export; and the second group is iced products and frozen products (mainly shrimp) accounting for 32–35 per cent. Shrimp is the most expensive among the aquaculture products. The production of shrimp products from both natural exploitation and cultivation accounts for 3.2 per cent of total production of the world aquaculture products, but the value of shrimp products for export accounts for 13.2 per cent of the total value of the world aquaculture products (about US$ 11 billion in 1998). On the world market, the two main kinds of shrimp traded are cold water shrimp and warm water shrimp (at the ratio of 1:5). The cold water shrimp are from west European countries, Canada, etc. The warm water shrimps are either exploited or cultivated in the tropical areas of Asia, Africa, South America, and the U.S.

Supplies of shrimp in the international market: According to the latest announcement by FAO, after nearly two decades from 1980 to 1998, the world shrimp products had increased by 175 per cent, the highest increase in comparison with that of other important aquaculture products. The total world production of shrimp products was 1,680 thousand tonnes in 1980; 2,639 thousand tonnes in 1990; 3,288 thousand tonnes in 1995; 3,601 thousand tonnes in 1997; and 3,827 thousand tonnes in 1998. 70.1 per cent of the production in 1998 was from natural exploitation and 29.9 per cent from cultivation. See the following figures.



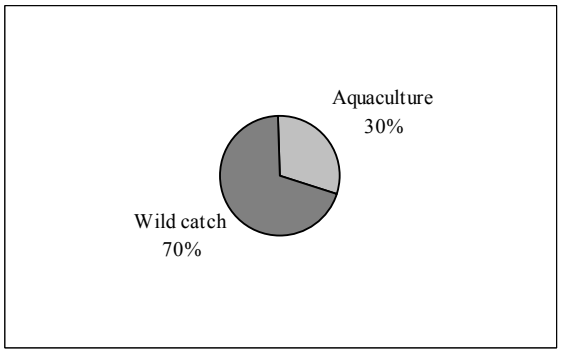


Figure 1 and Figure 2 World shrimp production in thousand tonnes for the period 1980–1998 (Both from nature and aquaculture) and 1998 world shrimp production split between shrimp harvested from nature and farmed in aquaculture

In 1998, the world production from natural exploitation was 2,713 thousand tonnes, of which 827,000 tonnes came from China, accounting for 30.5 per cent. China has been the largest shrimp exploiter over the last 10 years, followed by India, Indonesia, the U.S., Thailand, Canada and Vietnam. Along with the great achievements resulting from world shrimp cultivation, and its contributions to economic development in poorer countries, many challenges have been presented. These problems include shrimp diseases spreading over large areas and causing huge losses, devastation of wetlands and forests, pollution of land and water, and degradation of the environment. This has caused the shrimp production to fluctuate since 1992, the year in which the highest production was achieved (840,000 tonnes). World production was 820,000 tonnes in 1998, decreased to 796,000 tonnes in 1999, and an estimated figure for 2000 was 864,000 tonnes. Among all shrimp species cultivated, grass shrimp gave the highest production, accounting for 70 per cent of the total cultivated shrimp production. This specie is mainly cultivated in Asian countries and India (81,000 tonnes in 1988). Thailand was the world's largest producer of grass shrimp (250,000 tonnes in 2000). Indonesia ranked second with 110,000 tonnes in 2000, and Vietnam third with 105,000 tonnes. Following were the Philippines with 40,000 tonnes in 2000 and Taiwan with 6,000 tonnes in 2002. The figures below illustrate the ups and downs of the world's cultivated shrimp production as well as the production held by selected countries.

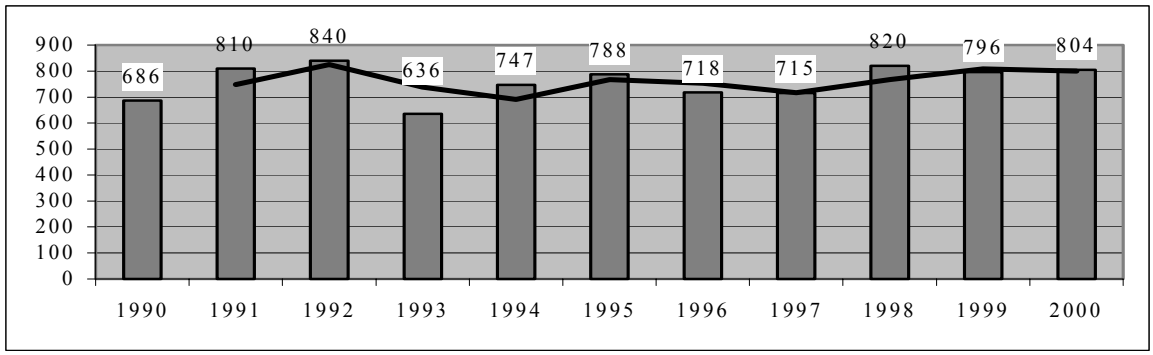


Figure 3 World shrimp production in thousand tonnes between 1990 and 2000
Sources: (1) FAO – Center for Trade Information, (2) Ministry of Trade.

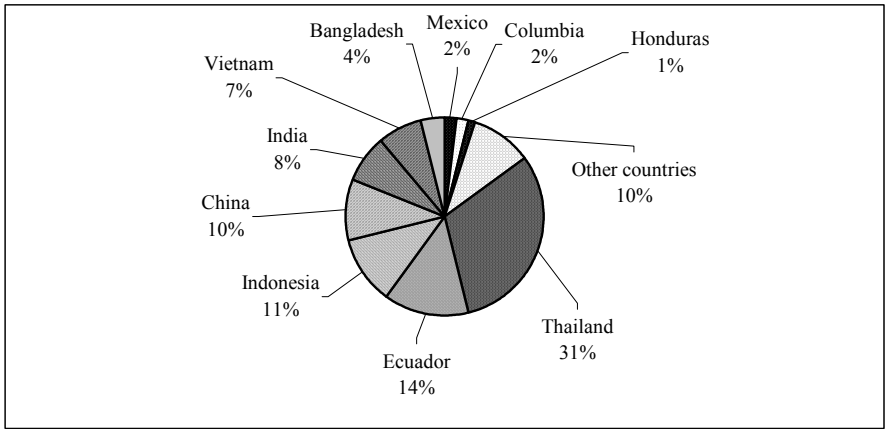


Figure 4 Proportion by selected countries in 1995
Sources: (1) FAO Website, (2) The USA Department of Agriculture (USDA), (3) The USA Fishery Products Annuals 2001.

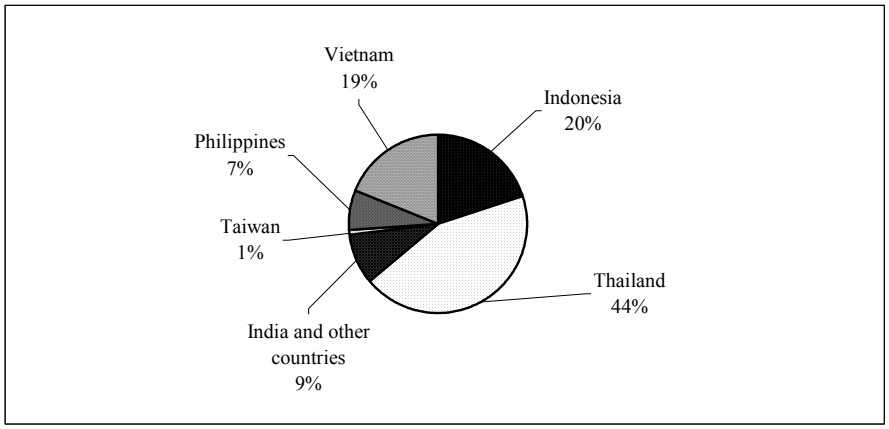


Figure 5 Proportion by selected countries in 2000
Sources: (1) FAO Website, (2) The USA Department of Agriculture (USDA), (3) The USA Fishery Products Annual 2001.

6.1.2 Shrimp product demand by world markets

There has been a new trend in shrimp consumption along with the boom of shrimp cultivation throughout the world. The consumption of shrimp has become much more popular: the competitive low price of shrimp cultivated in the tropical countries allows the product to widely penetrate the European and U.S. markets, where the consumption per capita is one third compared to that of the Japanese market. In addition, though shrimp is considered a luxury product, it is not in short supply. This has led to the fact that shrimp products are consumed widely in families, though they used to be served only in restaurants in Japan and the U.S.

After the period of huge demand for shrimp products in the beginning of the 1990s, consumption in the three largest markets, namely Japan, the U.S. and Europe, had reached the saturation point. A high increase of demand was expected only if the prices went down to the “popular price” (as for commodity goods), and in fact this happened. In some emerging markets such as China, Korea, Taiwan and Hong Kong, the demand has sharply been increasing between 1993 and 2000. These emerging markets have imported more than 100,000 tonnes of shrimp products.

Thus, it could be noted and forecasted that the Asia Pacific region has become a main world market for imports of shrimp products. This region is becoming the largest shrimp consumption market at the beginning of the 21st century.

After about 20 years, the demand for shrimp imports has tripled. The world's total import was 625,000 tonnes of different kinds of shrimp with the total value of US$ 2,633 billion in 1985, and 1,245,000 tonnes with the value of US$ 10,819 billion in 1998. The major import markets are Europe, the U.S. and Japan. The imports to U.S. markets account for 29.5 per cent of total world import. In 2000, the U.S. imported 343,000 tonnes of frozen shrimp products, valued at US$ 3,748 billion, accounting for 37.5 per cent of total U.S. imports of aquaculture products.

Imports of shrimp products to the EU market have increased quickly and steadily. After a decade, the total value of imports has doubled, from 370,000 tonnes in 1999, valued at US$ 2,186 billion. Spain, France, and Italy are the main importers within Europe, accounting for 56 per cent of the total imports to the EU market.

Before 1997, the year in which imports of shrimp products to America were more than that to Japan, Japan used to be the biggest importer. After reaching the record of 303,000 tonnes in 1994, shrimp product imports to Japan decreased to their lowest figure of 239,000 tonnes in 1998, then recovered slowly to 247,000 tonnes in 1999 and 246,000 tonnes in 2000.

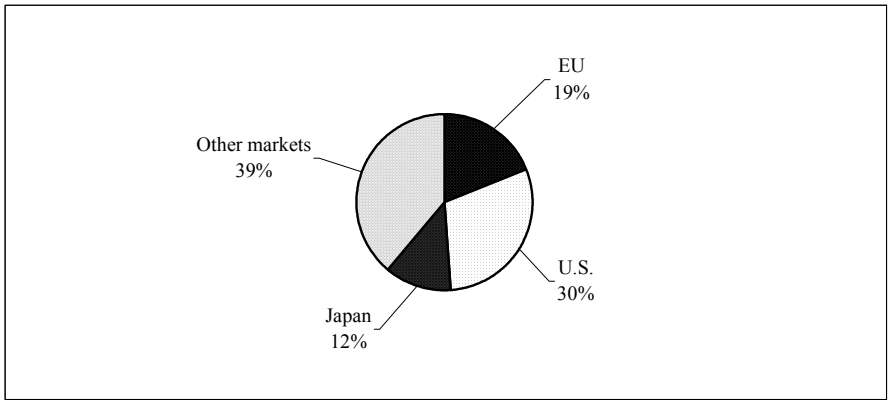


Figure 6 Market structure of world shrimp product imports – 1998
Sources: Swedish EIA Centre-Uppsala Sweden: Shrimp Aquaculture State of the Art Report

6.1.3 Shrimp exports from Vietnam to some major markets from 1997 to 2002

Facts about the export of aquaculture products and shrimp products from Vietnam

Since 1995, Vietnam's aquaculture sector has shown potential for development and has developed steadily. The annual growth rate of the aquaculture production was 12.3 per cent over the period of 1996–2000. In 2000, total production of the country was 2.22 million tonnes, an increase of one million compared to that of 1995. In 2001, total production was 2.4 million tonnes, of which the production from wild catch was 1.74 million tonnes, accounting for 72.5 per cent; and 0.66 million tonnes from cultivation, accounting for 27.5 per cent. To June 2002, were 250 processing factories for aquaculture products throughout the country with a total annual capacity of approximately 250,000 tonnes of products for exports (223,000 tonnes in 2001). Of these processing factories, 68 businesses have been accepted by EU for exports to the EU market and more than 100 businesses have applied HACCP (Hazard Analysis Critical Control Point), the standard eligible for exports to the U.S. market. The technology used for processing of aquaculture in Vietnam is at a middle-advanced level.

The annual average growth rate of Vietnam's aquaculture products for exports was 20 per cent over the period from 1991 to 2000. In 2000, exports of aquaculture products reached US$ 1,475 million (an

increase of 6.2 per cent compared to that of 1990), accounting for 10.2 per cent of total Vietnam exports. The high rate of growth and the large portion of the country's exports have made aquaculture an important sector, forcing the growth of Vietnam's exports. To date, Vietnam's exported aquaculture products are present in 60 countries around the world. The Japanese market used to account for 50–60 per cent of Vietnam products, but now accounts for less than 30 per cent. Since August 2001, the U.S. has outdone Japan and become the largest market for exports of Vietnamese aquaculture products (in 2001, Vietnam's aquaculture export to Japan was US$ 471 million, accounting for 26.2 per cent of Vietnam's total exports; while Vietnam aquaculture export to the U.S. was US$ 500 million, accounting for 28.5 per cent of Vietnam's total exports). China is the third emerging and promising market for export of Vietnam's aquaculture products (export of Vietnam's aquaculture products to China accounted for 12.4 per cent of Vietnam's total exports in 1999; it accounted for 15 per cent in 2000 and 18 per cent in 2001). The EU is one of the world's largest markets for imports of aquaculture products, but also the most picky/selective. This is why, though great efforts have been made by both the government of Vietnam and Vietnamese businesses that only 68 businesses are eligible to export in accordance with the EU council's Code 91/493/EC. As a result, the export of Vietnam's aquaculture products to the EU accounted for only 9.6 per cent of Vietnam's total exports in 1999, and reduced to seven per cent in 2000 and to six per cent in 2001.

The NICs, Asian and Southeast Asian countries are large markets for the consumption of aquaculture products available from Vietnamese aquaculture. The NICs such as Korea, Hong Kong, and Taiwan, each import about five per cent of Vietnam's total export of aquaculture products.

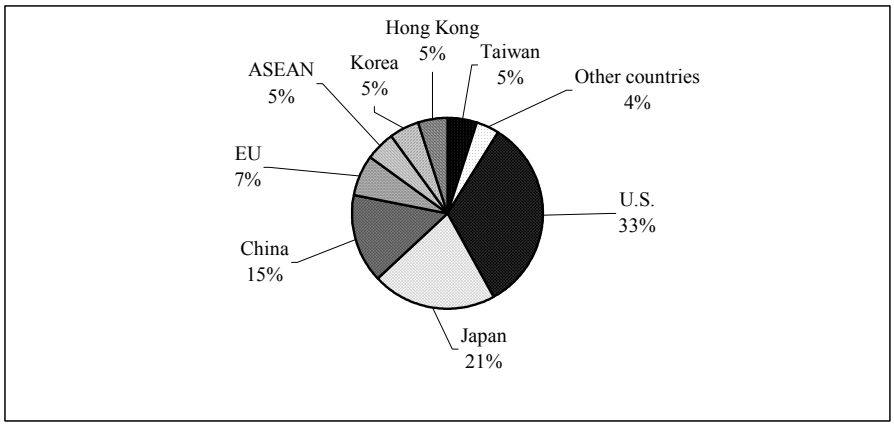


Figure 7 Market structure for exports of Vietnamese aquaculture products – 2002
Sources: Centre for Science and Technology Information – Ministry of Fishery: Information on Aquaculture Science and Technology, Series No. 2 and No. 3, 2002

Among Vietnam's aquaculture products for export, shrimp is the dominant product and accounts for the largest portion of Vietnam's total annual export value. However, the value portion of shrimp export has a declining tendency because prices of exported shrimp are decreasing while prices of other exported products are increasing. In 1986, out of 24,890 tonnes of exported aquaculture products, shrimp accounted for 15,900 tonnes, equivalent to 64 per cent; in 1996, the number was 70,000 tonnes out of 150,500 tonnes accounting for 46.5 per cent; in 2001, the value of shrimp export was US$ 777.8 million (from 87,000 tonnes), accounting for 44 per cent of the total export value of aquaculture products and accounting for 5.15 per cent of Vietnam's total export value. Over the past five years, shrimp prices have suffered from a descending tendency, and the price of exported shrimp has been reduced by nine per cent when comparing the prices in 2002 to those of 2000 (from US$ 9.81/kg to US$ 8.92/ kg).

Two major markets for Vietnam's export of shrimp products are the U.S. and Japan. Vietnam is the third largest exporter among many countries exporting their shrimp products to these two large markets. It is possible that Vietnam will outdo India and become the second largest supplier of shrimp to these two

giant markets in 2003. However, Vietnam still has a long way to go before becoming the largest exporter to the U.S. (must outdo Thailand) and to Japan (must outdo Indonesia).

6.2 Facts about Vietnam's shrimp exports to some major markets

6.2.1 Japan shrimp market and Vietnamese shrimp export

Up until 1996, Japan had been the world's largest market for shrimp products. In 1997 the U.S. outdid Japan and became the largest market. Imported shrimp accounts for 98 per cent of total shrimp supply in Japan. The volume of imported shrimp to Japan increased sharply between 1980 and the beginning of the 1990s, but has decreased since 1994. The reduction is partly caused by reducing world supply due to shrimp diseases in cultivating countries, and partly because Japanese consumers have been increasingly concerned about food safety and hygiene. There have been other economic concerns as well (devaluation of the Japanese Yen against the U.S. dollar leading to crisis in the Japanese economy, therefore citizens spend less on luxury goods such as shrimp).

Competition between exporters of shrimp to the Japanese market is very intense. The five largest countries exporting shrimp to Japan are Indonesia, India, Vietnam, Thailand and China, but none have absolute competitive advantages. Between the beginning of the 1990s up to 1996, Indonesia was the number one exporter of shrimp to Japan, however due to a 1997 cultivation failure in Indonesia, India took over the leading position. One of the main reasons India became the number one exporter was because its shrimp were prohibited in the EU market beginning from August 1997. Vietnam gained the third position from Thailand after 1997 because Thailand focused on exporting into a more attractive U.S. market and production was reduced by disease. Other exporters of shrimp to the Japanese market, include China, the Philippines and Greenland, which have all reduced their exports since 1997. Only China is still a strong competitor since it has huge potential for shrimp cultivation (about one million tonnes/year) and it is ready to increase export to Japan.

Within the first 11 months of 2001, Japan imported 235,110 tonnes of shrimp, valued at US$ 1,192 million, an increase of 7.8 per cent in terms of volume and a decrease of 19.5 per cent in terms of value. On average, the price of frozen shrimp in 2002 was reduced by 26 per cent compared to the same period in 2001. Indonesia was the number one exporter of shrimp to the Japanese market with 50,000 tonnes, valued at US$ 510 million; India was number two with 39,000 tonnes, valued at US$ 337 million (a decrease of 345 tonnes in terms of volume and a decrease of 21 per cent in terms of value compared to that of 2000). Vietnam still holds the third position with 32,800 tonnes, valued at US$ 225 million (an increase of 7.2 per cent in terms of volume and an increase of 2.8 per cent in terms of value compared to that of 2000). The following figure shows the development in exports to Japan from different countries.

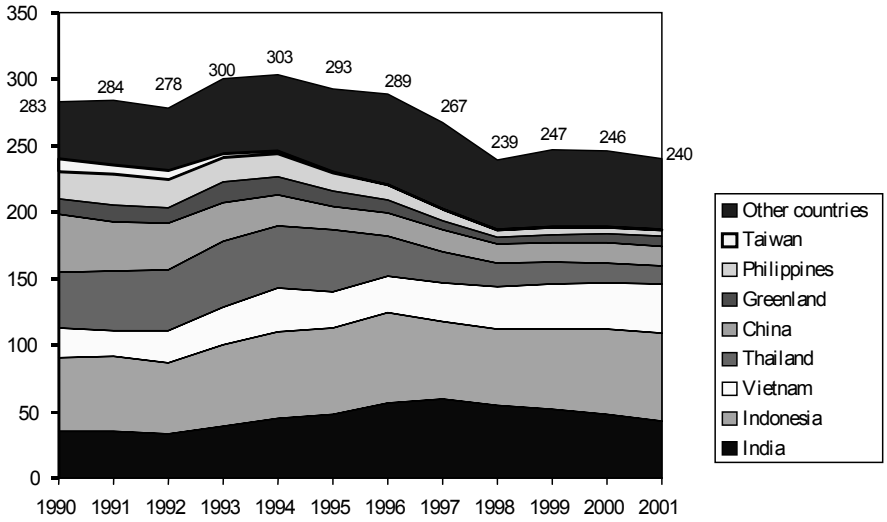


Figure 8 Shrimp exports in thousand tonnes from different countries to Japan

Distribution channels of shrimp in Japanese market

Besides maintaining a frozen store room system to ensure a regular supply of shrimp for the market (the volume reserved in these frozen stores is approximate 80,000 tonnes in Japan and approximately 20,000 tonnes in the U.S.), this reserved volume is also used as an index for importation of shrimp. Unlike the U.S. market, the Japanese distribution system has many levels. The ratio of middle distribution levels are 2.9, while in the U.S. this ratio is one and in France it is 0.9. This is the reason why the import of shrimp by the Japanese market is mainly managed by trading companies.

In the Japanese market, trading companies partly regulate prices, in addition to the prices set by a normal supply-demand ruling market. Besides supporting all the reserved volume (four times compared to the U.S.), the trading companies, on one hand, have an influence on the selling price, and on the other hand, have bargaining powers to negotiate with exporters for better deals. Fortunately, due to international competition for shrimp products, market forces still have the dominant influence in determining prices for shrimp products in the Japanese market.

