The Experience and Development of Responsible and Eco-friendly Aquaculture Production Practices to Aquaculture Foods' Safety and Traceability in Taiwan

Fu-Sung Chiang, Ph.D.

Professor and Director, Institute of Applied Economics, National Taiwan Ocean University, Taiwan and Executive Director, Taiwan Tilapia Alliance, Taiwan
2 Pei-Ning Road, Keelung, Taiwan 20224
E-mail: frank@ntou.edu.tw
Tel: +886-2-2462-2324 Fax: +886-2-2462-7396

A Paper will be presented in the 2006 FFTC-RCA International Workshop on Innovative Technologies for Eco-friendly Fish Farm Management and Production of Safe Aquaculture Foods, Sari Segara Beach Hotel and Spa, Bali, Indonesia, 4-8 December 2006

Abstract

The awareness of environmental conservation, food safety, and responsible aquaculture production has been the key factors to changes in the development of the world aquaculture and seafood communities. Aquaculture plays an important role in supplying fish for the increasing population and becomes one of the main sources of the animal proteins; the catches from the sea were not able to increase due to the reduced quotas across open seas, limited fishing periods and areas, and increased license fees. To meet this trend, aquaculture industry has to prepare to enter an era of restructuring and increasing concern for sustainability. Recent developments in responsible and eco-friendly aquaculture production practices to enhance aquaculture foods' safety and traceability in Taiwan are described in this paper.

Keywords: Responsible and Eco-friendly Aquaculture, Food Safety, Traceability, Taiwan

I. Aquaculture - the "New Industry" in the Next 50 Years

The awareness of environmental conservation, food security, and global greenhouse effect has been the key factors to change the development of the world fisheries and seafood communities. It has been well-documented that catches from the sea were not able to increase due to the reduced quotas across open seas, limited fishing periods and areas, and increased license fees. A recent article published by the journal *Science* showed that the state of global fishing stocks is in accelerating severe declines and the world's marine species will collapse by 2048 because of overfishing, pollution, habitat loss and climate change (Worm *et al.*, 2006). Thus, aquaculture plays an important role in supplying fish demanded by the increasing population and becomes one of the main sources of the animal proteins.

Drucker (2002) predicted that the "bio-technology" and "aquaculture" will be the "new industry" in the next fifty years. He used salmon as an example to describe the relationships between wild catch and fish farming products. He also believed that new and different species will be developed in the fish farming besides salmon. Thus, aquaculture or fish farming is filling the growing demand of seafood and providing animal protein to human beings in the future.

During the last three decades, Taiwan's aquaculture industry has developed rapidly due to the combined efforts of aquafarmers, investors, and experts from academia and research institutes. Taiwan has gained worldwide reputation in aquaculture technologies and has made tremendous contributions to fisheries production and value. To meet the challenges of increasing trend toward globalization, food safety, and environmental conservation, Taiwan's aquaculture industry has to prepare to enter an era of restructuring and increasing concern for sustainability (Chiang, Chiang, and Liao, 2001). The experience from Taiwan could be an example to the other countries.

This paper describes how Taiwan develops responsible and eco-friendly fish farming practices to meet the global trends on food safety and traceability. Firstly, this paper presents an overview of the global fisheries production with a focus on aquaculture, which provides

an understanding of the role of aquaculture in the human food supply in the future. Secondly, this paper describes the current status of Taiwan's aquaculture sector. Then, several measurements will be used to demonstrate the recent developments in responsible and eco-friendly aquaculture production practices to enhance aquaculture foods' safety and traceability in Taiwan. Finally, an outlook of fish farming industry will be presented.

II. Overview of Global Fisheries Production

The changing trends in capture fisheries worldwide include: 1) depletions of many fish stocks in the marine resources; 2) overfishing and by-catch have been serious problems; and 3) formal and legal change relating to the implementation of several international laws. A study from Worm *et al*., (2006) supports one of the above statements. Worm *et al*. found that more than 2,200 commercially fished species worldwide had collapsed by 2003, only six in 1950. Due to the increase in population and changes in food consumption patterns, consumption of fisheries products has increased. Because of the general over-exploitation of wild aquatic organisms, the food supply from capture fisheries will probably decline; and the yields from aquaculture are increasing as a result of the progress of aquaculture technologies and their adoption.

The aquaculture industry can provide consumers with high quality, safe and affordable seafood and thereby reduce pressure on wild stocks and help their recoveries. Aquaculture can also make great contributions to regional economy by providing employment and business. Based on the importance of small-scale socially-oriented aquaculture and changes in market characteristics, the aquaculture sector should continue to develop toward its full potential, forming a sustainable industry in a responsible manner (FAO, 2000). In general, the global trends in aquaculture are: 1) rapid growth in aquaculture production; 2) farmed fish has become an important food supply; 3) aquaculture contributes to the economy: employment and business; 4) aquaculture development in maximizing its fully potential contribution; 5) it has become an environmentally responsible and socially acceptable industry;

and 6) increased quality and safety toward a sustainable industry.