Barriers of customs and non-customs duties imposing on exports of shrimp to Japan's market

There is no limitation of volume for shrimp export to the Japanese market. The shrimp export to Japan is imposed an import tax based on value, and the GSP system is applied to shrimp exports from developing countries (as of January 1, 1998, in accordance with WTO, the import tax for all shrimp products is 1.4 per cent). This tax level is not high, however, a consumption tax increase from three per cent to five per cent by the Japanese government has an impact on import and consumption of shrimp (because the consumption tax imposed on imported goods is computed by: consumption tax = [CIF + import tax] x 5 per cent). In addition, the more difficult barriers are the standards for technology quality, food safety and hygiene, which are regulated under the laws on food hygiene and laws on isolation of foods.

Vietnam has constantly been promoting its shrimp export to the Japanese market. By 1996, Vietnam became the world's third largest supplier of shrimp products in terms of volume to Japan, surpassing Thailand and China. However, the images/brand-names of shrimp from Vietnam and Indonesia are regarded differently. Japanese consumers pay higher prices for shrimp from Indonesia, while shrimp from Vietnam receives lower prices so that more can be exported and so that they do not lose their market share to shrimp from Thailand, China, etc. In 2000, Vietnamese export of shrimp to Japan reached 33,000 tonnes. Within 11 months of 2001, Vietnam exported 32,800 tonnes to this market.

6.2.2 U.S. market and Vietnamese shrimp export

The U.S. domestic supply of shrimp accounted for 25 per cent of total demands (1990), reduced to and accounted for 18 per cent (1997) and accounted for 15 per cent by June 2002. This is mainly because of increases of shrimp consumption and decreases of production from both domestic natural exploitation and domestic cultivation. The shortage of domestic supply leads to more than 80 per cent of the demand for importing. Currently the U.S. is the number one world importer of shrimp (after 1997). Import of shrimp to the U.S. market had continuously increased over the period 1985–1994 (reached the record of 284,800 tonnes in 1994), decreased in 1995 and 1996, then increased steadily from 1997 (294,100 tonnes) and (343,000 tonnes) in 2000. The graph below illustrates shrimp import into U.S. market over time.

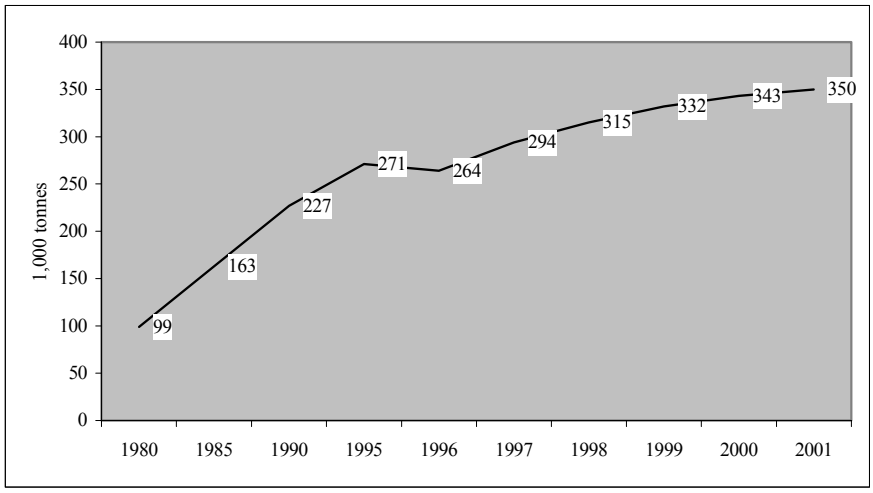


Figure 9 Import of shrimp to the U.S. market – 1980 to date
Sources: (1) FAO publication/information on FAO Website; (2) the U.S. Department of Agriculture (USDA); (3) USA Fishery Products Annual 2001

Demands and trends in consumption of aquaculture products and shrimp products in the U.S.

In general, consumption of aquaculture products in the U.S. has not changed in terms of volume, but has changed in quality and been favourable towards high economic value products such as prawn, lobster and other processed products. This is reflected by a high increase of total imported value, though there is no increase of imported volume. (In 1992, imported volume was 270,000 tonnes, valued at US$ 2,105 million; in 1997 imported volume was 294,000 tonnes, valued at US$ 3,035 million; in 2000, imported volume was 343,000 tonnes, valued at US$ 3,748 million).

Supply

Before 1990, Latin American countries were the main suppliers of shrimp to the U.S. market. Since 1990, large production and low prices, thanks to the rapid development of shrimp cultivation in tropical areas, have allowed Asian countries to become the main suppliers of shrimp to the U.S. market. Thailand is number one, then Vietnam, India and China. Currently, competition in the export of shrimp to the U.S. market is very intense. The 10 major countries exporting to the U.S. market are in descending order: Thailand, Vietnam, India, Mexico, Ecuador, China, Indonesia, Guyana, Brazil and Honduras.

Thailand is the world's largest shrimp exporter and has also been the number one exporter to the U.S. market. In 1993, exports from Thailand to the U.S. were 66,800 tonnes. The figure doubled in 2000, reaching 126,000 tonnes, valued at US$ 1.2 billion and accounting for 36.6 per cent of the total market share for shrimp exported to the U.S. This surpassed all other competitors.

Vietnam's exports of aquaculture and shrimp products to the U.S. from 1998 to current

In 2002, the export of Vietnamese aquaculture products to the U.S. market increased sharply by 2.14 times compared to that of 1999 (from 18,000 tonnes, valued at US$141 million, to 34,560 tonnes, valued

at US$ 302.4 million). This is the highest increase compared to all countries exporting to the U.S. market, and it accounted for three per cent of the total value of the U.S. aquaculture product imports. Frozen shrimp was in the majority with a volume of 15,700 tonnes, valued at US$ 218 million, and accounting for 76 per cent of total value of Vietnam's aquaculture products exported to the U.S. market. In this year, Vietnam became the world's fourth largest exporter of shrimp products in terms of volume to the U.S. market. Three main types of frozen shrimp products that have high economic value for export are: off-shelled frozen shrimp (US$ 103.7 million), processed frozen shrimp and unshelled frozen shrimp. Vietnam frozen shrimp accounts for 5.8 per cent of the total value of shrimp imported by the U.S. Though shrimp export to the U.S. market has a high growth rate, its market share is still rather small.

The volume of Vietnamese shrimp exports to the U.S. achieved its highest growth rate in 2001 and jumped up to the second position with 73,343 tonnes, more than two times the volume in 2000. The following table illustrates the general picture of shrimp export from ten main countries to the U.S.

Table 20 Shrimp export from ten main countries to the U.S.

Country	1997		2000		2001	
	Volume (thousand pound)	Percentage (%)	Volume (thousand pound)	Percentage (%)	Volume (thousand pound)	Percentage (%)
Total	***294.0***	***100***	***760.757***	***100***	***882.583***	***100.0***
1. Thailand	73.4	24.96	278.767	36.6	299.998	34.0
2. Vietnam			34.652	4.5	73.343	8.3
3. India	63.7	21.66	62.556	8.2	72.485	8.2
4. Mexico	34.0	11.56	64.097	8.4	66.175	7.5
5. Ecuador	20.0	6.80	42.101	5.5	58.995	6.7
6. China	12.9	4.38	40.130	5.3	61.766	6.9
7. Indonesia	12.8	4.35	36.942	4.9	34.939	3.9
8. Guyana	-	-	19.032	2.6	25.772	3.1
9. Brazil	-	-	12.998	1.7	21.647	2.5
10. Honduras	-	-	17.372	2.3	21.352	2.4
Other countries	-	-	152.110	20.0	146.111	16.5

Sources: (1) Glofish highlights series number 1993–1998; (2) the U.S. Department of Agriculture (USDA); (3) USA Fishery Products Annual 2001.

Distribution channels

As in the Japanese market, the U.S. has frozen store room systems to ensure a regular and sufficient supply for domestic market. The imported aquaculture products are also distributed to consumers through the distribution channels that are used for domestically produced aquaculture products. The store room system in the U.S. reserves about 400,000 tonnes of aquaculture products, of which 20,000 tonnes is shrimp. A country could export shrimp to the U.S. under a direct trading contract through the local distribution system, or through authorized agents in the U.S.

The most difficult obstacles in penetrating the U.S. market are non-customs barriers under the forms of indices for food safety and hygiene, quality, packaging, labels, etc., by FDA. Since December 18, 1997, the U.S. has applied the HACCP system.

6.2.3 EU market and the Vietnamese shrimp export

The European Union (EU) is one of the largest markets for shrimp. The three biggest importers are France, Spain and Italy, with an annual volume of more than 200,000 tonnes, accounting for more than 50 per cent of the total imports of shrimp to the EU market. In this market, cold water shrimp are the traditional products with three main categories: (1) cold water unshelled shrimp; (2) warm water unshelled shrimp; (3) processed off-shelled shrimp. The main suppliers of cold water unshelled shrimp are Norway, Greenland and Denmark. Warm water shrimp has been imported to the EU market since the end of the 1980s and always gains large market shares in Britain, France, Spain, and Italy. Warm water

shrimp, mainly cultivated in India, Ecuador and Bangladesh, have also gained a portion of market shares in the EU market.

EU shrimp import has increased dramatically and steadily since 1990. In 1990 import was 246,000 tonnes of all kinds of shrimps, valued at US$ 1,252 million,. In 1999 this figure increased to 370,000 tonnes, valued at US$ 2,186 million, almost twice the value imported in 1990. In 1999, major importers were Spain with 94 thousand tonnes, France with 73 thousand tonnes Italy with 41,000 tonnes and Germany with 24,000 tonnes. In 2002 the EU imported different kinds of shrimp representing a value of US$ 2,580 million.

The difficulties in penetrating the EU market for shrimp and other aquaculture products are non-customs barriers and the application of HACCP as a barrier for trade protection. The decision 91/493/CEE on quality and safety and hygiene of foods in accordance with HACCP standards, effective from July 1, 1998 allows products from countries with equivalent standards (in terms of laws, quality control, safety and hygiene-equivalent standards applied by the EU businesses) to be imported into the EU market. To date, the following ASEAN countries are eligible: India, Bangladesh, Singapore, Malaysia, Indonesia, Taiwan, the Philippines, Japan, Korea, China and Vietnam (68 enterprises of Vietnam are eligible to export their aquaculture products to the EU).

The major markets for Vietnam's shrimp exports within the EU are: Belgium, Italy, the Netherlands, Germany, Britain, France, Spain, Sweden and Denmark. To date, Vietnam shrimp products have not been able to penetrate the markets of Ireland, Finland and Luxembourg.

6.3 Competitive potentials of Vietnamese shrimp exports to some selected countries

In order to assess the comparative advantage of Vietnam shrimp for export with those of some other countries, namely Thailand, Indonesia, China, etc., the Revealed Comparative Advantages Indices (RCA) will be used. RCA is defined as the ratio between market share of a product from a country in the world market for the product, and the market share of the country's total export in the world total exports. RCA > 1 indicates that the country has comparative advantage in exporting the product, on contrary RCA < 1 indicates that the product does not have comparative advantage for export. It is noted that RCA reflects comparative advantage of a product at a point in time – at which all other factors are held unchanged.

6.3.1 Vietnam

In 1995, Vietnam's shrimp exports accounted for 5.64 per cent of the world total shrimp exports; market share of Vietnam's total export for all goods accounted for 0.106 per cent of the world total exports of all kinds of goods. Thus, we have RCA = 53.21. By 1998, the corresponding percentages were 5.43 per cent and 0.172, and RCA = 31.56. In 2001, the corresponding figures were 5.8 per cent and 0.26 per cent, and RCA = 22.3. These figures are reflected in the following table.

Table 21 Vietnamese shrimp exports and their value

Year	Market share of Vietnam's shrimp exports			Market share of Vietnam's total exports from all kinds of goods			Vietnam RCA for shrimp export
	Vietnam's shrimp export (thousand tonne	World's shrimp export (thousand tonne)	Market share of Vietnam's exported shrimp (%)	Vietnam's total export (mil. US$)	World's total export (mil. US$)	Market share of Vietnam's all exported goods (%)	
1995	62.2	1,245	4.91	5,449	5,103,000	0.106	46.3
1998	73.9	1,361	5.43	9,361	5,418,100	0.172	31.5
2001	87.0	1,500*	5.80	15,100	5,800,000**	0.260	22.3

*Notes: * and ** are estimated figures.*
Sources: (1) Annual statistics 2000, (2) Vietnam General Office for Statistics, Statistics Publishing House, Hanoi, 2001.

As can be seen from the table, Vietnam's RCA has gone down since 1995 (from 46.3 to 22.3).

6.3.2 Thailand

In 1995, Thailand exported 246,500 tonnes of shrimp, accounting for 19.79 per cent of the world's total shrimp exports; value of Thailand's total export was US$ 56.349 million, accounting for 1.105 per cent of the world's total value from exports thus RCA for shrimp exports of Thailand is 17.90. In 1998, the value of Thailand's exports was US$ 2,307 million (of which value from frozen shrimp exports was US$ 1,412 million and the value from canned shrimp exports was US$ 895 million), accounting for 21.32 per cent of the world's total value from shrimp exports (US$ 10,819 million); the value of Thailand's total exports from all kinds of goods was US$ 54,456 million, accounting for one per cent of the world's total exports, thus RCA for exports of Thailand's shrimp was 21.32.

Thus, over the period 1995–1998, RCA index for Thailand's shrimp exports increased (from 17.9 to 21.32). By 1998 only Vietnam's RCA was higher than Thailand's RCA, but by 2001 Vietnam's RCA equals Thailand's RCA in 1998. (In 2001, the value of Thailand's shrimp exports was US$ 2.1 million and its RCA for shrimp exports was 23.5).

6.3.3 Indonesia

In 1995, Indonesia exported 110,000 tonnes of shrimp, accounting for 8.83 per cent of the world's shrimp exports. The value of Indonesia's total exports from all kinds of goods was US$ 45,417 million, accounting for 0.88 per cent of the world's total exports; thus, Indonesia's RCA was 10.03. By 1998, the value of Indonesia's shrimp exports was US$ 862 million, accounting for 7.96 per cent of the world's shrimp exports. The value of Indonesia's total exports was US$ 48,487 million, accounting for 0.89 per cent of the world's total exports; thus, Indonesia's RCA was 8.9. In 2001, estimated value of Indonesia's shrimp exports was US$ 900 million (of which, US$ 520 million from export to Japan market, US$ 256 namely Vietnam, Thailand, and Indonesia, thus RCA was 8.5.

Table 22 Summary of the three largest shrimp exports

Year	RCA for shrimp of Vietnam	RCA for shrimp of Thailand	RCA for shrimp of Indonesia
1985	46.30	17.90	10.03
1988	31.50	21.32	8.90
2001	23.30*	23.5**	8.50***

*Notes: *, **, *** are estimated figures, not official.*
Sources: (1) FAO yearbook – Fishery Statistics Commodities 1994/1995, 1980–1998, (2) 2001 annual statistics, General Office for Vietnam statistics, (3) Statistics Publishing House – Hanoi 2001.

The figures in the table illustrate that RCAs of Vietnam and Indonesia are decreasing while Thailand's RCA has increased since 1995. However, currently, Vietnam, one of the countries with the highest

competitive advantage for export of shrimp (three times higher than Indonesia's RCA and almost equal to that of Thailand).

However, it should be noted that RCA criteria reflect the comparative advantages for shrimp export at a hold status (all other factors are constants). It does not reflect the dynamic attributes of the comparative advantages. To have a comprehensive comparison, the other factors, namely productivity of cultivation, cultivated production, average price of exported shrimp, capacity of the industry sector for processing of shrimp for export, etc., should be taken into consideration.

Table 23 Summary of RCA indices from different countries

Comparative criteria	Vietnam		Thailand		Indonesia	
	1995	1998	1995	1998	1995	1998
1. Cultivated production (1,000 tonne)	39	87	257	240	89	103
2. Processed production of frozen shrimp (1,000 tonne)	39	42	165	147	78	124
3. Processed production of canned shrimp (1,000 tonne)	0	0	110	104	19	19
4. Production from natural exploitation (1,000 tonne)	-	80	-	124	-	226
5. Average productivity of cultivation (tonnes/ha/year)	0.282	-	2.444	-	-	-
6. Average price of shrimp products for export (US$/kg)	5	-	>10	-	-	-

Sources: (1) Centre for Science and Technology Information – Ministry of Fishery, (2) Fishery Information Series No. 2 and 3, 2002.

The data in the table show that almost all indices of Thailand are far better than those of Vietnam, especially productivity of cultivation (Thailand's productivity is 8.66 times higher than Vietnam's productivity). The price of Thailand's exported shrimp is always US$ 2.0–2.5/kg higher than that of Vietnam and Indonesia for the same kind of products when exporting to the U.S. market. Price of Indonesia's shrimp exporting to Japan is more than 10 per cent higher than that of Vietnam's products of the same kind.

6.4 International market trends and the potential impacts of increased shrimp production on the prices

6.4.1 Trends of international market prices of exported shrimp

Prices of shrimp in the international market have been up and down. Levels of fluctuation depend on specific markets, specific shrimp of different sizes, different quality, different processing methods, and places of origin. In general, the prices decreased over the period 1988–1992 due to abundant supply, resulting from a boom of shrimp cultivation in the world, and reduction of demand in the large markets due to economic crises. From 1994, the prices increased due to reduction of shrimp supply from China. In early 1995 and during 1996, the prices slightly decreased and demand in Japan and the U.S. markets fell into stagnation. Over the period 1997–1999, the international prices of shrimp increased sharply due to shortage of supply of cultivated shrimp (especially from Thailand), resulting from diseases. In the U.S. market, within 1997, prices for normal-sized shrimp dropped by 20 per cent, and even in 1998 compared to US$ 5.25 in March 1997. In the EU market, the price of grass shrimp of all sizes in late 1997, was US$ 2/kg, higher than in late 1996. In 1998, prices in Japan and all other markets were maintained high. Price of head-cut shrimp and grass shrimp from India and Thailand of size 16/20 was more than US$ 20/kg in February 1998, the highest price since 1994. From 1999, prices of shrimp in the international market have been stagnant due to economic crises and reduction of consumption in the Japanese market.

Prices of shrimp in the international market are strongly affected by the changes in demand in three giant markets, the U.S., Japan and the EU.

The U.S. market

In 2000, the United States of America, the largest importer of frozen shrimp, imported shrimp of US$ 3,700 million in value, accounting for 37 per cent of total import of all kinds of aquaculture products. Average price for shrimp imported into the U.S. market increased from US$ 7.8/kg in 1991 to US$ 9.6/kg in 1996 and US$ 10.9/kg in 2000. In other words the price index increased by 40 per cent after 10 years. According to an announcement by the U.S. navigation office, Vietnam exported into the U.S. market 15,718 tonnes of frozen shrimp, valued at US$ 218 million, at a very high average price of US$ 13.8/kg.

In early 2002, prices for shrimp imported from Middle East countries were still high: US$ 7.30–7.40/kg for shrimp of size 16/20. Prices for shrimp from Asian countries slightly decreases, for example Thailand's unshelled shrimp of size <15 decreases to US$ 7.80–7.90/kg.

Japanese market

In 2001, the imported volume of shrimp decreased about 1.6 per cent from that in 2000, but the imported value deceased by 6.5 per cent, and the average price of imported shrimp decreased by 5.1 per cent (average price for the imported shrimp was 1,137 JPY/kg in 2001, and was 1,197 JPY/kg in 2000). In 2001, the price for frozen shrimp from Indonesia for the Japanese market decreased by 6.5 per cent in comparison with its price in 2000. Current prices for frozen shrimp exported from Vietnam to Japan are very low, only 981 JPY/kg while the average price on this market is about 1,137 JPY/kg (the highest prices of 1,338 JPY is for Thailand’s grass shrimp).

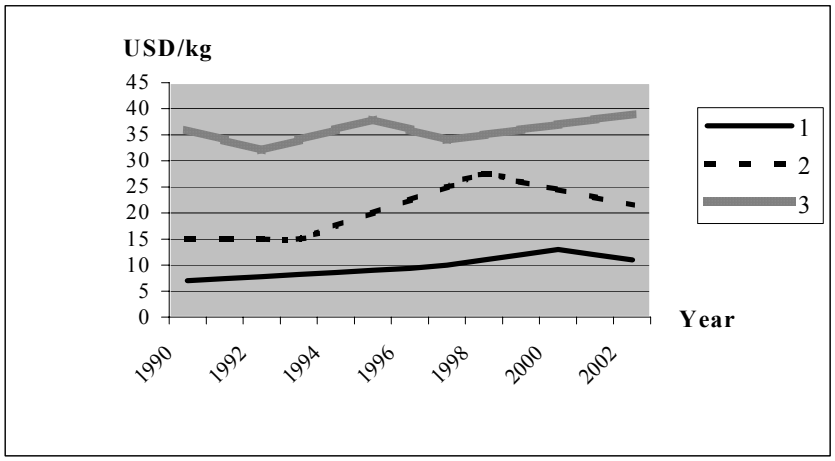
According to predictions, world shrimp production will increase by an average rate of 3.5 per cent/year over the period 2002–2005 and by 3.2 per cent/year over the period 2006–2010, reaching 4,504,000 tonnes by 2005 and 5,272,400 tonnes by 2010.

Shrimp demands

With a high increase of shrimp production and cheap comparative prices, consumption of shrimp becomes more popular in all countries. However, shrimp remains a product for high-income communities. According to predictions, world shrimp consumption will increase by an average rate of 3.2 per cent/year up to 2005 and 3 per cent/year over the period 2006–2010. The highest growth rate of consumption will be in China, Korea and Taiwan.

The growth rate in value of exported shrimp during the booming period 1985–1995 was 14 per cent/year. Over the period from 2002 to 2005, the forecasted growth rate will increase by 2.6 per cent/year (due to maturity of markets in the U.S., Japan and the EU). Because the supply of shrimp will not be very high and demand in the Japanese market will recover, the world price for shrimp will remain high.

From the above analysis and prediction about price prospective, the following figure illustrates changes in shrimp prices in the international market over two periods: 1985–2002 and 2002–2010.



1: Illustrating prices of frozen shrimp in the U.S. market
2: Illustrating head-cut grass shrimp (size 16/20) in Japan and other markets (shrimp from Thailand, India and Vietnam)
3: Illustrating prices of lobster in Hong Kong market

Figure 10 Changes in shrimp and lobster prices on the world market from 1990 to 2002
Sources: (1) Infolish International No.1/1997 (2) Centre for Trade Information, Ministry of Trade (3) U.S. Department of Agriculture (USDA); (4) Japan Fishery Products Annual 2001.

6.4.2 Potential price impacts of shrimp product increase cultivated on sandy land

There are four main factors that influence demand changes, changes of shrimp for export, and prices in the international market.

- Economic growth of major shrimp markets: U.S., Japan and the EU.
- Scale and growth rate of shrimp production from cultivation throughout the world, especially in Asia.
- Level of meeting standards on food's safety and hygiene as imposed on imported shrimp products by major importers (U.S., Japan and the EU).
- Level of meeting standards about environment of cultivated shrimp as imposed by main importers (U.S., Japan and the EU).

The main causes of changes in shrimp import by Japan and of decreases of shrimp prices in international markets are difficulties and economic crises in Japan during the 1990s and high prices of shrimp. A boom of shrimp cultivation throughout the world directly caused a decrease of shrimp prices in the international market during the period 1988–1992, and the spread of disease in shrimp cultivated in Asia, especially in China (1994) and in Thailand (1997). As a result, disease caused a reduction of shrimp production, leading to an increase in price in the international market in 1994 and 1997–1998. Besides general customs duties that are gradually reduced thanks to implementation of free trade policies (especially, from the Uruguay negotiations that defined the tax rate for aquaculture products to be imported into developed countries as only five per cent, a decrease of 26 per cent compared to the previous rate), the international rules and principles have direct influence on the decrease of shrimp prices in the international market. Other non-customs duties relating to food safety and hygiene and environment requirements also set obstacles for international trading of shrimp, particularly on volume and prices of shrimp exported from developing countries which depend heavily on shrimp export. For example, since December 18, 1977, the U.S. has applied HACCP and also implemented an embargo (set to be effective from May 1996 by the U.S. court) on the import of shrimp where the cultivation has caused devastation of wetlands and other environmental degradation. All of this has limited the export of shrimp from Asian countries to the U.S. In 2002, China's shrimp industry faces a downturn with huge price decreases due to a rejection of shrimp imported from China with a value of US$ 285 million. EU inspectors arrived at this rejection agreement after discovering contamination of Chloramphenicol in exported products from China in 2001. Similarly, prices of shrimp in the Thailand market decreased considerably because of the fears by consumers that shrimp imported from Malaysia may contain lead because of an increase in shrimp weight.

It is obvious that the development of shrimp cultivation on sandy lands presents a new direction and has great potential since it eliminates the risks of shrimp cultivation on wetland areas and forests, such as diseases from contaminated and polluted environments and the degradation of the environment, etc.

Development of shrimp cultivation on sandy lands (eliminate and control diseases) ensures a stable supply, helping to reduce the comparative shrimp prices in the international market. In addition, shrimp cultivated on sandy lands could well meet standards on food safety and hygiene, and standards on the environment. This will allow protective barriers imposed by major markets such as Japan, the U.S. and the EU to be overcome leading to higher prices in comparison with prices for shrimp cultivated in wetland areas or forests.

6.4.3 In summary

Shrimp cultivation on sandy lands would have great impact on the prices of shrimp in the international market in two ways: (1) decrease of prices thanks to stable supply (with elimination and control of disease); (2) increase of prices thanks to increase in demand as a result of the application of new cultivation and processing technologies which allow increased productivity; reduced prices on raw materials; and therefore a reduction of the price on export products. In addition, the trade liberation process in the world also forces importing countries to reduce tariffs and non-tariff barriers, thereby facilitating good exchanges that will influence the shrimp price by reducing it on the international market.

6.5 Challenges for Vietnam as a shrimp exporter when penetrating foreign markets - some suggested solutions

The potential challenges are illustrated within the following major aspects:

6.5.1 First

The production costs of Vietnamese shrimp for export are much higher than competitive countries (Thailand, Indonesia and China). This is mainly due to low productivity and low quality. Areas for industrial and intensive cultivation account for a small percentage. The aquaculture cultivation program for the period 1999–2010 set its objectives of only 260,000 ha for grass shrimp cultivation, of which 60,000 was for industrial cultivation and 100,000 ha for semi-intensive cultivation by biological balance model (in fact it is extensive cultivation). According to fishery economics experts, investment in intensive cultivation will result in a return on investment ratio of 2.2 times higher than that of extensive cultivation, and productivity three times higher than that of extensive cultivation.

High costs and low quality of materials, together with a number of other weaknesses in the processing industry for aquaculture products: 60 per cent of businesses are using obsolete equipment and technology that would not comply with strict standard control, while the standard determines the prerequisite conditions for export to markets of the EU, the U.S. etc. This also leads to low quality, high export costs and a weak competitive position.

In order to overcome these obstacles, on one hand, Vietnam needs to further promote industrial and intensive cultivation. On the other hand, Vietnam should enhance changes in technology and equipment in processing enterprises, in order to improve capacity and quality and reduce shrimp export costs.

6.5.2 Second

Shrimp for export from Vietnam are mainly cultivated in wetland forests, wetland areas in the southern lands and coastal areas. Therefore, shrimp are easily infected by toxins and diseases. As a consequence, Vietnamese shrimp exports face a lot of difficulties in meeting technical standards, food safety and hygiene barriers, and "green barriers" imposed by strict markets like the EU, Japan and the U.S. The expansion of shrimp cultivation areas in the world has led to severe devastation of wetland forests, contamination of water and land, salting down of agricultural lands, and degradation of the environment. As a result, the giant importers of shrimp, namely the U.S., the EU, and Japan are increasingly concerned and paying more attention to balancing international trade and environment in order to ensure sustainable

development. As a result, these large countries will be much stricter in applying "green barriers" and barriers on food safety and hygiene. Under such circumstances, if Vietnam has not been able to shift to industrial cultivation and the practice of cultivation on sandy lands, it will face even more obstacles in penetrating world markets.

To address this problem, Vietnam should not enhance the expansion of wetland areas in the southern lands for shrimp cultivation. Instead it should shift to investment in and development of shrimp cultivation on sandy lands in the coastal areas in the northern and central parts of the country.

6.5.3 Third

On one hand, in all three large markets for shrimp – the U.S., the EU and Japan – there exist well-established, widely-covered, and well-functioning systems of multi-levelled distribution channels (especially in the Japanese market). On the other hand, Vietnamese businesses that export shrimp, lack experience working in foreign markets and lack resources for market expansion. As a consequence, Vietnamese businesses will have many difficulties if they try to establish their own systems of channels in these three markets.

To overcome this difficulty Vietnamese businesses should find ways to penetrate these markets, or cooperate with foreign businesses that are already involved in the existing distribution channels in the EU, the U.S. and Japan). It means that Vietnamese businesses should not enter into direct competition, but cooperate with main players of both aquaculture products and shrimp products in existing distribution channels in these large markets.

7 SUMMARY ON WORKSHOP AND RESEARCH REPORTS ON SANDY LAND AQUACULTURE

By

Dr. Vu Van Trieu, Vice Director
International Cooperation Department, MoFI

7.1 Introduction

Since the early 1990s, sandy land aquaculture has been performed in Southeast Asia, and the production of tiger shrimp for export has been robustly developed. Recently, tiger shrimp farming has developed strongly in the Middle East in countries like Oman, Saudi Arabia and the United Arab Emirates, and in Eritrea in Africa.

However, on-sand tiger shrimp cultivation was not introduced in Vietnam until 1999, when a small area was converted at Tu Thien ward, Phuoc Dinh commune, Ninh Phuoc district, Ninh Thuan province. The cultivation was conducted on an area of 0.5 ha with nylon materials covering the edges and bottom of the cultivation pond, serving as a waterproof measure. Since the economic and productive achievements were encouraging, the cultivation area had increased to five ha by 2000, and allowed two crops per year with an average productivity of two–three tonnes/ha/crop. Shrimp cultivation has proven to be capable of producing high economic returns, which has led to increasingly large areas being converted to aquaculture purposes. In Ninh Thuan province alone, the area used for shrimp cultivation had increased to 120 ha in 2001, and already within the first six months of 2002 the area was 180 ha. In a bid to prevent cultivation ponds from being established in a scattered and unplanned way, Ninh Thuan Fisheries Department drew up a plan for the development of shrimp cultivation on sandy land covering an area of 648 ha, using a model combining fisheries and forestry. The Fisheries Department also requested that the government invest in the development of roads, power supplies, pumping stations, water supplies and drainage channels, totalling a cost of VND 20.3 billion (US$ 1.3 million).

In 2000, the Fisheries Economics and Planning Institute within the Ministry of Fisheries (MoFI) conducted successful surveys on establishing tiger shrimp ponds on sandy land, using nylon covers as waterproof material.

The potential of sandy land aquaculture was announced in the mass media, raising the awareness of the provincial Fisheries Extension Agencies and Departments together with fishermen living in the central coastal provinces. They also visited Ninh Thuan and Quang Ngai provinces in order to learn about this cultivation technique.

Leading officials within MoFI were also aware of the great potential of sandy land aquaculture in the central coastal areas of Vietnam. Therefore, in order to assess and learn about the risks and impacts of this development on the environment and on economic and social conditions, in early 2001 MoFI directed the provincial Fisheries Departments and Fisheries Extension Centres to conduct field trips within their provinces. Furthermore, MoFI directed the Central Fisheries Extension Centre to prepare a national workshop on sandy land aquaculture to be held in early 2002, so that experiences could be exchanged and a general orientation towards securing sustainable development could be agreed upon.

By the end of 2001, the International Institute for Sustainable Development of Canada (IISD) and IUCN – Vietnam agreed to provide support to MoFI by assigning experts to conduct research on sandy land aquaculture development in five focal provinces. Several fieldtrips were conducted to the provinces of Ninh Thuan, Quang Ngai, Quang Binh, Quang Tri and Thua Thien Hue during May and June 2002. A national workshop on the challenges and opportunities of developing aquaculture on sandy lands was held in Ninh Thuan on July 22–23, 2002, with 184 people participating. The organization and execution of the

workshop was assisted by the People's Committee of Ninh Thuan province who hosted the workshop in Phan Rang.

The challenges, opportunities and proposals for the future that were recognized at the workshop are presented below.

7.2 Potential of on-sand aquaculture areas

The central provinces of Vietnam possess large areas of fallow sandy land and land used for growing low-productivity cash crops. This land can be beneficially converted into aquaculture development. According to reports, the total sandy land area of the five surveyed provinces is 73.300 ha, distributed as 39.000 ha, 13.000 ha, 10.000 ha, 10.000 ha and 1.300 ha in Quang Binh, Quang Tri, Quang Ngai, Ninh Thuan and Thua Thien Hue respectively.

Preliminary estimation of sandy areas in the central southern provinces is about 100.000 ha, 15.000 of which can be reclaimed for aquaculture purposes.

7.2.1 Preliminary results of sandy land aquaculture in the five surveyed provinces

- Ninh Thuan province: The first sandy land aquaculture pilot site was established here, and the province has the fastest development of on-sand tiger shrimp farming. Whereas the initial 0.5 ha established in 1999 had a productivity of two tonnes/ha/crop, the average productivity had increased to three tonnes within a year. In 2001, shrimp ponds covered an area of 120 ha producing an average of four–five tonnes/ha/main crop and yielding a yearly average of 7.5 tonnes/ha. Some ponds even produced as much as 9.6 tonnes/ha/main crop generating an average profit of VND 140 mill/ha/year. By the first half of 2002, as much as 180 ha of sandy land has been converted to the cultivation of tiger shrimp and the average productivity is estimated as high as seven–eight tonnes/ha/year.
- Quang Ngai province: In this province pilot sites have been set up successfully by the Fisheries Economics and Planning Institute in 2000. By 2002, the total farming area was 40 ha with a productivity of 2.9– 4.5 tonnes/ha/crop.
- Quang Binh province: By 2002 the area used for on-sand tiger shrimp cultivation was 14 ha producing three–five tonnes/ha/crop.
- Thua Thien–Hue province: In 2002, 16.2 ha of sandy land is being utilized for cultivating tiger shrimp and produce between two–four tonnes/ha/crop.
- Quang Tri province: In 2002, six ha are being used for on-sand tiger shrimp cultivation with an average productivity of three tonnes/ha/crop.

7.3 Advantages and disadvantages of developing aquaculture on sandy land

7.3.1 Main advantages

- Central coastal provinces have huge areas of unutilized sandy land, agricultural land with low productivity, ineffective land for salt production and fallow land. Much of this land is located in tidal areas with reasonable stabile environmental conditions that will allow a shift to aquaculture in general and tiger shrimp cultivation in particular.
- Sandy areas or unproductive land that has been planned for aquaculture purposes generally does not affect other infrastructure developments. The cost of land clearance is quite low and progresses fast, which favours this kind of development.
- The establishment of ponds in sandy areas using insulation materials will prevent water leakage and also reduce the potential spread of diseases between ponds.
- Sandy land shrimp cultivation is a dynamic activity. Water supply does not depend on tidal flooding since it is pumped directly from the sea, thereby ensuring water quality. By placing the ponds on high

ground and covering the edges and bottoms with nylon material, they can easily be cleaned to prevent disease.

- Intensive and semi-intensive shrimp cultivation based on a limited water change or, at least, on one only using treated water, has been applied by provinces and has shown good results and cost-effectiveness.
- In practice, sandy land aquaculture in the coastal areas of the central provinces of Vietnam has shown that productivity can be doubled by implementing co-efficient methods of pond usage, thereby reducing costs and improving shrimp productivity.
- On-sand shrimp cultivation contributes to the improvement of the coastal environment by increasing humidity and thereby favouring surrounding plant growth.
- On-sand shrimp cultivation brings about high economic returns, provides jobs and reduces hunger and poverty, thereby improving overall livelihoods while reducing the pressure on inshore fishing. Furthermore, the development of sandy land shrimp farming is expected to create favourable conditions for the development of other industrial sectors by, for example, increasing demand for waterproof materials, feed supply, fish fry and mechanical services.

7.3.2 Main disadvantages

- Presently, most of the households engaged in the cultivation of shrimp are pumping marine water directly from the sea into the settlement ponds, where it is treated before it is transferred into the cultivation ponds. Freshwater is extracted from underground sources via wells. Whereas the supply of marine water is plentiful, the supply of freshwater is lacking due to limited surface water and groundwater resources in adjacent areas. The development of on-sand shrimp cultivation is therefore faced with a problem of freshwater shortage. The exploitation and use of deep groundwater will affect the land layers and, in the long run, cause earth compilation that will impact the infrastructure and lives of local people.
- The sandy areas of the central coastal provinces are recognized as being extremely warm. Whereas this condition is favourable for shrimp growth, the severe heat creates high evaporation, thereby increasing the salinity level in the culture ponds. If the freshwater problem is not solved so that salinity levels can be controlled, the productivity of the shrimp will fall.
- Many households do not pay enough attention to the treatment of waste and sludge from the cultivation ponds, and the discharged water is not treated before led into the surrounding environment. Sooner or later this will cause adverse impacts on the surrounding environment and may, in the end, even affect the cultivation itself.
- Because the development of aquaculture is a new production method in sandy areas, it demands high investments. Many of the potential production sites lack the appropriate infrastructure, power supply, water supply and drainage systems. The problem is that the coastal communities are often very poor and therefore lack the capital needed for the investments.
- Although ponds are located in high tidal areas and therefore quite secure, they are still contiguous to the sea. Storms and high winds affect the aquaculture production and the infrastructure's durability is reduced.
- Improved cultivation techniques specifically targeted at shrimp cultivation on sandy lands are needed in order to secure high productivity and long run sustainability. Specifically, this involves researching alternative insulation materials and how to use of organic or inorganic fertilizers and other bio-product in the initial phases of production, without creating severe adverse environmental impacts. Fertilizers are needed since the water's nutrient level is very poor.

7.4 The technology process of sandy land aquaculture

Overall, the technology and methods applied when cultivating shrimp on sandy land are much the same as those used in ponds in other high tidal areas. The same considerations and farming techniques are applied

when it comes to the site design, the setting of the culture and settlement ponds, the water supply and drainage systems, the cleaning of the ponds before releasing the fry (pH adjustment), the use of fertilizers, the removal of trash fish, the density of the fry, the breeding regime, the culture time and the harvest methods. However, cultivating shrimp on sandy land does require the adoption of special water keeping regimes that involve covering the pond edges and bottoms with waterproof materials. The distinctive characteristics and conditions surrounding sandy land aquaculture are outlined below.

- Water is kept inside the pond by using waterproof materials like PE nylon, thin layered tarpaulin or HDPE imported from Malaysia, which is expensive but durable.
- As the sandy embankments and waterproof materials are thermal absorbers, the water temperature inside the pond is subject to fluctuations, which negatively influence the shrimp's willingness to feed and causes algae-death.
- The correct colouring of the water is more difficult compared to in-land based ponds.
- The cleaning and treatment of the pond bottom is easier and better in minimizing the contamination of the water caused by the dissolution of waste.
- The pond’s bottom is siphoned during the culture period, thereby reducing organic sediments and ensuring clean water.
- Harvesting the shrimp is rather unproblematic since the walls and bottoms of the ponds are quite smooth.

Thanks to the technical guidance of the Fisheries Departments, many involved parties, to a large extent, have managed to follow the technological procedures for cultivating shrimp on sandy land. The achievements are therefore followed with optimism. However, some farmers have not attended any training courses and therefore lack the technical knowledge and expertise concerning issues such as: the need to control salinity levels, the appropriate pond water level in the different growth periods, the impacts of shallow water levels on the growth rate, the optimal density of shrimp and the appropriate way to treat water discharged from the cultured ponds. In some cases water is even discharged directly into the sea close to the water supply, which eventually will have an adverse impact on the cultivation process.

7.5 Environmental issues linked to sandy land aquaculture activities

7.5.1 Benefits from cultivating shrimp on sandy land

- Sandy land shrimp cultivation contributes to the reduction of coastal erosion and increases the solidity of the coastal areas.
- By developing sandy land shrimp cultivation, fallow and low-producing areas are reclaimed and exploited in a more efficient manner.
- The shrimp ponds increase air humidity and the plantations created around them are developed in line with models for forestry-shrimp production, and will contribute to improving livelihood and the national defence security.
- Beneficial production techniques:
    - The structure and set-up of the cultivation ponds make them easy to clean by removing organic matter, drying the sandy bottom and adjusting the pH level.
    - Cleaning the ponds during the cultivation period by siphoning the bottom, reduces the contamination of the water caused by resolution of shrimp faeces and remaining feed.
    - In order to ensure the hygiene and safety of harvested shrimp, sandy land cultivation limits the use of chemicals and antibiotics.

7.5.2 Environmental challenges faced by developing aquaculture on sandy land

When culturing any species, there is a need for appropriate and sufficient awareness regarding aspects of environmental sustainability. Raising awareness is therefore an important element in orientating production development. For shrimp cultivation on sandy land the relevant environmental issues are as follows:

7.5.3 Groundwater exploitation for shrimp cultivation

According to expressed opinions and practices, some provinces are able to estimate the amount of freshwater needed for one ha of sandy land shrimp cultivation.

The estimation is based on the following considerations and assumptions:

a) The water level of the pond used for leasing the fry is about 0.8–1.0 m which, after two weeks, gradually is increased until the water level is stable at 1.4–1.5 m or more.

b) A certain volume of freshwater is needed to reach the salinity level most appropriate for each growth period of commercial shrimp.

Based on an average depth of 1.4 m during the cultivation period (six months), the total water volume per ha/pond is 14,000 m^3. Every two weeks, this volume should be increased 20 per cent (2,800 m^3) to account for evaporation. During the entire cultivation period a contingency of 50 per cent (7,000 m^3) is included. In summary, this means that the total water volume required for cultivating one crop is 54,600 m^3/ha (14,000 m^3 + 12 x 2,800 m^3 + 7,000 m^3).

Of the 54,600 m^3, 30–50 per cent should be freshwater, allowing for appropriate adjustments to the salinity level. This means that for each farming cycle there is a need for freshwater in the range of 16,380 m^3–27,300 m^3 per ha. If there are two farming cycles per year the amount of freshwater needed increases to 32,760 m^3/ha – 54,600 m^3/ha.

As mentioned earlier, the abuse of groundwater from wells will cause landslides and increase the salinity intrusion into the inland areas.

Water discharged from shrimp cultivation ponds

Farmers lack the experience in environmental management in aquaculture practices. The discharge of wastewater from cultivation ponds will contribute to the contamination of groundwater, causing adverse impacts on the plants and livelihood.

Possible risks of cultivating shrimp on sandy land

At present, people voluntarily spend their money investing in pond development. However, there is no planning and people lack knowledge and experience of cultivation technology and sustainable environmental management. This, together with the fact that the local authorities have not yet issued specific regulations, causes the following:

- Protective forests will be reduced rapidly.
- Groundwater is extracted in an unplanned manner leading to overexploitation, landslides and salinity intrusion that directly impacts the people's livelihoods.
- The unregulated discharge of wastewater directly to the surrounding environment will cause the spread of diseases and groundwater contamination.
- The careless selection of cultivation sites and the refusal to integrate aquaculture development with afforestation, will cause sand to fill the ponds during production.
- Due to the complicated terrain of some coastal areas, the development of a water supply system is difficult, and the use of these areas for cultivation purposes is therefore either brief or non-existent.