Figure 1 shows the global fisheries production in the last 35 years. The world's wild capture production increased from about 64 million M.T. in 1970 to 96 million M.T. in 2004 (FAO, 2006). During the same period, the fish farming production worldwide increased significantly from 4 million M.T. to 59 million M.T. This rapid growth in aquaculture production has made the sector important to the food supply and to the economies of many developing countries. Figure 2 shows the increasing trends of global aquaculture production from 1990 to 2004. It is reasonably expected that the ratio of aquaculture products to world fishery products could increase to 40% from 29% before 2010.

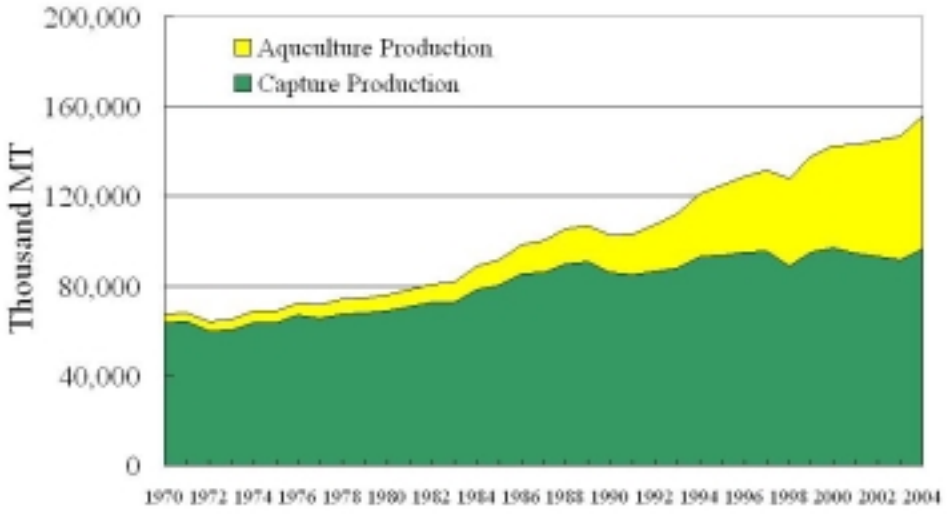

Figure 1. Global Fisheries Production, 1970-2004

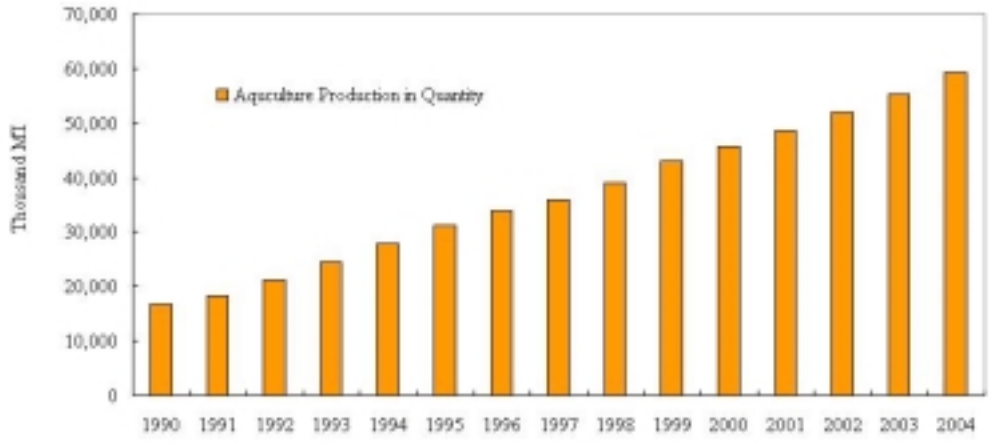

Figure 2. Global Aquaculture Production, 1990-2004

III. Current Status of Taiwan's Aquaculture Sector

In addition to the distant-water fisheries, Taiwan has gained worldwide reputation in aquaculture technologies. In 2005, Taiwan fisheries production was about 1.31 million M.T., including 752,118 M.T. of deep-sea fisheries, 254,625 M.T. of inshore- and coastal-fisheries, and 307,352 M.T. of aquaculture products. The exported and imported aquatic products were 650,477 M.T. and 381,968 M.T., respectively (Fisheries Agency, 2006). Taiwan's aquaculture products accounted for about 23% of the total fishery production in 2005. In 2005, the total value of aquaculture products was NT$31.3 billions (or US$948 millions), or 34% of total fishery revenues in Taiwan. The major species of aquaculture products are tilapia, milkfish, eel, hard clam, oyster, fresh-water clam, and shrimp.