7.5.4 Measures needed to be implemented in order to reduce environmental impacts and to improve shrimp productivity

- Planning is crucial when developing aquaculture investment projects on sandy land.
- Selected localities should gradually implement the co-management model for sustainable exploitation of land resources.
- Priority should be given so that sandy land shrimp cultivation is conducted on fallow land or in deserts for the benefit of economic development and environmental improvement (air humidity increase, development of afforestation).
- The development of aquaculture projects on sandy land should take the following into consideration:
  - An EIA, including the assessment of groundwater resources is needed as a basis for identifying areas for expansion and appropriate cultivation species.
  - In terms of projects focusing on the development of intensive tiger shrimp cultivation (over 10 ha), the pre-requisite should be given to securing freshwater resources from reservoirs, lakes and rivers.
  - For areas where only one groundwater source exits, projects should plan accordingly the cultivation of species. Part of the areas can be used for farming tiger shrimp (in accordance with groundwater volume), but the remaining area should be used for species compatible with high salinity levels and direct feed such as marine fish and mollusc-like sweet snails.
  - For areas suffering from sand storms, the location and setting of the ponds and water supply system should be carefully considered and protective measures be taken (afforestation).
- Regarding production techniques:
  - In order to ensure a lengthy use-period and long durability of the shrimp cultivation ponds, the average depth of the pond should be 1.5 to 1.6 m.
  - A 30–50 cm layer of sand, creating good living conditions for shrimp, should cover the insulation material on the bottom of the pond.
  - Very frequent water change should be avoided in order to limit the risk of spreading diseases (water is mainly changed if any incidents happen).
  - The water quality and amount of water in the cultivation ponds should be clean and of a sufficient amount according to the technological requirements of the growing periods. Shrimps with a size of PL 15 should be released into the cultivation ponds (shrimp sizes of two–three cm should be avoided, as they are easier infected). The density of PL 15 sized shrimp should be in the range of 30–40 individuals per m^2 (40 individuals being the maximum).
  - The salinity level should be adjusted according to the growing periods: the first month: 20–30 per cent; the second month: 18–25 per cent; the third month; 15–18 per cent; the fourth month: 20–30 per cent.

In brief, in order to achieve a high productivity of shrimp, farmers should strictly follow the technical processes from the time the site is selected until the pond is constructed, and from the time the layout design is created (culture pond system, water supply and drainage system) until the reclamation of ponds, cultivation and harvest.

The Fisheries Extension Departments should bear the costs of conducting training courses on sandy land shrimp cultivation techniques and sustainable environmental management. Visits to the successful cultivation sites should be organized, enabling people to gain access and information about the successful methods of production. Information about production development policies and relevant regulations on environmental protection and sustainable shrimp cultivation should also by transferred to the people.

7.6 Proposals

7.6.1 Proposals to the government

- The government has proposed to increase the annual state budget allocated for aquaculture development including infrastructure, power and water supply, drainage systems and wastewater treatment for sandy land shrimp cultivation.
- Based on the hardship of the people living in the sandy areas, the Prime Minister should be prepared to give mortgage-free loans in the amount of VND 50 million to households engaged in aquaculture.
- It is proposed that the loan should be given for a five-year period, as is the case for mountainous areas according to Decision 132/2001/QD-TTg.
- The government is kindly requested to strengthen the capacity and funds available for fisheries extension activities.

7.6.2 Proposals to the ministries and sectors

- The Ministry of Planning and Investment has proposed balancing the budget to allow for increased annual investments in the aquaculture program. .
- The Ministry of Science, Technology and Environment and the Ministry of Agriculture and Rural Development are requested to assist in solving the planning issues of aquaculture development, in order to ensure the sustainability and protection of the ecological environment as well as the hygiene and safety of cultivated products.

7.7 Conclusion

Aquaculture, including cultivation on sandy land, is in a transitional phase. The wise use of sandy areas includes the conversion of fallow and unproductive land to aquaculture development. The integration of aquaculture as part of the ecosystem and environment, as well as the protection and development of protective forests, are compatible with the principles of developing sustainable shrimp cultivation.

The development of aquaculture on sandy land fully utilizes the natural conditions when specific species like brackish water shrimp and other economically valuable species are cultivated. The development of sandy land aquaculture in general and shrimp cultivation in particular, have the potential of being sustainable and effective by creating products for society, as well as ensuring high quality and safe products for export.

Developing sandy land aquaculture will provide jobs for the people, thereby contributing to poverty reduction and hunger alleviation in the coastal areas.

Aquaculture on sandy land should be based on the well-planned development of specific areas. The planning of alternative production structures should be agreed upon by the producers and technicians.

Based on directions given by the government, MoFI, in cooperation with MPI, MoF, MARD and MoSTE, will create favourable conditions for coastal provinces, which have the potential to develop sandy land aquaculture. Favourable conditions will include investments in infrastructure (roads, power supply and marine and freshwater supply system) according to approved plans. At the same time, the aforementioned ministries will facilitate the needed capital and provide technical guidance to the people who wish to take part in setting up sandy land aquaculture, thereby creating jobs, generating income and contributing to the overall socio-economic development of the area.

APPENDIX

WORKSHOP AGENDA

July 22–23, 2002 at Phan Rang, Ninh Thuan

Monday (July 22, 2002)

- Visiting sandy land shrimp aquaculture sites

Lunch

- Introduction of participants and opening statement by Dr. Nguyen Viet Thang, Vice-Minister of Fisheries

  "The most important question that needs attention is how to make sure that Sandy Land Shrimp Aquaculture is managed sustainably. SLSA offers great potential as a means of poverty alleviation and rural development, and is therefore highly supported by the government."

- Opening Statement by Chairman/Vice-Chairman of Ninh Thuan Province

- Presentation by Dr. Nguyen Van Thanh, Vice-Director of The Fisheries Department, MoFI

  "Sandy Land Aquaculture, Restructuring Production"

- Presentation of research report by Mr. Tran Van Quynh, Director of The Centre for Fisheries Extension, MoFI

  "Report on Status Appraisal and Development Trend of Tiger Shrimp Culture on Sandy Soil"

- Presentation by Mr. Luu Xaun Vinh, Director of Ninh Thuan Fisheries Department
  "Current Status of Shrimp Aquaculture on Sandy Land in Ninh Thuan Province"

Tea/coffee break

- Presentation of research report by Ms. Nguyen Thi Phuong Lan, Science and Technology Department, MoFI

  "Status of On-sand Shrimp Culture in the Central Provinces and Sustainable Management of the Environment"

- Presentation by Mr. Tran Ngoc Hien and Mr. Do Van Ngo, farmers from Ninh Thuan Province

- Presentation by Biotech Company introducing organic farming products

- Presentation by Dr. Prof. Nguyen Van Truong, Director of ECO-ECO (local NGO)

Dinner

Tuesday (July 23, 2002)

- Presentation by Dr. Ha Xuan Thong, Director of the Institute for Fisheries Economics and Planning, MoFI

  "Planning of Aquaculture Activities for the Shrimp Aquaculture Development Toward Safe And Sustainable Environment, Hygienic Production and Urgent and Strategic Demands"

- Presentation by Mr. Mr. Phan Phu Rong, Vice-Director of Ninh Thuan Department of Science, Technology and Environment

- Mr. Mai Xuan Thu, Director of Quang Binh Fishery Department (*on behalf of Mr. Hoang Dinh Yen*)

  "Potentials for the Aquaculture Development on Sandy Lands in Quang Binh Province and Development Orientations"

Tea/coffee break

- Presentation of research report by Dr. Tran Cong Sach, Director of Science and Training Department, Ministry of Trade

  "A Study on International Export Implication of Expanding Aquaculture in Vietnam"

- Presentation by Dr. Enamul Haque, expert from Bangladesh

- Presentation by Dr. Nguyen Tu Cuong, Director of NAFIQACEN Centre

  "Report on the Current Status of the Concentration of Antibiotic, Toxic Chemical Residues In Fisheries Products of Vietnam and Requirements on Safe Hygiene for Shrimp Products"

- Presentation by Mr. Aaron Cosbey, International Institute for Sustainable Development

- Conclusion and Closing

Lunch

END

LIST OF PARTICIPANTS

Ministry of Fisheries

Dr. Nguyen Viet Thang, Vice Minister

- Department of Fisheries
  Dr. Nguyen Van Thanh, Vice Director
  Engineer. Duong Tien The, Expert
- Department of Science and Technology
  Prof. Dr. Nguyen Xuan Ly, Director
  Mrs. Nguyen Thi Phuong Lan, Senior Expert
- International Cooperation Department
  Dr. Vu Van Trieu, Vice Director
- Economic and Planning Institute
  Dr. Ha Xuan Thong, Director
  Engineer. Nguyen Hai Duong, Senior Expert
- Department of Legislation
  Mr. Quy
- Department of Fisheries Resources Protection
  Dr. Vu Huy Thu, Vice Director
- Cabinet of Ministry
  Mr. Nguyen Ngoc Chung, Vice Director
- Central Centre for Fisheries Extension
  Mr. Tran Van Quynh, Director
  Mr. Le Thanh Tung, Expert
  Ms. Van, Expert
- Fisheries Information Centre
  Ms. Trang
  Ms. Hien
- National Fisheries Inspection and Quality Assurances Center (NAFIQACEN)
  Mr. Nguyen Tu Cuong, Director
  Mr. Thuan
- Research Institute for Aquaculture No.1
  Dr. Le Thanh Luu, Acting Director
- Research Institute for Aquaculture No.2
  Mr. Trong, Vice Director
- Research Institute for Aquaculture No.3
  Mr. Dien
  Mr. Tri
- Fisheries University in Nha Trang
  Prof. Dr. Tran Thi Luyen, Vice Rector
- Fisheries Review Magazine
  Mr. Hanh

Ministry of Planning and Investment

- Department of Agriculture and Rural Development
  Mr. Nguyen Van Ty

Provincial People's Committees

- Ninh Thuan
  Mr. Dao Tham, Chairman
  Mr. Truong Cong Thin, Vice-Chairman
- Quang Binh
  Mr. Mai Xuan Thu, Vice-Chairman

Provincial Fisheries Departments

- Thanh Hoa
  Mr. Thong
- Nghe An
- Ha Tinh
  Mr. Le Van Hoa, Director
- Quang Binh
  Mr. Du
- Quang Tri
  Mr. Phan
- Thua Thien-Hue
  Mr. Nguyen Luong Hien, Director
- Quang Nam
- Da Nang
- Quang Ngai
- Phu Yen
- Binh Dinh
- Khanh Hoa
- Ninh Thuan
  Mr. Luu Xuan Vinh, Director
  Mr. Nguyen Tan Tung, Vice Director
- Binh Thuan

Provincial Fisheries Extension Centres

- Ninh Thuan
  Mr. Nguyen Khac Lam, Director
  Mr. Do Kim Tam, Vice Director

Ninh Thuan Provincial Departments

- Department for Planning and Investment
- Department for Science, Technology & Environment
  Mr. Pham Phu Rong, Vice Director
- Department for Agriculture and Rural Development

International Participants

- North South University of Bangladesh
  Dr. Enamul Haque, Chair, Economics
- IISD – The International Institute for Sustainable Development, Canada
  Mr. Aaron Cosbey, Associate and Senior Advisor, Trade and Investment
- IUCN – The World Conservation Union
  Mr. Mikkel Kallesøe, Environmental Economics Program Officer

Non-Governmental Organizations

- Fisheries Association of Vietnam
  Mr. Vu Dinh Lieu, Chairman (former Deputy Prime Minister)
  Mr. Nguyen Bang, Director
- The Institute for Ecological Economy
  Prof. Dr. Nguyen Van Truong, Director

Mass Media

- Television
- Voice of Vietnam
- News Agency
- *Nhan Dan* Newspaper
- *Agriculture of Vietnam* Newspaper

8 SANDY LAND AQUACULTURE, RESTRUCTURING PRODUCTION

By

Dr. Nguyen Van Thanh, Vice Director
Fisheries Department, MoFI

8.1 Introduction

Coastal provinces situated in the central and south-central regions of the country have good environmental and climate conditions for developing aquaculture, especially shrimp cultivation in brackish water. However, due to a narrow coastline and limited availability of fresh surface water suitable for shrimp aquaculture, the freshwater that was available has mainly been used for breeding sugpo shrimp (common tiger shrimp). The sugpo shrimp is therefore the cultivated species dominating the brackish water aquaculture industry in Vietnam. In 2001, the total area converted to brackish water shrimp aquaculture was 18,680 ha with a total production of 25,890 tonnes covering 4.16 per cent of the total area utilized for shrimp cultivation in Vietnam. Although this type of aquaculture only occupies 4.16 per cent of the total aquaculture area it produces 15.9 per cent of Vietnam's total shrimp production. The incentive to invest directly in (shrimp) breeding activities in marine water is limited, partly because of unsuitable natural conditions. Hereunder, the difficulty of preventing negative impacts from storms on the breeding cages.

The environmental conditions in the central coastal provinces are very good for farming shrimp seedlings. In 2001 a total of 2,980 shrimp seedling farms where located is these areas (equivalent to 37 per cent of the total number of shrimp seedling farms in Vietnam), and produced 11,205 billion P15 shrimp seedlings (equivalent to 69 per cent of Vietnam's entire shrimp seedling production). In the first half of 2002, these farms supplied nearly eight billion shrimp seedlings (equivalent to 74.4 per cent of total shrimp seedling production of Vietnam). This production of shrimp seedlings is able not only to meet the demand of the central coastal region of Vietnam, but can cover the entire country's demand including the high demand coming from the lower Mekong provinces.

Sandy lands and wastelands in the central and south-central regions of Vietnam are not suitable for agricultural production. However first attempts to utilize this land for shrimp aquaculture have provided promising results supporting the possibility of developing shrimp aquaculture in this region.

8.2 The current situation of sandy land aquaculture

8.2.1 Potential area

Along the coastline of the central and south-central provinces of Vietnam there are a lot of narrow strips of sandy land and land with a low concentration of nutrients. The potential yields generated by cultivating food crops on this land are low and agricultural production is therefore not attractive. The local people therefore suffer from the shortage of good agriculture land and face difficult lives. In 1998, the Institute for Fisheries Economics and Planning proposed to conduct a survey researching the potential of developing sizeable shrimp aquaculture farms in these areas. The survey revealed the possibility of developing shrimp aquaculture on sandy land, leading to a proposal for five pre-feasibility projects on industrial shrimp farming practices on sandy land. According to this survey, the coastal provinces stretching from Ha Tinh to Ninh Thuan have several hundred thousand hectares of sandy land. Sandy beaches in the central region are mostly located higher than the tidal levels and it is easy to pump seawater directly into cultivation ponds. As a consequence, the water in these shrimp ponds would be quite clean and have a suitable salinity level for aquaculture development including the farming of the sugpo shrimp. Also wastewater can easily be discharged back to the sea and so facilitate the sanitary procedures for cleaning the ponds after every breeding cycle.

There are approximately 39,000 ha of sandy land in Quang Binh and between 10,000 ha and 14,000 ha in Quang Ngai, Quang Tri, Phu Yen and Ninh Thuan provinces. The area suitable for aquaculture development in this region is estimated to be between 18,000 ha to 20,000 ha, from which 4,000 ha to 4,500 ha are located in each of the provinces of Quang Ngai, Quang Binh and Quang Tri. Furthermore 3,000 ha of suitable sandy land exists in Ninh Thuan and 1,300 ha in Binh Dinh. If shrimp farming activities could be well controlled, the economic gain would be high, thereby encouraging further development of aquaculture on sandy land (not considering the possibility of converting land used for salt production, unproductive rice fields and wastelands, for fisheries development in general).

8.2.2 The current situation of converting sandy land to aquaculture development

Under Decision No. 224/199/QD-TTg, the Prime Minister has approved a program for developing the aquaculture industry in the period 1999–2010. The program allows the conversions of salt-intruded land, salt-producing land and unsustainable rice fields in the low land areas, into ponds for shrimp cultivation.

In Resolution No. 09/2000/NQ-CP (outlining some guidelines and policies encouraging structural changes in the production and consumption of agricultural products), the government also authorizes the use of low lands and land located in the coastal areas for aquaculture development purposes.

In compliance with the implementation of Decision No. 224/199/QD-TTg and Resolution No. 09/2000/NQ-CP, many provinces have initiated a planning stage focusing on developing aquaculture on salt-intruded land, salt-producing land and unsustainable rice fields in the low land area. In Vietnam, according to primary statistics, nearly 236,500 ha were converted for aquaculture development in 2001 alone. 230,000 ha were converted from unsustainable rice production; nearly 1,700 ha from salt-producing land; and the remaining 4,800 ha from unused sandy land and wasteland. The converted sandy land is mainly concentrated in the provinces of Ninh Thuan, Phu Yen, Binh Thuan, Quang Tri and Quang Ngai. In Ninh Thuan province alone, 120 ha were converted for aquaculture purposes.

In 2002, Ninh Thuan province proposed a project aiming at developing 648 ha of shrimp aquaculture on sandy land in Phuoc Dinh and An Hai communes of Ninh Phuoc district. Furthermore it is anticipated that by the year 2003 the region will produce shrimp on 400 ha of sandy land. In 2005 this area is expected to have expanded to between 800 ha and 1,000 ha with an estimated production of between 1,500 and 1,800 tonnes of sugpo shrimp. Quang Binh province is expected to convert 130 ha of sandy land and Quang Tri 170 ha into shrimp production. Binh Dinh province proposes to farm shrimp on 500 ha of sandy land in My An, My Thang and Phu Cat districts. Danang City plans to farm shrimp on 50 ha of sandy land at Hoa Hai commune in Ngu HanhSon district whereas Quang Ngai province seeks to develop the industry of shrimp farming at Duc Phong (MoDuc district) and Pho Vinh (Duc Pho district). Finally, Phu Yen province is expecting to convert 60 ha into the shrimp cultivating industry.

8.2.3 Results generated by aquaculture production on sandy land in the coastal areas of central Vietnam

Ninh Thuan was the first province to engage in shrimp aquaculture on sandy land. In 1999 in Phuoc Dinh commune in Ninh Phuoc district, a farmer started to cultivate shrimp on 5,000 m^2 of sandy land using plastic canvas as water storing material by covering the pond's edges and bottom. The farmer was able to generate an economic profit of VND 25 million (US$ 1,612) by selling his first harvest of 1,000 kg of commercial sugpo shrimp (equivalent to a productivity of about two tonnes/ha). In 2000, the area developed for aquaculture in Ninh Thuan province was five ha and harvest was 30 tonnes (average productivity about six tonnes/ha) yielding a profit of approximately VND 100 million (US$ 6,451) per hectare.

The Institute of Fisheries Economics and Planning also tested other kinds of materials for water storage on sandy land and selected the most suitable material for shrimp farming purposes. The attractive economic results from shrimp aquaculture on sandy land in Ninh Thuan province have encouraged the spreading of shrimp aquaculture farms on sandy land not only in Ninh Thuan but also in other provinces.

In 2001, Ninh Thuan province has expanded the area for shrimp aquaculture to 120 ha and harvested 800 tonnes of products accounting more than 22 per cent of the shrimp production in the province. The average productivity for the main season was four–five tonnes per ha, and the annual productivity was 6.7 tonnes per ha. The economic turnover was around VND 140 million (equivalent to US$ 9,032) per hectare.

Many other provinces such as Quang Binh, Quang Tri, Thua Thien Hue, Da Nang, Quang Ngai, Binh Dinh, Phu Yen and Binh Thuan have also invested in the development of shrimp ponds on sandy land and generated promising results.

- Thua Thien Hue: Here shrimp was cultivated on 16.2 ha generating a harvest of 30 tonnes, implying an average productivity of 1.85 tonnes/ha/crop the highest productivity was 4.5 tonnes/ha/crop.
- Quang-Ngai: In this province the average productivity was three tonnes/ha/crop.
- Binh-Dinh: Here shrimp was cultivated on 2.4 ha and the harvest ranged from 1.72 to 5.5 tonnes/ha/crop. Until now this year, the area for shrimp aquaculture in Ninh Thuan province is approximately 180 ha. The productivity of this area is for several households about five–six tonnes/ha/crop.

Results like these create opportunities for regions having a limited supply of land and freshwater needed for agricultural. However there are plenty areas of sandy land, wasteland and hills, which can be used for aquaculture development in general and for shrimp cultivation in particular, thereby generating profits that are many times higher than that received form an agricultural production.

8.3 Advantages and obstacles of developing aquaculture on sandy land

8.3.1 Advantages

- There are large areas of sandy land, land used for agriculture and salt production development with a low productivity, and wastelands in the coastal provinces in the central part of Vietnam. These include large areas situated above the high tidal level and are therefore relatively stable and suitable for restructuring the production toward fisheries aquaculture in general, and shrimp aquaculture in particular.
- Sandy land can be converted to fisheries aquaculture without having major effects on infrastructure and without demanding high compensation. The possibility of high-speed area clearance sets good conditions for the construction of aquaculture ponds.
- It has been noticed that the use of plastic materials to cover the pond's edges and bottom can effectively minimize the drainage of water from the pond and at the same time prevent disease dissemination from one pond to another.
- Because the position of the pond is higher than the tidal level, the water for shrimp farming can be pumped directly from the sea to the pond. Therefore, the transparency level will be higher and the possibility of influence from suspended materials can be minimized. This position also allows an effective cleaning of the pond, thereby minimizing the spread of diseases.
- Semi-intensive and intensive shrimp farming techniques used for ponds on ordinary soil where a limited amount of water is exchanged with treated water have also been tested in ponds on sandy land with some modifications and improvements. The results where good and seemed to be economical.
- The experience from shrimp aquaculture in central provinces, especially the southern part of the central region, indicates that shrimp cultivation can be effectively conducted in two seasons annually, implying a nearly all-year-round production. This means that the pond utilization rate can be increased, product costs can be reduced and the effectiveness of shrimp aquaculture can be improved.
- Shrimp aquaculture on sandy land can also contribute to environmental improvements by increasing humidity, thereby facilitating the growth of the surrounding vegetation.

- Shrimp aquaculture on sandy land is highly attractive economically, and creates employment opportunities for local residents living in the coastal areas and therefore reduces pressure on shallow water fishing. At the same time, it contributes to poverty alleviation and may even help some farmers to become rich. Shrimp aquaculture also encourages the development of other sectors such as the industrial sector by raising the demand for waterproof materials, shrimp feed, shrimp seedlings and mechanical accessories.

8.3.2 Major obstacles

- Currently, a large number of farmers pump salt water from the sea into their ponds through filtering and treating systems and sedimentation ponds, and freshwater is extracted from groundwater storage deposits. The limited amount of groundwater resources in the surrounding areas could cause a shortage of the freshwater needed for shrimp farming on sandy land and could be a big problem when developing the shrimp farming business. The utilization of the freshwater resource would reduce groundwater levels in the surrounding areas. Furthermore, the extraction of groundwater from deep layers will affect geological strata and can in the long run lower the land surface, which again could affect the infrastructure and life of local residents.
- The areas of sandy land in the central provinces have plenty of sunlight and a warm climate which is suitable for growing shrimp. However, because the high temperatures and the high evaporation rates can increase the salinity level in the shrimp ponds, productivity may be affected since no adequate measures to control the freshwater input exists.
- Many households do not pay enough attention to the issue of treating wastewater and mud from shrimp ponds before discharging it into the surrounding environment. Currently, the water from shrimp ponds is discharging directly into surrounding areas including the sea. This course of action will sooner or later have a negative impact on the environment.
- By shifting the production towards fisheries aquaculture including shrimp aquaculture, we are heading in a new direction that requires an appropriate infrastructure. However, in the coastal areas, the infrastructure covering transportation network, power transmission lines, water supply and sewage systems can all be considered inadequate. Therefore, shrimp farming in these areas requires large investment, but local residents are mainly poor and do not have the funds needed for improving these facilities.
- Although the shrimp ponds in the central provinces are usually located higher than the tidal level and are relatively stable, they are also situated near the sea and therefore often suffer from many storms. In addition, in many places due to the lack of sand and wind protection forests, sand movements often reduce the durability of the constructed facilities and create a lot of difficulties for the production activities and for the livelihood of local residents.
- Considering the prevailing shrimp farming technology, it is necessary to improve technical procedures in order to achieve sustainable and high production. At the initial stage, the nutrient level in ponds using plastic materials as insulation is usually poor, and therefore fertilizers and other biochemical products are often added to stabilize the water environment in the ponds. It is necessary to have adequate measures to minimize the effects of these production inputs and to increase the efficiency of shrimp farming.

8.4 Orientations on aquaculture development on sandy land and measures that should be taken

8.4.1 Orientations

- Fisheries development including shrimp aquaculture on sandy land is a step toward restructuring production and achieving optimal use of sandy and wastelands and integrating fisheries aquaculture with ecological and environmental protection by integrating the development of protection forests. Furthermore the development benefits the social and national security.

- Fisheries development on sandy land makes maximum use of the natural conditions facilitating the cultivation of suitable species, with a preference for multi-species development. However, in the near future, preference will be given to shrimp cultivation in brackish water with high economic value.
- Fisheries development in general, and shrimp aquaculture in particular, on sandy land could bring about high economic efficiency and create high-quality methods for producing safe hygienic products for export. Fisheries development on sandy land also creates more job opportunities and therefore effectively contributes to hunger eradication and poverty alleviation for people living in the coastal communes.
- Planning for fisheries development in general, and shrimp aquaculture in particular, on sandy land should be based on the social-economic plan of the area. The plan of production restructuring should get strong support and the participation of the local people.

8.4.2 Proposed measures for implementation

Planning measures

- Provinces should conduct surveys in order to investigate and identify suitable areas of sandy land, land used for salt and rice production, but with low productivity, and wastelands, which can be converted to fisheries development. It is necessary to plan fisheries development with different species and appropriate technology.
- Planning the fisheries development in general, and shrimp aquaculture in particular, on sandy land should be based on the socio-economic plan for the locality. It is also necessary to include ecological and environmental protection along with social and national security when developing fisheries aquaculture.
- It is necessary to pay adequate attention to the protection and development of protection forests. Furthermore it is necessary to strictly prohibit encroachment of wind and storm protection forests in order to secure a sustainable environment.
- Planning for fisheries development in general, and shrimp aquaculture, in particular on sandy land should be based on good coordination among relevant sectors such as agriculture, forestry, irrigation, science, technology and environment in order to find the optimal option for the development of coastal areas.
- It would be beneficial to encourage different economic sectors to participate in the planning of and investment in aquaculture on sandy land as well as the concentrated seedling production of fisheries species.

Scientific and technological measures

- Continue to test and apply waterproof materials for pond insulation working towards reducing investment prices and increasing material duration in order to lower production prices. Apply appropriate technology in order to prevent pollution of the surrounding environment when using salt water and freshwater, when treating wastewater and when waste mud is taken from the bottom of the pond
- Develop technology that allows for sustainable shrimp aquaculture without the use of chemicals and antibiotics that are found on the prohibited list, thereby ensuring safe and hygienic food production.
- Strengthen the monitoring of residues of toxic and antibiotic agents, heavy metals in the breeding areas and the finished product itself.
- Study, select, apply and import breeding technology for different species with high economic value aiming at diversifying the breeding industry in order to reduce potential impacts from market changes, in order to improve ecological and environmental conditions and to limit pollution and the risk of diseases.

Fishery extension activities

- Apply advanced technology in shrimp aquaculture development, which has effectively been applied in other regions generating stable and high productivity. Document the effective models set up by different communes and disseminate this information to farmers for application.
- Develop breeding models with different levels of productivity and quickly disseminate this information to farmers for application.
- Reinforce the technical training and organize different workshops where sharing of technical knowledge and experience is possible, thereby increasing farmers' awareness and helping them to gain knowledge.

Seedlings, feed, disease control and environmental protection

Reinforce the management dealing with the quality of seedlings. The shrimp seedlings should be healthy and without diseases, and undergo quarantine procedures.

- The feed used when cultivating shrimp should be high-quality, industrially-produced feed and must not contain chemicals or antibiotics that are listed as prohibited for the fisheries industry.
- It is essential that the treatment of pond water, necessary to stabilize the farming environment, is done properly by using biological products. Chemicals or antibiotics listed as prohibited chemicals and antibiotics for the fisheries production should not be used.

8.4.3 Policy implications

Regarding the investment policy

- The state should financially support the development of aquaculture by allocating part of the state budget (either from the central or local budget) for the construction of infrastructure in the areas where fisheries development is concentrated. This should be done under the Aquaculture Development Programme.
- The government should apply an appropriate mechanism to encourage aquaculture development and give credit in the form of soft loans to provinces and towns under the direct central management of the government so that projects creating infrastructure in accordance with Decision No. 132/2001/QD-TTg of the Prime Minister on the financial mechanism for the construction of roads in rural areas and infrastructure for fisheries aquaculture can be implemented.
- Enterprises and farmers can, in accordance with existing regulations, invest their capital or take credits to cover the construction costs of building ponds, developing the needed infrastructure and to secure equipment and production expenditure
- The owners of the farms can take credits to invest in fisheries aquaculture and if this amount is equal to or less than VND 50 million (US$ 3,225), the owners of the farm can obtain this credit without mortgage. In this case, the farm owners should submit the credit application together with the original certificate of land use or certification that the use of land is without conflicts and that it is endorsed by the People's Committee of the relevant commune, ward or town. Furthermore, the project proposal proving the effectiveness of the production options and the ability to pay back taken credit (in accordance with the Decision No. 423 of the General Director of the State Bank on bank credit policy for farming economy) should also be submitted.

Regarding the land policy

- Based on the plan for fisheries development on sandy land in areas approved by assigned authorities, the local authority can assign organizations, households and individuals to stabilize their production activity in the long run (in accordance with land laws).
- The government should encourage organizations, enterprises and investors to invest in the construction of infrastructure facilities needed for the fisheries development on sandy land.

8.5 Recommendations

8.5.1 Actions required at the governmental level

- The government is asked to increase investment funds set aside in the annual state budget for aquaculture development in order to develop infrastructure such as roads, electric transmission lines, and water supply and drainage systems for projects focusing on fisheries cultivation, including fisheries development on sandy land.
- Regarding the credit scheme for households engaged in fisheries cultivation on sandy land, it is recommended that the Prime Minister allow these farmers to extend the credit time to five years as is the case with people living in mountainous areas in accordance with Decision No. 132/2001/QD-TTg, since the people living in these areas are mainly poor.
- The government is asked to increase the budget for fisheries extension activities.

8.5.2 Actions needed at related ministries

- The Ministry of Planning and Investment is together with the Ministry of Finance requested to balance the budget in order to increase the annual investment for programs focusing on fisheries development and submit it to the Government for approval.
- The Ministry of Science, Technology and Environment (MoSTE), and the Ministry of Agriculture and Rural Development (MARD) are asked to support the planning of shrimp aquaculture to ensure sustainable development and to ensure that aquaculture development is addressing environmental issues properly, thereby ensuring safely-farmed products.

9 CURRENT STATUS OF SHRIMP AQUACULTURE ON SANDY LAND IN NINH THUAN PROVINCE

By

Mr. Luu Xuan Vinh, Director
Ninh Thuan Fishery Department

9.1 Tiger shrimp farming: present conditions

Ninh Thuan is the most southern province in central Vietnam with a total area of 3,360 km^2 and a 105 km coastline, along which are quite a number of lagoons and river mouths that facilitate the farming of aquaculture products. And as the province with the lowest annual rainfall (average of 750 mm), few waterways and seawater of a stable but high salinity level, the province enjoys several advantages in developing aquaculture products of high economic value.

The farming of tiger shrimp in Ninh Thuan has been promoted since the 1990s with the focus on semi-intensive cultivation with one yearly crop. Since then, new technologies have been adopted as part of the process of moving towards more intensive farming methods. In 2001 the farming area was 1,150 ha. By the first five months of 2002 this had increased to 1,260 ha including 180 ha of tiger shrimp farming on sandy soil. The total output for 2001 was 3,600 tonnes, making a provincial average productivity of 3.13 tonnes/ha/year.

Another advantage in Ninh Thuan is that the province hosts a large number of farms producing shrimp seedlings. In 2001 the number was 600 compared to 350 in 2000 (an increase of 140 per cent). The farms produced 2.1 billion P15 sized seedlings in 2001. Within the first five months of 2002, the number of farms growing shrimp seedlings had increased to 900 accounting for a production of 1.28 billion P15, an increase of 77.9 per cent over the same five-month period the year before. About 20 per cent of the seedlings are supplied to the provincial market and the remaining 80 per cent are exported to the southern provinces. The seedlings of Ninh Thuan have always been appreciated for their quality and have a good reputation. This is an advantage from which Ninh Thuan could benefit by becoming one of the country's main shrimp seedlings producing areas.

9.1.1 The development of tiger shrimp farming on sandy soil

The first model for tiger shrimp farming on sandy soil was established in 1999 in Tu Thien ward of Phuoc Dinh commune in Ninh Phuoc district. Initially the farm just comprised of a 0.5 ha large pond applying nylon sheets as the sole waterproof measure. By the end of year 2000, the farming area had increased to five ha with the farming density reaching 15–20 shrimp/m^2, and producing two–three tonnes/ha/crop with two crops a year.

In the year 2000, shrimp farming on sandy soil brought about good economic returns for the farmers thanks to high market prices for commercial shrimp, but most importantly because of the higher average productivity of this area compared to others in the province. Overall the area of sandy soil used for shrimp farming had increased dramatically by the end of 2000.

In 2001, the area was 120 ha—24 times bigger than that of 2000—and occupied 10.43 per cent of the total aquaculture area of the province. The sandy land areas are mainly found in the communes of An Hai and Phuoc Dinh of Ninh Phuoc district (25 ha and 95 ha respectively).

Up until now, the area of shrimp farming on sandy soil in Ninh Thuan province has reached 180 ha (140 ha in Phuoc Dinh and 40 ha in An Hai).

9.1.2 Some implemented tasks and outcomes of tiger shrimp farming on sandy soil

Planning

The Fisheries Department has commenced a project on tiger shrimp farming on sandy soil in the communes of An Hai and Phuoc Dinh of Ninh Phuoc district. The project covers 648 ha employing a combination of forestry and fishery. The government in responsible for investing in communications, electricity and pumping stations along with irrigation and sewage systems. The total estimated investment cost is VND 45.4 billion (US$ 2,929,032) out of which VND 20.3 billion (US$ 1,309,677) is supplied by the government in order to improve key infrastructures. The remaining funds are accounted for through private/family investments in shrimp farming ponds and other infrastructure. This project is believed to have quite a number of advantages including low rate of investment, high economic return, and a good contribution to environmental and social rehabilitation.

So far the project has finished surveying the geological and topological conditions and is finalizing the feasibility report, and has turned to the next phase of establishing technological documents and designs as well as assigning available land. The assignment phase will, upon completion, allow for the commencement of the project in 2002. However, the biggest difficulty the project is facing today is the lack of investment capital.

Scientific and technological tasks

Farming tiger shrimp on sandy soil is a new farming practice, not just in Ninh Thuan, but in the whole country. While setting up the production patterns and conducting field studies, it was recognized that pond water rarely needed to be changed when farming shrimp on sandy soil. The water is supplied to the ponds at the start of the production cycle and then supplemented by saline and freshwater according to evaporation rates. To facilitate further development of this type of aquaculture, it is however necessary to have comprehensive studies on soil composition, waterproof measures, farming techniques and sewage treatment measures, etc. In 2001, the provincial fisheries department, in coordination with the provincial department for science, technology and environment, conducted a project on developing models for transferring technologies on farming tiger shrimp on sandy soil, to a 10 ha area in An Hai commune. The project linked shrimp farming with afforestation development as a preventive sand movement measure, ensuring ecological balance and encouraging a sustainable shrimp-farming environment. The project is based on funds allocated by the Ministry of Science, Technology and Environment and has constructed most of Phase I—structures on a one ha large area. By the completion of the project, a model farm will have been created serving as a technological centre where knowledge and experience can be gathered by visiting farmers.

The Fisheries Promotion Centre (FPC) has worked together with the University of Fishery on compiling a CD on commercial tiger shrimp farming practices on sandy soil, to serve training purposes and disseminate the technique. The CD has been completed and is now ready for distribution.

The provincial FPC has also received assistance from the national FPC in establishing models of shrimp farming on sandy soil. The models include conducting training courses with due emphasis on issues such as overproduction causing exhaustion of the freshwater supply and degradation of the soil, the necessity to develop preventive forests to curb sand movements and phytoplankton farming techniques in the initial stages.

Pond design and waterproof materials

The base soil of the coastal area is comprised of low adhesion water retention soil, which is poor in nutrients. To avoid pond boundary erosion due to sea waves, the farming system is constructed in areas above the wave mark, including cultivation and treatment ponds. The cultivation ponds normally cover an average area of 0.4–0.5 ha with a depth of 1.2–1.5 m and a sloping factor of 1:1. Treatment ponds represent, on average, about one third of the cultivation ponds in area, but are deeper to increase the volume. Saline water is pumped directly from the sea at high tides while freshwater is supplied by on-site wells. The need for freshwater when practising aquaculture on sandy land is a constraint. This could lead

to the exhaustion of groundwater if over exploited. Existing farming ponds have not yet been designed with an attached sewage treatment system, as the government still has to invest in such facilities, hence wastewater is released directly into the sea.

In order to prevent water leakage, transparent PE nylon sheets are used to cover the entire bed and boundaries of the ponds before being covered with a 40–60 cm thick layer of sand. The ponds' boundaries are also consolidated with a double layer of tarpaulin plastic sheets to protect the PE nylon and prevent erosion. Apart from utilizing the above-mentioned materials, there are also two farming models using HDPE waterproof sheets, but the cost is high.

Results from tiger shrimp farming on sandy soil

In 2001, most of the farming ponds produced two–three crops/year, and from the total farming area of 120 ha, the output was 900 tonnes implying an average productivity of 7.5 tonnes/ha/year. This production accounted for 22.2 per cent of the total output of cultivated shrimp in the province.

To date, the shrimp farming area in Ninh Thuan province, as mentioned, has been developed to about 180 ha with a number of ponds reaching a productivity of five–six tonnes/ha/crop.

Table 24 Results from shrimp farming on sandy soil between 1999 and 2001

Year	Farming area	Output (tonnes/year)	Productivity (tonnes/ha/year)	Production efficiency (VND mil./ha/year)
1999	0.5	1	2.0	+50
2000	5	30	6.0	+100
2001	120	900	7.5	+140

Coastal shrimp farming on sandy soil has introduced a new way to exploit otherwise useless areas of land. Especially so for Ninh Thuan, a province that has large areas of sandy land and only a very limited area suitable for conventional agriculture. The farming of tiger shrimp on sandy soil has helped create employment opportunities (some 1,000 direct and indirect labourers are needed) and, at the same time, has increased the earnings of the local people. The combination of tiger shrimp farming on sandy soil and the development of preventive forests have helped rehabilitate the local climate as well as curb sand movement, thus enhancing the efficiency of land utilization.

9.1.3 Assessment of the favourable conditions and difficulties for shrimp farming on sandy soil

Favourable conditions

Most of the coastal land has been left fallow or is cultivated with low efficiency. The shift to aquaculture cultivation thus helps enhance the efficiency by which the land is utilized, creates jobs and increases people's income. At the same time, the planning and construction of infrastructure and farming facilities is easy on this kind of land.

Ninh Thuan's coastal sand stripes are formed horizontally and, as such, the chance of exchanging water with the sea becomes greater than in closed inland ponds. At the same time, the seawater is rather clean here given the natural biological filters like coral reefs and because the area is not affected by flash floods. Ponds developed on sandy land, which is situated above the influence of sea tides, can be completely drained and dried out, allowing for the sunlight to fully prevent dissemination of diseases from one pond to another. At the same time, this newly-established farming zone is unaffected by cyclones and floods, it is inhabited by farmers and armed with experience drawn from other locations in the province together with new technology. As such, farmers could quickly apply advanced farming models involving semi-intensive or intensive farming methods and obtain a productivity of five–six tonnes/ha/crop with two–three crops/year.

All the farming ponds have their beds and boundaries covered with plastic sheets, thus ensuring the independence between them and avoiding diseases spreading from one pond to the other. This in turn calms the farmers, and prevents them from the extensive use of chemicals and antibiotics when treating shrimp diseases. The low use of chemical and antibiotic residues in the cultivation process leads to the harvest of high-quality shrimp. Also, this region can have an extra yearly crop that does not coincide with the harvest time in other regions, thereby allowing for higher commercial values and marketable advantages of products cultivated in Ninh Thuan.

Difficulties and measures too by addressed

Coastal sandy soil usually lacks freshwater due to limited groundwater reserves. Furthermore, other infrastructures like communications, power lines, pumping stations, etc. are also lacking, restricting the supply of seawater to the entire farming area. At present, farming is found only in areas that enjoy sufficient seawater supply. To develop shrimp farming on a large scale and secure sustainable and long-term development, it is necessary to have the government invest in infrastructure, the construction of irrigation and drainage systems, the establishment of water treatment facilities, and improved transportation and power supply.

In order to ensure a stable, long-term and sustainable farming environment, it is also necessary that each cultivation pond be associated with a settling and water treatment pond. A common treatment pond for the entire farm should also be developed, before discharging water back to the sea or the surrounding environment. Shrimp farming should also be linked to the development of coastal eco-villages.

Most horizontal sand strips are affected by storms and winds, which can be seen by the establishment and movement of sand dunes. The sand dunes badly affect communication routes and damage other constructions. It is therefore necessary to develop aquaculture by combining shrimp farming with the planting of preventive Casuarinas forests in a forestry-fisheries compound model.

The access to lines of communication and power supply is difficult for this poverty-stricken population. The government thus needs to invest further into improving infrastructure and provide preferential loans so that local people can invest in shrimp farming and combat poverty.

Technologically speaking, sandy-bedded ponds are usually poor in nutrients, hence the difficulty in creating green pond water within the first month and a half of the farming cycle. To maintain the growth of algae, fertilizers and some other biological agents can be used to create a stable microbiological system in the water, thereby stabilizing the cultivating environment.

9.2 Potential, development orientation and some implementation measures

9.2.1 Potential

Ninh Thuan's coastline is 105 km long, out of which 30 km are accompanied by white strips of sand. In many areas, mountain branches reach out to the coast, creating a number of excellent lagoons and bays that facilitate the development of aquaculture. At present, the region needs a proper strategy for job restructuring to bring into full play the province's potential and inner strength to develop its economy in a sustainable and lasting way.

The survey on planning and development of aquaculture which was carried out in October 2001, showed that Ninh Thuan's coastal sandy soil occupies some 10,000 ha, of which 1,500 ha could be used for tiger shrimp farming. Most of this land is found in the communes of Phuoc Dinh, An Hai of Ninh Phuoc district and Vinh Hai of Ninh Hai district.

9.2.2 Targets and development orientation

The sustainable and stable development of the fisheries sector is based on a speedy investment, in which the government invests in infrastructure while the farmers themselves invest in the pond construction and production processes. This is the development strategy cited in the government's Fisheries Development

Programme and in the 10th Provincial Party Committee Resolution as well as in Decision 04-NQ/TU by the Ninh Thuan Party Committee issued November 20, 2001. The Decision deals with the development of the provincial fisheries sector from 2001 to 2005 and further on to 2010. By 2005, it is expected that the total area of shrimp farming will be at least 2,000–2,500 ha with an output of over 5,000 tonnes and with a productivity of 2.5 tonnes/ha or more. This is a 2.78 times increase in production compared to the total production of year 2000, and the majority of the product is expected to be safe for export.

In order to obtain the above targets, it is necessary to bring into full play the land potential, and especially the inclusion of coastal sandy soil in the aquaculture industry under advanced farming methods (semi-intensive and intensive). For now, it is necessary to maintain the average productivity of 5–6 tonnes/ha/crop in the shrimp farming area by applying advanced technology as well as improving farming techniques designed for sandy soil conditions, on the basis of ensuring a sustainable culture and product quality.

Concrete targets

- For the year 2002: Planning and construction of infrastructure for shrimp projects in An Hai, Phuoc Dinh of Ninh Phuoc district;
- For the year 2003: Utilizing 400 ha of sandy soil for tiger shrimp farming with an expected output of 1,500–1,800 tonnes; and
- By the year 2005: Increasing the farming area to 800–1,000 ha with an expected productivity of seven–eight tonnes/ha/year and a total output of 4,000–5,000 tonnes, allowing export earnings of US$ 20–25 million and creating employment for about 5,000 coastal workers.

9.2.3 A number of measures for shrimp farming on sandy soil

Planning and designing farming models

- To complete planning activities for farming on sandy soil, i.e., to ensure sustainable development by investing into: seawater and freshwater supply systems, drainage systems, other infrastructure and pond systems, waterproof measures, and production techniques as well as other environmental protection measures including the development of coastal eco-villages.
- To combine aquaculture with the development of coastal preventive forests as a means of preventing sand movement and damage caused by strong winds on the horizontal sand strips, and to protect other constructions as well as a stable farming practice. This will contribute to the rehabilitation of the environment so that newly established ecosystems will have better conditions than the former ones.

Science and technology transfer and fisheries promotion

- Researching, applying and improving new technology on: environmental and water treatment; diagnosis and prevention of diseases; high-quality parent shrimp cultivation; and diversifying into other aquatic products to be farmed on sandy soil apart from commercial tiger shrimp.
- To further apply R&D activities involving the diversification of waterproof materials to ensure the best ion exchange with the farming pond environment, good durability and efficiency at a low cost.
- To plan for training of staff to address the technical shortage at the localities in a timely fashion, and to boost fisheries promotion activities as well as supply training for farmers.
- To pay due attention to the reproduction and protection of natural breeds and to promote farming models that require low water exchange and that don't use chemicals harmful to the soil, the water, the pond environment or the overall ecological system.

Breed and feed

- To build up a network of suppliers and to tightly control feed and veterinary drugs used in each farming area.

- To have an appropriate seedling production and distribution plan corresponding to the time of production in each area.

Policies

- *Land policies:* to encourage people to invest in aquaculture development on the land available according to the approved plan, and to contribute land when needed for infrastructure constructions. At the same time, the issuance of land use certificates (red books) should be implemented according to the law, thereby making people concentrate on production.
- *Capital policies:* it is government policy that the state and the people work together. The state should invest in major infrastructure like roads, power lines, dykes, pumping stations and irrigation systems. The people, on the other hand, should invest in the construction of ponds, organizing their own production and developing preventive forests. Credit organizations should provide loans under various schemes (short, medium and long term) to assist people in this aquaculture endeavour.

Coordination and implementation

- In terms of planning, the provincial Department for Fisheries will have to set up plans for each farming area according to the project. To make the plans complete, it is necessary to involve the agriculture and forestry sectors as well as government water and land management branches, in order to effectively coordinate the utilization of land proposed for preventive forest development, residential and tourism areas. This would form a base for concrete planning and allocation of infrastructure in each area.
- The Aqua-Resources Protection Cell would have the responsibility of working out the plans for inspection of shrimp seedlings and feed to ensure the quality of these products supplied to farmers. Farmers are also advised to check the products before including them into the production.
- The FPC should be responsible for considering, applying and improving new technologies on environmental treatment and other disease protection and prevention measures, for the areas of shrimp farming on sandy soil. The FPC should also make plans for the training of technical staff, boosting fisheries promotion activities and regularly disseminating technology for shrimp farming on sandy soil among the population.
- Banks and other credit organizations should make funds available for aquaculture investment, in accordance with current regulations on credit and mortgages. The population of the project areas is thereby provided with the capital needed to develop aquaculture.
- The People's Committee should, at all levels, enhance their land management and the management of the shrimp production according to current regulations so as to ensure the sustainable development of shrimp farming.
- The Provincial Association of Fisheries should further promote environmental protection by consolidating community awareness among its members, and by encouraging those farming shrimp on sandy soil to plant trees in the surrounding area.

9.3 Recommendations

In the last few years, shrimp farming on sandy soil has seen many developments in Ninh Thuan and other central Vietnamese provinces. This business has created high economic returns and quite a few employment opportunities improving the income of the coastal population. It has contributed to the rehabilitation of an area once dominated by wasteland, poor infrastructure and a low production efficiency, into an area that has a commodity economy with a high economic efficiency and newly improved ecosystem. In order to ensure that the cultivation of shrimp on sandy soil continues to be comprehensive, sustainable and efficient, the Ninh Thuan Department of Fisheries proposes the following:

9.3.1 Concerning the central government, Ministry of Fisheries and other central ministries

- To advocate for policies on investment in infrastructure including water supply systems, pumping stations, drainage systems (including sewage treatment systems) and communication and power lines in sandy land areas. This will create the basic foundation for combining forestry and fisheries, overcoming the present shortcomings and ensuring sustainable production development with lasting efficiency under the motto "the state invests in infrastructure and the people in ponds and production management."
- To continue with R&D activities concerning: perfect farming techniques; the development of new waterproof materials and cultivation patterns suitable for eco-villages; investigating salt-tolerant and drought-enduring plants for sandy soil areas as well as measures capable of addressing the issue of moving sand; and, finally, the diversification of the product range to ensure sustainability and durability. (apart from tiger shrimp, abalone, sea cucumber, winkle and other aquatic products should be considered)
- Since big investments are needed for aquaculture activities on sandy soil, the government should, together with and central ministries and agencies, issue policies securing attractive credit schemes making capital available from the Development Assistance Funds and the Export Assistance Funds.
- To supply capital investment for Ninh Thuan's project on tiger shrimp farming on sandy land in An Hai and Phuoc dinh communes of Ninh Phuoc district. The project has completed the phases of planning and project formation and could be a model for the development of shrimp farming on sandy soil in the whole country.

9.3.2 To the provincial People's Committee and other provincial agencies

- To give direction and help to coordinate the provision of investment capital, to facilitate the fisheries sector to fulfil its planning activities, to assist in the implementation of suitable infrastructure projects in sandy soil areas and to recognize the combination of forestry and fisheries.

10 TIGER SHRIMP FARMING ON SANDY SOIL

By

Mr. Tran Ngoc Hien
Shrimp farmer

My name is Tran Ngoc Hien and I live in Phan Rang, Thap Cham, Ninh Thuan.

I started farming shrimp in late 1999, when the movement of tiger shrimp farming on sandy soil started. I myself recognized that shrimp farming was an interesting business and provided rather high profits. Farming tiger shrimp on sandy soil, despite its high initial investments, can generate a high productivity thanks to intensive farming methods, taking full advantage of the clean seawater sources and the on-site groundwater resources, thereby avoiding animal diseases and epidemics.

In early 2000, I started cultivating the first shrimp crop on an area of two ha. As a newcomer to the business, I had almost no technical knowledge and the model of farming on sandy soil was also new. Through regular exchange of experience with the forerunners, and thanks to the assistance of the technical staff at the Fisheries Promotion Centre (FPC), I gradually gained experience. The results from my first crop in 2000 were 10.6 tonnes of shrimp with a productivity of 5.3 tonnes/ha and a profit of over VND 400 million (US$ 25,806).

Following the first crop, I renovated the ponds and continued with a second crop. After four months, I got nine tonnes of shrimp with a productivity of 4.5 tonnes/ha and a profit of over VND 200 million (US$ 12,903).

The success of the first year encouraged me to expand my farming area in 2001. The first crop of 2001 was done on an area of four ha, giving 24 tonnes of shrimp with a productivity of six tonnes/ha and a profit of over VND 500 million (US$ 32,258). In the second crop, I got 6.25 tonnes/ha and a total output of 25 tonnes. The results obtained in the last few years are not higher than others participating in this business in the province. However, I would like to present my experiences and steps taken in the farming process:

10.1 Experiences

10.1.1 Farming facilities

- It is necessary to firmly construct the water supply and drainage system in order to actively supply water in a timely fashion.
- The appropriate size of a cultivation pond would range between 4,000–5,000m^2.
- About 20 per cent of the farm's area should be reserved for ponds holding untreated water and wastewater.
- The entire pond system should be covered with nylon sheets on their beds and thick tarpaulin sheets on their banks to ensure minimal water loss. On the sheets, there should be a 0.5–0.7 m thick layer of sand.

10.1.2 Equipment

- Intensive shrimp farming on sandy soil requires sufficient investment in equipment.
- At present, apart from the installation of water fans, it is necessary to equip the ponds with air pumps supplying oxygen to the pond’s bottom to allow high-density farming.
- It may be a good idea to install mud removers for the ponds. In the first two months of a crop, it is necessary to remove the bottom mud every 20–30 days to the wastewater treatment pond. If this is

well conducted, it can help reduce the risk of pollution, enhancing the health and growth rate of the shrimp.

- It is necessary to have sufficient measuring equipment to monitor the level of pH, NH_3, alkalinity, salinity and pond water clarity (using a secchi disk).

10.1.3 Pond preparation

- For newly constructed ponds, it is necessary to clean them several times before farming by pumping in new water and then letting them dry out completely. In between, one should apply lime and matured cattle manure. After that, the ponds can be left to dry under the sunlight before pumping in water reaching a depth of 0.8–1 m, which can be accompanied by the removal of unwanted particles and formations of nutrients. Once the water level reaches 40 cm, we can start to bring in the shrimp seedlings.

10.1.4 The selection of seedlings

- Selection of seedlings is a very important step that determines the success or failure of the entire crop. Normally, we only use seedlings from known farms in the province.
- We buy seedlings from producers in Binh Son, Phu Tho, Khanh Hoi and My Tuong that are carefully selected under the following steps:

1. The shrimp seedlings should be of similar size, about P15 (length 1.1–1.2 cm) from the same mother and belong to the first or second batch.
2. The seedlings should be active, brightly coloured and have feed filling the digestive track.
3. The seedlings should be healthy and grow fast.
4. After the 30–minute salinity shock of 0‰, the survival rate should be 90 per cent.
5. MBV test: no infection.
6. The suitable farming density is 30–40 individuals/m^2.

10.1.5 Feed

- Only use 100 per cent high-quality industrial produced feed four–five times a day in combination with other feeds according to the development stage of the shrimp. It is necessary to strictly control feed quantity to avoid feed waste that can pollute the ponds.
- In order to define the suitable feed quantity at any given time, check shrimp growth every 10–15 days. From the average shrimp weight in the pond, and according to the feeding formula based on shrimp weight for each type of feed, we can define the suitable amount of feed to be given and thereby avoid waste and pollution.
- To increase the depth of the pond during the cultivation period from 1.3 to 1.5 m in order to stabilize the water temperature and environment, to create a larger space for the shrimp and to reduce the development of weeds on the bottom of the pond.
- Within the first two months of farming shrimp on sandy soil, a loss or sudden death of algae usually occurs in the ponds, due to the low nutrient level. As such, it is necessary to use fertilizers to sustain the growth of algae and the most commonly-used fertilizers are Urea, NPK (20:20:0) and DAP at one–two kg/1000m^2 for each supply.

10.1.6 Managing the pond environment

- The management of the pond environment follows the method recommended by the FPC including a low water exchange, using settling ponds to treat the water before transferring it to the cultivation ponds.
- The use of chemicals is prohibited in farming ponds except for bio-products like BrF2, E.M, Biobac, Bacillus, Alt 98 etc.

- After farming for 1.5–2 months, we can change the pond water with water taken directly from the sea. It is necessary to change the water once the level of algae becomes too high causing the water clarity to fall below 30–40 cm or the pH level to exceed 7.5–8.5. If the pH level becomes too high, we can supply sand or molasses into the pond at two–three kg/1000m^2. Also, it is necessary to regularly use lime and other minerals ($CaCO_3$, Daimetyne, Dolomite, Zeolite) to improve the water environment, adjust the pH level and stabilize the pond bed.
- In certain periods, it is necessary to increase the level of oxygen in the water, by using fans and air pumps in balanced amounts, if the highest efficiency is to be reached. The use of fans also cleans the pond bed, moves waste to the centre of the pond and creates space and clearer water in the entire pond.

10.2 Favourable and unfavourable conditions for shrimp farming on sandy soil

10.2.1 Favourable conditions

Shrimp farming on sandy soil has the following advantages:

- The use of clean seawater and freshwater sources.
- A low risk of pollution allowing for good growth rates and healthy shrimp.
- The possibility of farming several crops a year thus bringing about high economic returns.

These advantages encourage farmers to invest in intensive farming on sandy land.

10.2.2 Unfavourable conditions

Due to the lack of a master plan for aquaculture development on sandy land, shrimp farming in these areas remain a disorganized business leading to higher investment costs. Infrastructure like roads and power lines have yet to meet production requirements, causing major difficulties.

10.3 Recommendations

- The state should invest more in infrastructure, improving lines of communication, transport and power supply suitable for shrimp farming.
- A master plan should be developed to avoid uncontrolled production. It is necessary to ask farmers to construct wastewater ponds, settling ponds and treatment ponds if the pollution of the sea and the surrounding environment is to be avoided.

10.4 Conclusion

- By synchronously investing in the following equipment: pumps, water-fans, and oxygen suppliers for the cultivation ponds and treatment ponds, the farmer can assist the success by implementing an intensive and high-density farming model.
- The quality of seedlings is a decisive factor in determining a crop's success. Excellent and disease-free seedlings allow fast and equal growth, good disease resistance and high productivity.
- Only use high quality industrial feed to avoid environmental pollution. Utilizing bio-products is an effective solution to stabilize the farming environment and produce clean commercial products free from harmful chemicals.
- The farming of tiger shrimp on nutrient-poor sandy soil requires an enhanced use of fertilizers and minerals to ensure a stable cultivating environment sustaining excellent shrimp growth.

May delegates enjoy good health.
May the workshop be a success. **Tran Ngoc Hien**

11 ON THE OUTCOMES OF IMPLIMENTATION OF TIGER SHRIMP ON SANDY SOIL

By

Mr. Do Van Ngo
Shrimp farmer

I am Do Van Ngo, resident of Phan Rang town, Thap Cham, Ninh Thuan.

My family and I focus on the sale of agro-products, husking and polishing rice and producing ice. I started farming tiger shrimp in year 2000 on one ha of sandy soil in Son Hai ward of Phuoc Dinh commune in Ninh Phuoc district. After the first crop, I noticed that this was not a tough job even if clean water sources were available and the proper investment had been made in the ponds, seedlings and feeds and if a proactive approach to cropping time and management of the farming environment was adopted.

In 2001, I decided to develop a three ha large area on sandy soil in Tu Thien ward of Phuoc Dinh commune with a total water surface of 2.2 ha including five ponds (the smallest of which is 0.3 ha and the largest 0.6 ha). Initially, with technical support and assistance from Ninh Thuan Fisheries Promotion Centre (FPC), I agreed to try shrimp farming on sandy soil with an area of one ha (two ponds). After four months, I got a productivity of 3.63 tonnes/ha/crop and a net profit of VND 64 million (US$ 4,129). Making use of the experience I had acquired during the first crop, the second crop of 2001 produced five tonnes/ha/crop totalling the output on the 2.2 ha to 11 tonnes of commodity shrimp.

During the first six months of 2002, I expanded my farming area with 1.6 ha of water surface (three ponds) in which seedlings were simultaneously released and are now ready to be harvested. With a total farm area of 4.8 ha, including the 3.8 ha of shrimp cultivating ponds on sandy soil and given an expected productivity of five tonnes/ha/crop, I should be able to supply the market with some 50 tonnes of commodity shrimp this year.

Based on the above-mentioned achievements, my family and I were honoured with a certificate from the Ministry of Fisheries in June 2002.

I would like to take this opportunity to brief you about the steps taken in the farming process:

11.1 Features on the environment, water sources and soil structure

Farming shrimp on sandy soil involves bringing into full play the natural potential of the environment, like clean seawater found along the horizontal sand strips far away from populated areas and the nearly unpolluted sandy land itself. The soil here is usually lightly-coloured, loose, poor in nutrients, soft, it easily absorbs organic matter and is fast drying under the sun.

Cultivation ponds on sandy soil are usually located above the tidal level, meaning from four to five m and implying that pumps should have a high capacity, so that they are able to bring sufficient seawater for the needed water changes during the growing period of the shrimp.

The construction of cultivation ponds is not very easy since these ponds and the settling ponds have to be covered with plastic layers in order to avoid water losses. It also requires high skills to closely manage and operate machines like soil diggers and bulldozers. The construction of a seawater pumping station is costly and involves the joint efforts of many households since one such pumping station can supply water for 10 ha and requires an investment of VND 100 million (US$ 6,451).

During farming, the first two months require strict adherence with the technical guidelines, involving a minimum exchange of water and only to add freshwater coming from wells. It is necessary to keep the

pond environment clean and manage the volume of organic waste in the pond well, if pollution, environmental change and shocks affecting the shrimp's health are to be avoided. Moreover, it is necessary to adjust environmental indexes like pH, oxygen, stable water colour etc., in order to avoid shrimp diseases.

11.2 Farming process

11.2.1 Pond renovation

It can be said that proper pond renovation is half the way to success. As such, it should be prepared carefully from the beginning of harvest, with the following steps:

- Discharge (or pump out) all the water in the pond, and then let the pond dry out during a period of 7–10 days.
- Remove organic waste (sludge) from the pond, and avoid storing it nearby as rain could cause it to run back into the pond.
- Plough the bottom of the pond so that proper air ventilation is created supporting the decomposition of remaining organic matter. After this operation it is necessary to level the pond's bottom again.
- Distribute lime to the pond according to the pH level of the soil. We could use $Ca(OH)_2$, $CaCO_3$ or CaO.
- Filter new water back into the pond.

11.2.2 Preparing the water

Sustainable shrimp farming implies "farming the water." In practice, correct water treatment includes:

- Pumping water into the pond during high tide ensuring a clean water supply.
- Pumping the water through thick nets or cloth bags in order to: prevent mediums from carrying pathogens of diseases like white spots, red body (in crustaceans) and animals that could compete for the feed (fish).
- Pumping until the water level reaches a height of 1–1.2 m. When the correct water level is reached, the water fans and airing system should be installed and should run continuously for two–three days, thereby destroying all the fish eggs and other unwanted animals that have passed through the filters.
- The destruction of pathogen mediums, sources of virus and microbes involves using specialized products such as Saponin at a concentration of 10–20 PPM depending on the salinity and Vikron, Crente, Bioxide, etc. with the prescribed doses.
- Pumping in freshwater 24 hours after the treatment to reduce salinity.
- "Colouring" the water.

When the water level in the pond reaches 0.4–0.5 m, we should start colouring the water supporting the development of algae and other phytoplanktons that will cover the bed and prevent pond-weed from growing.

- *Organic method used to colour the water*: apply matured cattle or poultry manure at a ratio of 5–10 kg/1000 m^2/time. The manure is placed in jute or cloth bags and put under running water for a few days. If the desired colour is obtained, we can reduce the volume of manure used next time by 50 per cent.
- *Inorganic method used to colour the water*: use urea, NPK (20-20-0) or DAP at the ratio of 1–2 kg/1000 m^2/time. Dissolve the fertilizers in water and spray them all over the pond in the morning around 8 or 9 a.m. This practice should be continued for a few days until the desired concentration is reached, where after the volume can be reduced by 50 per cent.

After checking and making sure that all the environmental indices reach the requirements (alkalinity of 80–160 PPM, pH 7.5–8.5, salinity 25–30 per cent, water depth 1.0–1.2 m, clarity 30–50 cm) and that the water has a light green, greenish yellow or greenish brown colour, it would be the right time to release the seedlings.

11.2.3 Releasing the seedlings

- Seedlings should be carefully selected, meeting the standard of P15, have a bright colour, be active and show signs of feed in their digestive canal.
- Shrimp seedlings should be carefully checked at the FPC technical cell to ensure that they do not carry diseases, viruses or MBV microbes.
- The farming density is best at 30–40 P15 individuals/m^2.

11.2.4 Feeds

We should only use high-quality, industrially-produced feed from producers like Hai Long, Cargill, etc. (with a protein content of 39–45 per cent).

In order to identify the amount of feed suitable for each farming stage, we should check the shrimp's growth every 10–15 days and look at the average shrimp's weight in the pond. We should also base our calculations on the shrimp's health, shell casting cycle, impacts from the weather, the environment and sea tides to increase or decrease the feed volumes in a timely manner.

The method for controlling the feed consumption level of the shrimp is to use feed baskets and place them in the pond's corners: we should check the baskets two hours after lowering them into the water to see if the shrimp have eaten everything in them or not. If the baskets are empty, we can increase the quantity of feed for the next feeding by 10–15 per cent. If, however, there is still about 10 per cent of the feed remaining in the baskets, the amount of feed should not be increased, and can even be cut by 10 per cent if there is 20 per cent or more left.

When to feed the shrimp

- First month: four times/day at 6 a.m., 11 a.m., 5 p.m. and 10 p.m.
- From the second month: five times/day at 6 a.m., 10 a.m., 2 p.m., 6 p.m. and 10 p.m.

11.2.5 Pond environmental management

- In the management of the pond's environment, chemicals should be avoided and instead the use of bio-products like BRF2 – Aquakit, Aquabac, Bacillus 1070, etc., should be applied. This would help stabilize the environment.
- The regular use of various types of lime and minerals can improve the water environment, adjust the pH level and stabilize the bed. Agricultural lime $CaCO_3$ can be used regularly in the pond to increase the buffer capacity, to stabilize and enhance the pH level (at an interval of seven days and a volume of 7–10 kg/1000$m^{2)}$. Dolomite can be used when the water clarity is high thereby leading to slow algae development and worsening water colour. The appropriate volume to be used is 10 kg/1000m^2. Daimetyn can be used regularly after six weeks in order to improve the bed soil.
- The water level in the ponds should be managed within the interval of 1.2–1.5 m according to farming time, stabilising the water temperature, creating space for the shrimp and preventing the development of pond bed vegetation.
- During the first two months of farming shrimp on sandy soil, regular use of fertilizers is required, as a poor nutrient content would cause the sudden death of algae, thus decolourizing the water.
- After two months of farming, if algae develop too much, we can increase the number of water changes as a way of keeping the water clarity at 30–50 cm and pH at 7.5–8.5.

11.2.6 Disease prevention and treatment

Throughout the farming process, I only used drugs to treat diseases like white spots and red body a couple of times during the first two months. The drugs cannot be used to prevent outbreak of diseases, which can only be done by managing the water environment well, by increasing the level of nutrients and by improving resistance through the supply of vitamins like: vitamin C, Bio for shrimp, Vitasol, Calciphos, S-one, etc. Good environmental management and stable shrimp growth are the best prevention methods.

We should observe daily the shrimp's ability to move, their colour and appearance as well as the colour of their organs. If the shrimp's behaviour or appearance changes unexpectedly, we can interpret their health status and apply treatment in time. Shrimp farming on sandy soil enjoys rather clean water supplies, but if the pumping system can not supply the needed volume, some diseases like grass formation, broken antennas, blackened thorax, etc, can appear. However, these diseases are not dangerous and can be treated easily.

11.2.7 Harvesting

After 3.5–4 months of farming, the shrimp can be harvested after they have cast their last shell, which takes 4–5 days. The pond water is released to a level of one meter and a net equipped with electric rods is used for the capture. The harvesting pace is normally one tonne/hour and the freshly-caught shrimp can now be sold to the markets or wholesalers.

11.3 Conclusions and recommendations

I have mentioned the steps to be taken in the farming process. On this occasion, I would like to propose some suggestions:

- The state should invest in infrastructure like roads and power lines to better serve farming activities.
- It is necessary to implement pilot farming models on sandy soil to discover the optimal method worth promoting among the population to achieve the highest efficiency.

Thank you very much.
May all delegates enjoy good health.
May the workshop be a success. **Do Van Ngo**

12 SOME THOUGHTS ON THE SHRIMP ECOSYSTEM OF NINH THUAN'S SANDY SOIL

By

Dr. Nguyen Van Truong, Director
The Institute of Ecological Economy (ECO-ECO)

Mr. Chairman of Ninh Thuan Province People's Committee,
Mr. Vice Minister for Fisheries,
Ladies and Gentlemen,

I have had the chance to visit an area filled with mounts and warps upon which there is growing a thin flora comprised of prickly plants that create a lifeless and deserted panorama, and another area that has constructed new salt water lakes and ponds to farm shrimp. It could be said that developing sandy land aquaculture is really an innovation of this dry land that would otherwise never produce any assets for human beings. Thanks to the new knowledge about shrimp farming, the development of a coastal shrimp-farming zone takes advantage of the vicinity of the sea and deserted land and already includes 180 ha of shrimp ponds. The job was rather easy: to dig a two m deep pond, cover its bed with waterproof material and pump in seawater. The ponds are constructed just 100 m away from the coastline and as such are not so expensive. The waterproof material can last for 20 years and is priced at VND 20,000/m^2 (US$ 1.29/m^2), which is acceptable.

I have also listened to reports from the Department of Fisheries, the Department of Science, Technology and Environment and some other technicians from concerned departments and offices on the tiger shrimp and its habitat. The Ministry of Fisheries has published three small papers on the technology for aquaculture and environmental issues that need attention. From the implementation process as well as the studies conducted, it could be confirmed that farming shrimp on the sandy soil of Ninh Thuan in particular, and on other sandy soils in general, brings about great economic benefits, awakening the potential of the coastal sandy land and creating jobs and products for the market. However, as it is often said, there are two sides to the coin. I would like to reveal some concerns regarding the tiger shrimp-farming model on sandy soil in Ninh Thuan.

- When we remove the sand for the ponds and open up new roads, we touch on sand already settled by plants and bushes. Therefore we have to secure the vegetation's capability of stabilizing the sand by replanting. This is compulsory when we open new mines and should also be applied to the case of constructing new ponds and other economic establishments on settled sand.
- It is necessary to emphasize the ecological conditions surrounding shrimp cultivation. Although an economic earner, we should not forget the production's ecological needs and, as such, should take care to treat the polluted water and protect the environment. That is why we should develop eco-villages in which the key trade is shrimp farming, but where farming is based on sound ecological principles.

12.1 The two eco-villages on the sandy soil in Trieu Van and Hai Thuy, and the development of aquaculture on the coastal sandy land

The ecological system of sandy areas is a major challenge to the life of people and other beings. At the same time, it also embraces a vast potential that could be brought into full play by improving the environment for these individuals. In order to obtain success in conquering the sandy areas, we should study the adaptability of suitable vegetation, and learn from the experience of the forerunners about growing trees and plants to prevent flying sand, and in constructing gardens and houses in such areas.

The coastal sandy soil contains huge underground water reserves that could be used to create fresh or semi-saline water reservoirs. Also, saltwater can be led on shore creating saline water reservoirs.

Freshwater lakes are scattered on all continents, but saltwater lakes are always located close to the sandy areas by the sea, and as such are not that popular. Furthermore, natural semi-saline water lakes can only be found on sandy land by the sea, since their creation requires both freshwater and saltwater sources, hence their scarcity. The lagoons in central Vietnam are all natural. Unfortunately, a number of them have already been covered with sand. In short, the intention to create aquaculture ponds in the coastal region is an initiative of much ecological and economic significance. Economically speaking, it is clear that seafood is a diversified source of nitrogen and when consumed contributing to people's health in the fight against malnutrition. On the other hand, the products are also important as Vietnamese seafood exports. In terms of ecology, the creation of ponds on these hot and sandy lands will cool down the atmosphere. Wind blowing in from the sea can facilitate the rotation of pond fans adding oxygen to the pond water, without the need of generators. Obviously the waste from the seafood processing industry can be used as feed for the cultivated aquaculture species.

The coastal sandy soil is also an ideal area to dig fishponds. However, it should be remembered that the bare sandy land is also very hot. Marine animals always enjoy deep water levels and wide space since the sun can only heat the top water layers, allowing the animals to dive down into the cooler ones. Even in the construction of ponds for aquaculture, people have to think about the heat-capturing surface of the sand and should grow trees around them and even over the ponds. In industrial husbandry, the high farming density also results in huge volume of waste and pollution. Raising a high number of individuals in a limited space causes oxygen shortage while their waste creates excellent habitats for microbes, viruses and harmful insects. The farmed species are indeed living beyond the normal limits of life. Farmers always aim for the highest profit per space unit, and as such they have left the animals to live outside the boundaries of a healthy life. We used to say "grasp all, lose all" and many environmental disasters have occurred during aquaculture production in some provinces. In the history of world husbandry, despite huge investment in hygienic breeding facilities, this industry has experienced the outbreak of many epidemics like mad cow disease, foot-and-mouth disease and the like. To avoid such dangers and their impact on the economy and human health during the establishment of the eco-villages, our people have applied agro-agriculture to drive away the risk of large scale mono-culture, combining a range of plants and trees on small areas to reduce the threat of insects and the use of chemical fertilizers and insecticides.

In short, if we can bring into full play the potential of the sandy land and limit harmful environmental impacts, we could turn this sandy land into a prosperous economy and harmonious ecological system for the sake of people and animals alike.

The lesson learned of incorporating the economy as well as the ecological system in a sustainable development effort should not be ignored in the construction of the lakes and ponds on sandy land. At a time when the world's people are calling to save the earth, economists in all fields should strive for the harmonization of economic and ecological concerns so as to ensure development in its right form, which is now sustainable development.

13 PLANNING OF AQUACULTURE ACTIVITIES FOR SHRIMP AQUACULTURE DEVELOPMENT TOWARDS SAFE AND SUSTAINABLE ENVIRONMENT, HYGIENIC PRODUCTION AND STRATEGIC DEMANDS

By

Dr. Ha Xuan Thong, Director
Economic and Planning Institute, MoFI

Aquaculture provides about 27 per cent of the total fisheries output but occupies nearly 35 per cent the amount of fisheries products consumed in the world. Thanks to their high export value, many aquaculture products, especially shrimp, have become the most widely circulated products in the market. Almost all shrimp products are farmed in the tropical and sub-tropical zones. Shrimp are usually produced in developing countries to be exported to developed ones. Apart from shrimp, farmed sea fish and mollusc have also become highly-valued aquaculture products in the global trade. Trade in aquaculture products has contributed significantly to economic growth in a number of countries in Asia and Latin America.

The integration of Vietnam into the international community in all fields, including fisheries, contributes to the commercialization of this sector. Along with the commercial development of this sector, consumers demand higher and higher product quality and food hygiene. As such, quality and food hygiene and safety become vital conditions for any export-oriented, aquaculture-producing economy.

Today, based on increasingly sophisticated modern equipment, the inspection of quality, especially concerning chemical residues considered harmful for human health, has been tightly conducted according to the laws and regulations of consuming countries. The quality of aquaculture products is not only determined by applying high-tech methods in production, preservation, distribution and processing, but also depends on the natural growth of the cultivated species. Therefore, to ensure safe and hygienic cultivation practice, every agent involved in the production chain of aquaculture products, from the seedling producing farmer to the cultivating farmer himself, must implement approved technology and regularly inspect the farming process and the preservation techniques, so as to ensure that the product has the same high quality wherever it comes from and that it does not contain harmful chemicals.

Aquaculture species are usually farmed in ponds that have close interaction with agricultural production via the irrigation system. However there are also popular farming systems not using ponds, but rather nets or cages directly set up in lagoons or rivers. Furthermore, the purely natural way of catching and farming species has gradually been replaced by more intensive farming methods involving the production of seedlings and feed, and the rehabilitation of the environment using manufactured compounds. As such, securing safe and hygienic products for consumption should already begin in the farming process.

If during the next 15–20 years, Vietnam's fisheries sector continues to view export as the main development engine, then export focusing on highly-developed or fast-developing economies as the main markets will become the key strategy and top priority of the sector. The domestic market, with a population of nearly 80 million continuously improving their living standard, will also be an important market.

Given the limited natural resources available, our country’s natural aqua- and marine resources are being overexploited. The development of off-shore and high-sea fishing is, based on our present technological capabilities, proving to be difficult, and therefore, in order to strongly develop fisheries until the year 2010, it would be best to focus on aquaculture.

In order to develop aquaculture for export and domestic consumption, when the markets are demanding higher and higher quality and a larger volume, it is necessary to produce what the market needs and not what it already has.

The bilateral and multilateral trade agreements signed between the Government of Vietnam and other countries in the world, have paved the way for the Vietnamese fisheries sector to strongly and quickly enter various markets. On the other hand, this requires us to comply seriously with the common strict regulations and standards.

In 1995, Vietnam joined the Association of Southeast Asian Nations (ASEAN) and the ASEAN Free Trade Area (AFTA). In 1998, Vietnam again joined the Asia Pacific Economic Cooperation Forum (APEC) while participating in the Asia-Europe Meeting (ASEM), becoming an observer of the World Trade Organization (WTO), with which our country is now in the process of negotiating for admission. Vietnam has also signed the Framework Agreement on Economic Cooperation with the EU and the Bilateral Trade Agreement with the USA under WTO standards.

In the field of agriculture, which has important impacts on aquaculture, the ASEAN programs focus on the facilitation and enhancement of trading capacities of agro-forestry-fisheries products within the association, thereby enhancing the role of the private sector, the management and maintenance of natural resources for the sustainable development of agriculture, forestry and fisheries, and enhancing competing capability.

Participating in AFTA, Vietnam has signed the Protocol No. 8 on measures for hygiene and plant quarantine.

- Before integration (or before becoming a full member of regional and international economic organizations), countries may have applied the following three types of barriers:

    - Tariffs;
    - Quotas;
    - Technical barriers including:
        + Technical barriers to trade (TBT)
        + Sanitary and phytosanitary (SPS)

- After integration, though tariffs and quota barriers can be reduced or even totally removed, the TBT and SPS barriers would be acknowledged in the trade agreements and could become a sharp weapon in preventing foreign goods from competing with domestic ones in the local market.

As Vietnam's export of aquaculture products expands, entering markets would become the most important factor of development, determining the success or failure of our strategic programs and desires.

There have been some indications warning us of the complexity of operating in the world market of aquaculture products in the future. Since 2001, competition in the trade of aquaculture products has become tougher and trade barriers have strongly affected our country's aquaculture processing industry and export. For example, EU, Canada and the USA have increased their inspection on antibiotic residues in our aquaculture products, and the USA in particular has been creating difficulties for Vietnam's *ba sa* and *tra* fish export.

Vietnam's aquaculture processing industry is expanding quickly with the establishment of more import-export and processing enterprises (to date there are about 300 enterprises in this field). Vietnamese aquaculture products are at the same time receiving gaining more preference in the world market. The export turnover has in the last few years increased by nearly 20 per cent per year.

In view of the future difficulties that the fisheries sector in general, and the aquaculture processing and export industry in particular, may experience, strong focus has been given to improving product quality and managerial standards, in order to meet the HACCP and ISO requirements thereby gaining wider access to the American and European markets. Under the Danish-sponsored project on capacity building in the Vietnamese seafood processing industry (SEAQIP), as well as other projects on capacity building from ADB and JICA, 100 processing units have met the national standards on food hygiene and safety

and more than 70 factories have met the standards for commodities exported to the EU and have received EU certificates.

The fisheries sector in Vietnam has also boosted its efforts to access foreign markets. Participating in these activities are the Ministry of Fisheries, Project SEAQIP II, the Vietnamese Association for Seafood Export (VASEP) and the Project on seafood business enhancement (SIRED). Their efforts have helped enhance overall marketing capabilities and research. Cooperation activities in marketing have continuously been increased, e.g., the establishment of contacts with ambassadors and foreign missions, trade offices, seafood associations, companies, and even with many departments and seafood businesses in the region and world-wide.

However, during the development of the processing industry, especially the processing of seafood, our country has to face tough and complex problems from competition and protectionism around the world, as well as trade barriers established because the issue of antibiotic residue in products for consumption: Chloramphenicol and nitrofuran. Then there is the question of the U.S. draft bill on anti-dumping for Vietnamese *ba sa* and *tra* fish.

Given these circumstances, the fisheries branch has advocated proactive measures. The Minister of Fisheries has issued Decision No. 01/2002/QD-BTS prohibiting the use of 10 antibiotics (aristolochid spp and its related products, chloramphenicol, chlorpromazine, colchicines, dapsone, dimetridazole, metronidazol, nitro furan and konidazole). The government has also issued in time Directive No. 07/2002/CT-TTg on the management of antibiotics and chemicals in the production and distribution of seafood products.

The Ministry of Fisheries has worked out a standard for a safe farming practice, instructing and controlling the use of antibiotics and harmful chemicals, collecting samples for inspection and encouraging enterprises and local fisheries departments to procure testing equipment (e.g., ELISA).

As such, while planning the cultivation of aquaculture products, it is necessary to pay special attention to issues perceived sensitive by the world's seafood trade market. These sensitive issues include damage caused to mangrove forests and coral reefs, endangered species (e.g., sea turtles and dolphins), wetlands, coastal ecological zones, surface and underground water resources, the use of antibiotics and chemicals in the cultivation process, and the introduction of genetically modified species. Causing damage to the above ecosystems and species, and applying cultivation methods based on the use of antibiotics and chemicals, could probably lead to the creation of a number of global trade barriers in the future and affect the sustainable development of the fisheries sector.

Vietnam has made quite a few serious efforts and implemented important policies towards the management and utilization of natural resources, environmental protection, and securing food hygiene and safety. Despite the introduction of environmental protection, seafood hygiene and safety, along with the education of aquaculture farmers on environmental issues, the development of the fisheries sector is far from sustainable, due to the following shortcomings and limitations:

- The sector's development policies as well as their implementation prove that they continue to focus on economic growth and social stability while proper attention has not been paid to sustainability. On the other hand, environmental and food hygiene and safety policies lack a vision for future needs. The socio-economic policy-making and planning process has not yet been integrated and incorporated closely with the environmental and food hygiene and safety policy-making process.
- Still missing is a coordinating agency that enjoys sufficient authority over the planning and monitoring process on settling sustainable development issues. There are too many coordinators applying different concepts and standards.

- Methods for managing and monitoring sustainable development, as well as food hygiene and safety, are yet to be distinctive and there is a lack of regulations necessary for controlling environmental protection and food hygiene and safety activities.
- Areas, enterprises and the majority of the farmers have so far only been focusing on the fast expansion of the aquaculture industry in order to meet the rapidly growing demand, while paying insufficient attention to the role of the ecological systems and the selection of suitable chemicals and drugs. In many farming areas, inappropriate planning and management have led to wide spread pollution and violation of safety standards.
- The fisheries and aquaculture sector is itself in a backward position with poor resources limiting conditions for sustainable development and good food hygiene and safety.
- An inter-sectoral and inter-regional management system is lacking while there are too many overlapping tasks and responsibilities between the branches and levels of authorities in the government, each of which conducts its tasks in its own way. As a consequence, it is not possible to effectively control factors affecting the environment, especially the water environment which is always moving and has very high transmission capability (e.g., the use of insecticides, antibiotics or chemical fertilizers could be permitted for some agricultural production but not in aquaculture).

Fully grasping the Party's socio-economic development policy and, with it, the wish to improve people's livelihood, the Vietnamese fisheries sector will continue to rely on export as the key contributor to development in the next 15–20 years. Expanding export thereby becomes the sector's key strategy and top priority, considering highly-developed or fast-developing economies its main market targets, while the domestic market potentially demands a more and more diversified range of products with improved quality (draft Master Plan for Fisheries to the year 2010 submitted to the government). At the same time, integrating with regional and international fisheries agencies is seen as indispensable. Vietnamese fisheries would strive for the strict adherence with international and regional conventions and laws to meet requirements on production and trading conditions, food hygiene and safety standards accepted by various markets (draft Master Plan for Fisheries to the year 2010 submitted to the government).

The overall strategy is to plan the principle of ensuring biodiversity and ecological safety, focusing on the development of aquaculture and export-oriented farming (especially shrimp), increasing the freshwater farming area, giving priority to the development of biotechnology in the prevention of disease and the production of seedlings and feed.

It is expected that aquaculture will be strongly developed in the south-west of southern Vietnam in the areas of saltwater, freshwater and brackish-water; employing all farming systems within each water category. Eco-farming would be given due attention to create more organic commodities. Apart from tiger shrimp, blue-legged shrimp, brackish fish and freshwater fish could all give good productivity and export values and, as such, could be developed on large scale. The Mekong delta area is expected to contribute with some 60 per cent to the country's total aquaculture output in the future.

Aquaculture, including salt, brackish and freshwater cultivation, would be developed in the following areas: the southern Vietnamese plains, the southern part of Central Vietnam, the northern part of Central Vietnam, the Red River delta, and the islands of Quang Ninh and Hai Phong. These areas would hold priority to intensive farming and develop aquaculture on shielded sea zones along the coast of Quang Ninh, Hia Phong and Khanh Hoa. The production is expected to utilize diverse farming methods producing species of high-value like fish, mollusk, shrimp and algae.

The central highland of Tay Nguyen and the northern mountainous areas could also develop freshwater aquaculture with an emphasis on poverty reduction and eradication, while providing on-site nutritious food.

Shrimp and fish seedling farms are foreseen as being distributed evenly according to the quantity and species available at each location. Principally, this business would be privatized. The state would consolidate and set up a system of aquaculture species in all environments to study, import, domesticate and cross-breed, and create a gene bank to supply parent breeds to farmers. The production of aquaculture species would be planned in such a manner that the producers gather in industrial zones to improve control and management, provide better services and lower production costs.

In the master plan until the year 2010, the target output is a minimum of two million tonnes and a maximum of 2.5 million tonnes of aquaculture products cultivated on a 1,400,000 ha area divided between 600,000 ha of freshwater and 800,000 ha of salt or brackish waters. This would be an increase of 400,000 ha against the 2001 figure, including an extra 200,000 ha in the freshwater zone and another 200,000 ha in the salt and brackish water zone. These are ambitious goals and fulfilling them will turn the aquaculture industry into the heart of the whole fisheries sector (accounting for two-thirds of the output and three-quarters of the export turnover).

This strategy can however only be implemented if most aquaculture products are sold instead of used for personal consumption. Aquaculture farms should be concentrated in areas that are surveyed closely so that the conditions and methods of production protect the environment, hygiene and safety of the products. Aquaculture areas should also be located away from other agricultural systems, population areas, industrial zones and urban settlements. The presence of waste treatment facilities in the concentrated farming areas and the areas producing seedlings and processing the products should also be a prerequisite to ensure environmental safety for the farming systems themselves, especially at the coast, river mouths and the sea.

Under present conditions, if environmental control measures and control of chemical and antibiotic residues continue to be insufficient, the selection of safe farming systems that allow minimal use of chemicals, industrial feed and disease prevention drugs should be given priority. These farming systems could combine aquaculture with gardening, rice cultivation and forest development, based on extensive and semi-intensive farming methods. Only in places that have implemented adequate facilities in terms of technology and environmental treatment should industrial intensive farming be applied.

14 POTENTIAL FOR THE DEVELOPMENT OF AQUACULTURE ON SANDY LAND IN QUANG BINH PROVINCE AND DEVELOPMENT ORIENTATIONS

By

Mr. Hoang Dinh Yen, Director
Quang Binh Fisheries Department
Presented by
Mr. Mai Xuan Thu

14.1 The potential for aquaculture development on sandy land in Quang Binh province

Quang Binh province has 39,000 ha of coastal sandy soil including 4,500 ha with the potential for developing farming of tiger shrimp and other aquaculture products for export. The sandy soil stretches to the east of national highway 1A and covers a long strip from Vinh Linh in Quang Tri to Deo Ngang between Quang Binh and Ha Tinh provinces.

The sandy soil area here bears the following features: loose and weak structure, high filtering capacity, low fertility, high decomposition rate of dead vegetation that further deteriorates soil fertility and low pH level. The soil is not very stable and moves due to the effect of wind and water runs.

There are over 145,000 people living on the coastal sandy soil of the 18 wards and communes of Ngu Thuy, Hai Thuy, Ngu Hoa (Le Thuy district), Gia Ninh, Hai Ninh (Quang Ninh district), Bao Ninh, Hai Thanh, Quang Phu (Dong Hoi town), Nhan Trach, Duc Trach, Hai Trach, Thanh Trach (Bo Trach district), Quang Phuc, Quang Tho, Quang Xuan, Canh Duong and Quang Phu, Quang Dong (Quang Trach district). Among them there are the especially poor communes of Ngu Thuy, Hai Thuy, Ngu Hoa, Hai Ninh, Canh Duong, Quang Phu and Quang Dong.

14.2 Status of the utilization of coastal sandy soil

For a long time, the people living in the coastal sandy soil areas have relied on fishing as their key livelihood. Apart from this activity they have utilized the land for forestry purposes including the development of wind and sand prevention forests (mostly Casuarinas). The low and even land to the west of national highway 1A can also be used to cultivate rice, cereals and other produce like red peppers, onions, garlic and melons.

Under the implementation of the Government's Aquaculture Program for 1999–2010, Quang Binh's Department of Fisheries has invested in the development of many forms of aquaculture in order to fully bring into play the potential of the land and the people on the coast, and to create employment, a fresh food supply and products for export. The present forms of aquaculture include:

- On the area to the west of national highway 1A, where freshwater is available, freshwater fish ponds have been developed to provide perch and grass carp. Today there are about 30 ha of freshwater fish ponds with a productivity of two–three tonnes/ha.
- On the banks of the river where saltwater sources are available, eight ha of shrimp farms have been constructed in Bao Ninh along the Nhat Le River, supporting semi-intensive tiger shrimp farming. The method employed in developing the pond is to utilize concrete pipes filled with sand upon which walls are constructed to hold the water. The walls are then covered with plastic sheets on the inside to prevent leakage. During the initial crops, the farming density was 8–15 individuals/m^2, producing 0.7–1.2 tonnes/ha.

- On the coastal sandy land in Quang Binh, five farms have been established to produce tiger shrimp and banana shrimp seedlings with a capacity of 1–10 million P15 individuals a year, meeting over 50 per cent of the province's demand. Many households have been able to build cement tanks several hundred square metres in size in order to cultivate seafood to supply to restaurants and hotels of the province. In 2002, with the introduction of new technologies for intensive farming of tiger shrimp on sandy soil in the provinces of southern central Vietnam, Quang Binh has set up a total of six ha of farms including 1.5 ha of stonewalled, cemented and nylon covered ponds (sized at 0.5 ha each) at a cost of VND 500 million/ha (US$ 32,258/ha). The remaining 4.5 ha have been constructed by digging ponds in the sand and covering the bottom and edges with plastic sheets, at an average cost of VND 250–300 million/ha (US$ 16,129–19,354/ha). The tiger shrimp farming ponds on coastal sandy soil have been in use since April/May. At present the shrimps are growing well.

Quang Binh province is also trying to farm grouper and trout in constructed tanks on sand, thereby complimenting the farmed shrimp. This will increase the different species of produced marine seafood with high export value, and also reduce the pressure from diseases on the shrimp, the main product.

The farming of tiger shrimp in constructed ponds along the coast has a number of advantages against the farming of shrimps along rivers in earth ponds located on the saline fields of Quang Binh:

- The utilization of new, large sources of land with good potential for developing high-value shrimp and other seafood products for export.
- The use of clean saltwater pumped directly from the sea and freshwater from underground wells, thus avoiding pollution caused by sewage water from agricultural and industrial production elsewhere.
- Almost no direct impacts from floods, allowing year-round, multi-crop farming.
- Contributes to decreasing the pressure on land used for agriculture by shifting cultivation towards land utilized for aquaculture.
- Creating employment for the extensive coastal labour force.

However, farming shrimp on sandy soil is also accompanied by certain difficulties, such as:

- Lack of experience in planning for development of farming zones and ponds.
- Moving and flying sand, ponds filling with sand and regular water invasions.
- High construction costs.
- The need for expensive water pumping equipment, the construction of pumping stations and an insufficient infrastructure including communication and power lines.

Tiger shrimp farming on sandy soil is a new farming technology and is effective if intensive farming methods are applied. As such, apart from applying the process of intensive tiger shrimp farming, it is necessary to pay special attention to the characteristics of the sandy soil area and also:

- The planning of the farming zone.
- The design and construction of freshwater and saltwater containers, farming ponds, water treatment ponds, major pumping stations, automatic water supply and drainage systems, as well as water links to the sea.
- The issue of colouring the water with the help of algae in the initial stage.

14.3 The orientation for development of shrimp farming on Quang Binh's sandy soil

To implement the program on aquaculture development and in order to bring the vast potential of the province's coastal sandy soil area into full play while utilizing the existing labour force and cultivating

products for export, the province of Quang Binh is planning to develop the farming of tiger shrimp on an area of 400 ha of sandy soil by the year 2005. The farms are expected to generate a productivity of 3–3.5 tonnes/ha and to be developed in the following localities:

Dong Hoi town:	150 ha
Le Thuy district:	100 ha
Quang Ninh district:	50 ha
Bo Trach district:	50 ha
Quang Trach district:	50 ha

By the end of 2002 each district will be conducting pilot farming on 1–1.5 ha to draw from the experience.

14.3.1 Planning of concentrated farming zones

In the first phase, priority is given to construction in areas that have favourable communication conditions; that are located near the national power grid; and have sufficient underground freshwater reserves to supply the farming zones while protecting the ecological environment of the Casuarinas forests preventing sand movements.

Coordination among the agricultural, transportation and power supply sectors is needed to develop roads and power lines in the shrimp farming areas, while at the same time designing and constructing the freshwater supply canal system from coastal water reservoirs like Bau Sen, Vuc Tron and Quang Dong. Furthermore the construction of freshwater and semi-saline water reservoirs is necessary to store rainwater in areas without irrigation reservoirs. At the same time, it will be necessary to build pumping stations to utilize the underground freshwater.

It is also necessary to study the possibility of constructing major pumping stations to attain water from the sea suitable for the windy conditions of the horizontal sandy stretches, and to study measures on how to bring down the cost of pond construction on sandy soil.

14.4 Recommendations

- The government should stipulate policies for capital assistance for constructing infrastructure like power supply systems, seawater and freshwater pumping stations, water canals, etc. to facilitate the development of shrimp farming on sandy soil.
- The Ministry of Fisheries should, as soon as possible, issue a unified process for shrimp farming that the sandy soil localities could apply.
- The Central Centre for Fishery Promotion should introduce the technology needed to construct major pumping stations on the horizontal land in order to supply saltwater to the shrimp farming areas.

15 THE EXPLOITATION OF SANDY LAND FOR AQUACULTURE IN NINH THUAN PROVINCE – A PROMISSING DEVELOPMENT PATH

By

Mr. Nguyen Khac Lam, Director
Ninh Thuan Fisheries Extension Centre

15.1 Introduction

Ninh Thuan is a coastal province in the south of central Vietnam and has a coastline of 105 km with quite a number of dams, ponds, bays and river mouths providing a total of 4,000–5,000 ha of water and land surface suitable for the development of aquaculture. Despite the small area, Ninh Thuan enjoys favourable natural conditions to farm a number of aquaculture products of high economic value like grown tiger shrimp as well as their seedlings, lobster, mollusk and algae. The development of aquaculture in recent years, especially the commercial farming of tiger shrimp, has recorded fast growth with important achievements, making shrimp the key export commodity of the province and contributing to the creation of jobs and income for local people. Thanks to its important position in the provincial economy, the provincial 10th Party Committee resolution has identified that in the next 5–10 years (2000–2005–2010), fisheries and aquaculture will continue to be the province's leading production, in which aquaculture will be the breakthrough requiring appropriate investments. The province should strive to bring the total farming area to 3,000 ha in 2005, using semi-intensive and intensive farming methods bringing about an output of 5,000–6,000 tonnes.

However, since this is a small coastal province, the potential farming area applicable to the development of aquaculture is somehow limited, though most of the area and water surface provide favourable conditions for commercial tiger shrimp farming or the development of some other high value commodities (the present total aquaculture farming area of the province is 1,200 ha). In order to achieve the targets defined in the mentioned resolution for the period 2000–2005, the fisheries branch of Ninh Thuan has planned to further exploit the coastal sandy soil stretches which have been considered to have potential in terms of area, but remain more or less deserted. The plan is to develop commercial farming of tiger shrimp and seedlings.

The commercial farming of tiger shrimp on sandy soil in Ninh Thuan province started in 1999–2000 with just two families agreeing to try on a five ha area and with a farming density of 15–20 P15/m^2. To limit water loss, they covered the pond's bank and bed with a thin nylon layer. The initial output gave 2.5 tonnes/ha and on average the households fetched a profit of VND 150 million (US$ 9,677). It was the success and efficiency of this initial start that drove the model of tiger shrimp farming on sandy soil in Ninh Thuan to develop strongly after 2000. The development covered all sandy land areas in the province and became a whole movement. While identifying the promising path for the utilization of the sandy soil areas for aquaculture, the province's Centre for Fisheries Promotion actively assisted by giving technical assistance to the farmers while at the same time coordinating with Nha Trang University of Fisheries on a study of perfecting the farming methods on sandy soil. The province's fisheries branch has also conducted surveys on the sandy soil areas that have the potential for aquaculture planning and development. Thanks to these active efforts, tiger shrimp farming on Ninh Thuan's sandy soil has obtained good and important outcomes.

The present aquaculture area on sandy land in the province is 180 ha, and the farming practice will continue to expand. The productivity of shrimp farming on sandy soil has been increasing continuously from one crop to the other, from 2.5 tonnes/ha/crop in 1999 to 2.8 tonnes/ha/crop in 1998 and 3.5 tonnes/ha/crop in the first crop of 2001. New technology has been applied effectively, improving and perfecting the farming process. Improvements to the service constructions have also been made, curbing to some extent previous shortcomings including water loss during the farming process, high water temperature (due to heat retention caused by the pond bed cover), algae loss in ponds and increased pH

level that affected shrimp development. It can be said that the model of shrimp farming on sandy soil in Ninh Thuan has consolidated its position after proving highly efficient in most farming areas. The production results are shown in the following examples taken in 2001:

Table 25 Production results from 2001

No.	Household	Area (ha)	Density (individuals/m^2)	Output (tonnes)	Productivity (tonnes/ha/crop)
1	Cao Van Bao	1.5	30	10.0	6.6
2	Nguyen Van Minh	0.8	25	5.2	6.5
3	Nguyen Van Phuong	2.0	30	8.0	4.0
4	Do Van Ngo	1.0	40	5.0	5.0

Based on the applied farming practice on sandy soil in Ninh Thuan since the year 2000, the following initial observations can be made:

15.2 Strong elements of the farming model

- The construction cost per hectare of farming ponds on sandy soil is about VND 250 million (US$ 16,129), (including pond bed cover material and equipment) which is not substantial compared with investments in construction on other soils of similar areas. As such, it is rather suitable for many different individuals to invest in this farming model.
- The production process of this model is not so difficult to implement if sufficient investments are made in equipment and if the technical instructions are followed strictly, even though it differs from other farming methods. The water temperature is usually 0.5–1.5°C higher than in other environments, the nutrient content of the pond bed is poor, the pond regularly loses algae and the pond water has a high salinity. However, with a density of 20–30 P20 shrimp per m^2, this model is still attractive.
- Most of the sandy areas are found along the coast and, as such, could secure rather clean water resources which are rarely polluted and easily accessible.
- The model can provide two crops a year and even during the rainy season since most of the sandy areas are not affected by floods, but rather enjoy extra supplies of freshwater which is limited during the dry season.
- Since the ponds are located higher than the sea tides, most of the ponds can discharge all their water when renovated and, as such, the chance to destroy pathogens is completely limiting the spread of epidemics.
- With sufficient investments in equipment and proper compliance with the technical instructions, the productivity of this model could reach four–five tonnes/ha/crop.

15.3 Limitations of the farming model

- Since the pond bed is made up of sand, which is poor in nutrients, the pond's environment is usually fluctuating in the beginning of a crop. The pond also faces regular loss of algae and a high pH level of over nine in the afternoons, thus affecting shrimp's health. Weed development in the pond after the first two months is a familiar phenomenon due to the pond's transparent water and its bed cover layer, which allows sunlight to reach the bottom. As such, the management of the farming pond's environment during the entire process is important in order to ensure the normal development of the shrimp, but this task requires more effort than in other environments.
- During the dry season (April–August) the key crop in Ninh Thuan is cultivated, but during this time freshwater becomes scarce, thereby limiting freshwater supply to the farming ponds. Most of the supply comes from groundwater reserves, but with the large farming area the reserves could prove to

be insufficient, resulting in high salinity levels in the ponds. During the dry season the salinity level can rise to 32–34 per cent affecting the shrimp's growth rate.

- Production cost for a crop is 8–10 per cent higher than that of other models because expensive pumping systems are necessary for water supply and exchange.
- The farming period per crop is 10–15 days longer than in other models. Normally, to produce shrimp of size four with a farming density of 25–30 P20/m^2, it will take 4–4.5 months for ponds on sandy soil while the duration for other models is about 3.5–4 months.
- Since most of the ponds rely on underground wells for freshwater supply during the dry season, the area could be affected by salt intrusion due to freshwater exhaustion. This would greatly affect the economic life of the population in the area. As such, this factor should be taken into account in any planning activity to ensure the smooth running of many other sectors requiring freshwater.
- At present, wastewater is released directly into the sea after each crop, which, in the long run, could affect the farming environment. Therefore, it is necessary in the planning process to find suitable solutions as to how wastewater should be treated, so that a stable farming environment is ensured in the long run.

All in all, the farming of tiger shrimp on sandy soil in Ninh Thuan, has in the last two years confirmed that this is a model suitable for large-scale development bringing about economic efficiency equal to other models. The development of this aquaculture model will contribute to the exploitation of the coast's waste sandy soil for commodity production, creating jobs and stabilizing the lives of local people. Besides, it also has significant implications for the strengthening of the coastal defence. However, to develop this model on a long-term basis that is stable and effective, the government should have concrete planning for each region so as to supply the appropriate development strategy. At the same time, there should be further scientific and technological studies to perfect the production process.

16 CURRENT STATUS OF THE USE OF ANTIBIOTICS, CHEMICALS AND BIOLOGICAL PRODUCTS IN SHRIMP FARMING

By

Dr. Vu Huy Thu, Vice Director
Fisheries Resource Protection Department, MoFI

While implementing the Program on Aquaculture Development for the period from 1999 to 2010, aquaculture production has in recent years undergone a vigorous development in terms of cultivated area, productivity and its diversified products. It is worth noting that shrimp farming has steadily developed, especially the cultivation of tiger shrimp. It is the strong development of shrimp farming that has brought about drastic development in other service areas such as the production and trading of drugs, chemicals and bio-products used in aquaculture. In fact, concerned government managerial agencies always desire to strongly develop aquaculture for high output, high quality in terms of food hygiene and safety, but at the same time, preventing pollution of the environment and ensuring ecological balances. The interest of the shrimp farmer is to get high productivity and a consolidated production yielding better earnings. Providers of shrimp seedlings to farmers are interested in getting the highest benefit while keeping the cost on parent shrimps at the lowest.

Because of the differences in the desires and interests of government agencies, shrimp farmers and shrimp seedling producers each tend to utilize drugs, chemicals and other bio-products in their own best interest. At this conference, we would like to present to you the current status on the use of antibiotics, chemicals and biological products in shrimp farming. With this information we hope that we can reach common ground while striving to achieve the objective of raising the quality of aquaculture products and at the same time ensuring good food hygiene and safety.

16.1 Current status of the production of drugs, chemicals and biotic products, and their businesses

16.1.1 The businesses producing and importing veterinary drugs for aquaculture

Decision No 17/2002/QD-BTS of May 4, 2002, issued by the Ministry of Fisheries, provides a list of veterinary drugs permitted in aquaculture production, and covers 325 different drugs allowed in the market.

Amongst these, 308 are permitted for ordinary use and are divided into the following groups:

- Drugs containing antibiotic active ingredients: 90 products
- Drugs containing chemical and mineral ingredients: 66 products
- Drugs containing biological products and vitamins: 152 products

Various Vietnamese and foreign companies have produced these drugs and registered them under different brand names and, as such, there is a large variety of these drugs.

There are 18 drugs permitted for limited use and most of them contain antibiotic active ingredients and have been supplied by pharmaceutical companies and importing agencies.

16.1.2 Regarding domestic drug manufacturers

By July 15, 2001, there were about 66 domestic drug manufacturers including the stock companies, limited liability companies, joint venture companies and private companies. The majority of drug manufacturing companies are set up in Ho Chi Minh City, Can Tho, Dong Nai, Binh Duong, Khanh Hoa

and some other provinces. The amount of drugs produced by these companies can meet only part of the demand for products used for disease prevention, water treatment and stimulating shrimp growth.

Most farm owners or workers responsible for technical matters need to acquire professional certificates or degrees, and most of them are veterinarians. They have been quickly approaching domestic and regional markets in order to build up strategies for their products. Most of the products supplied to the market have fine packaging with their own trademarks and can easily be recognized and differentiated.

16.1.3 Regarding import businesses

These businesses possess equipment and a technical force similar to those of the domestic manufacturing companies mentioned above, but their strengths are their financial resources and knowledge about the regional market. These advantages permit them to successfully, and in a rather short time, to import new kinds of medicine or pharmaceutical materials and supply them to medicine manufacturers in the country. The type of products that are being imported and the exporting country are registered at a border point in Ho Chi Minh City. During the first six months of this year, the records show the following:

Import volume

- Biological products: 10,563 kilograms and 110 litters
- Chemical products for environmental treatment: 4,881,537 kilograms
- Drugs for treating shrimp diseases: 27,662 kilograms.

Origin of the imported goods

- Biological products:

  24.32 per cent from the United States
  44.57 per cent from Thailand
  28.40 per cent from China

- Chemical products for environmental treatment:

  0.3 per cent from the United Kingdom
  0.4 per cent from India
  3.25 per cent from Taiwan
  4.6 per cent from Indonesia
  0.05 per cent from the United States
  86.85 per cent from Thailand
  4.55 per cent from China

- Drugs for shrimp disease treatment:

  0.45 per cent from India
  24.73 per cent from Taiwan
  6.51 per cent from France
  68.31 per cent from Thailand

16.1.4 The sale of aquaculture veterinary drugs

There are today hundreds of companies selling aquaculture veterinary drugs. In the provinces where shrimp farming is developed, the number of aquaculture veterinary drug dealers has increased. These dealers have the following common characteristics:

- Selling aquaculture veterinary drugs as well as agricultural veterinary drugs.
- Selling aquaculture veterinary drugs as well as aquaculture feed, fishing tools and nets.
- Working as agents commissioned by various drug producers or drug importers.

This way of conducting business has created gaps that allow illegal drugs to be imported as well as produced locally, a situation that makes it difficult for the government to effectively control this area.

The outcome of a survey on aquaculture veterinary drugs

In early 2002, the Minister of Fisheries issued Decision No. 262/QD-BTS ordering the establishment of a Working Group with the task of inspecting the implementation of Decision No. 01/2002/QDD-BTS in 12 key provinces. The provinces include Quang Ninh, Hai Phong, Da Nang, Khanh Hoa, Ninh Thuan, Ba Ria – Vung Tau, Ho Chi Minh City, Dong Nai, Can Tho, Soc Trang Bac Lieu and Ca Mau. Members of the Working Group came from the Science and Technology Department, NAFIQACEN and the Aqua-Resources Protection Department and were headed by the Deputy Director General of the Aqua-Resources Protection Department. The Working Group has held meetings with the heads of each province's Fisheries Department and has been inspecting some drug manufacturing companies and drug-selling agents.

Outcomes of the inspection

Decision No. 01/2002/QDD-BTS has been fully supported by all localities, and in just one month the localities have raised awareness about this decision among the people including the drug manufacturing companies and drug selling agents. Furthermore the official letter No. 72/BVNL-NL, issued by the Aqua-Resources Protection Department on measures how to carry out Decision No. 01/2002/QDD-BTS, has been announced. Almost all businesses have clearly understood the content of the above-mentioned decision and have corresponded by restructuring their strategies and making appropriate adjustments where necessary, i.e.:

- To withdraw from producing and circulating drugs containing prohibited antibiotic and chemical elements and to label the drugs in accordance with the regulations. Drug manufacturing companies have in general complied with the regulations stipulated in Decision No. 01/2002/QDD-BTS, and drug samples collected by the Working Group did not contain any prohibited antibiotic elements.
- The drug trading industry has also been thoroughly informed about the decision's content, and the majority of these businesses have committed themselves not to produce prohibited drugs as well as and not to sell any unlisted drugs. However, the inspection carried out by the Working Group and the Provincial Fisheries Department found the following:
- The personnel and equipment resources deployed by the Provincial Fisheries Departments are limited, and therefore conducting regular inspections of the drugs produced by the aquaculture drug manufacturing companies has turned out to be difficult.
- At present, the number of laboratories, set up by the ministry to analyze drug quality also remains limited. The laboratories belonging to departments of NAFIQACEN lack the equipment that can help analyze imported biological products circulating on the market.

16.2 Measures to be taken

In order to best control the use of aquaculture veterinary drugs in the future, the following measures should be taken:

- There should be coordination between the Aqua-Resources Protection Department, the Central Fisheries Promotion Centre, the Science and Technology Department and NAFIQACEN in publishing and announcing the targets and aims for the use of *safe* drugs. The permitted drugs should be distinguished from the prohibited or illegal drugs, so that people will use the right ones.
- The Ministry of Fisheries should finalize the Draft Decree on administrative punishments in the aquaculture sector as soon as possible in order to facilitate the control and treatment of violations in the manufacturing and selling of aquaculture drugs.
- The Aqua-Resources Protection Department should cooperate with other specialized departments in introducing guidelines for the testing of newly-imported or manufactured drugs so as to firmly control the circulating products.

- Provincial Fisheries Departments should instruct their branches to work out their budgets so that funding is reserved for regular aquaculture and veterinary drug quality inspections.
- The Ministry of Finance and the provincial Finance Departments should balance the annual funds reserved for the quality inspection of goods and commodities according to the present Decree on Goods and Commodity Quality.
- The Ministry of Fisheries should open a number of laboratories that have access to appropriate equipment and experienced inspectors from concerned agencies, in order to facilitate the analysis of aquaculture product quality.