There are three major types of aquaculture in Taiwan, namely, fresh water pond aquaculture, brackish water pond aquaculture, and marine culture. The total acreage of these three types of aquaculture is approximately 56,000 hectares. Located in the subtropical region, the environment of Taiwan is suitable for the aquatic breeding. With the

research and improvement of artificial propagation techniques and improved fish farming technologies, nearly 100 aquatic species can now be farmed in Taiwan. In the fresh water fish farming, major species are tilapia, eel, carps, giant freshwater prawn, and freshwater clams, etc. In brackish water ponds, sea bream, milkfish, grouper, sea bass, tiger prawn, and white-leg shrimp are commonly farmed in Taiwan. In the inshore farming, the main species farmed are oyster, hard clam, and small abalone. Cobia, sea breams, groupers, and yellowtail are the main species in offshore farming. In 2005, the total aquaculture production was 307,352 M.T. which included 172,903 M.T. of inland fresh-water pond culture, 94,766 M.T. of brackish water pond culture, and 34,922 M.T. of marine culture (Fisheries Agency, 2006).

IV. Recent Developments in Responsible and Eco-friendly Aquaculture Production Practices in Taiwan

The Taiwan's Seafood Industry realizes that high quality product, safety and sanitation are basic business practices to maintain the sustainable growth of an industry. Thus, Taiwan's future aquaculture development is committed to be eco-responsible and consumer/market-oriented aquaculture to comply with the trend of an era of restructuring and increasing concern for sustainability. Three principles are formed to fulfill the objectives. Developments are focused on: 1) potentially competitive species or livelihood widely related species such as fish fries, ornamental fishes, marine cage culture, and recreation aquafarm; 2) environment which is socially responsible and acceptable, e.g., code of fish farming practices; and 3) improving industry by forming an alliance among producers, suppliers, processors, and academics. Specific plans includes: 1) to form specific aquaculture areas; 2) to built infrastructure; 3) to have joint procurement; 4) to form fishermen's organizations via a strategic partnership to get common consensus and to conduct promotional programs; 5) to grant research programs; and 6) to form the aquaculture act.

Regarding the responsible and eco-friendly aquaculture production practices, the contents of the code of practices for fish farming including food safety, design and construct farms, feed and feed use, general pond

operation, health management, therapeutic agents and other chemicals, effluents and solid wastes, community and employee relations, and conservation of biodiversity are proposed to enhance the Good Aquaculture Practices (GAP) in Taiwan. The Council of Agriculture in Taiwan announced the regulations of the GAP in January of 2004 to process the certifications of the farms in the aquaculture sector in Taiwan. The Taiwan Tilapia Alliance also launched a program to set up three "tilapia production zone exclusively for exports" to implement the GAP starting in February 2004. Further, the Alliance is launching a "Taiwan Tilapia ID Project" to set up the model of traceability on tilapia fillet products in April 2005. Each fillet will be labelled a trace code and information about the farmer on the vacuum pack. Consumers can obtain the information pertaining to the farmer and processor using the trace code from the web site of the Alliance.

In addition to implementing the GAP, a traceability system is implemented to all agricultural and fisheries products in Taiwan. The system follows the EU format and standards. A global location number (GLN) is assigned to each individual fish farmer. Farmers keep production records periodically about their production activities as well as pond managements. Production records are stored in networked computers. Consumers can trace the fish products with trace codes in using computer or mobile phone.

A Taiwanese delegation visited the Laboratoire d'Etudes et de Recherches sur les Médicaments Vétérinaires et Désinfectants (AFSSA-LMV-CRL) in Fougeres and the School for Advanced Residue Analysis in Food (LABERCA) in Nantes, France in November 2004 to exchange the information and experience on drug residues analysis. The visit was very helpful to the Taiwanese tilapia farming and processing sectors in gaining updated information about the new developments in the drug analysis. In addition, the alliance hosted three training courses during May-June 2006 by inviting EU experts to be the lecturers to provide a high level of expertise in the field of residues and contaminants in food in Taiwan to: 1) improve the knowledge regarding general regulation of residues and contaminants in food, and discuss the expectations of the EU regarding importation of food products from third countries especially regarding forbidden veterinary drugs; 2) describe the

fit-for-purpose analytical methodologies used to survey residues and contaminants in food; and 3) train participants both on screening technique (ELISA, RIA, and hyphenated methodologies especially those based on gas and liquid chromatography coupled to mass spectrometry.

V. Outlook of the Fish Farming Industry

The flesh textures of medium/large fishes are different from those of small fishes. The ways of utilizing and preparing these fishes for consumption are different. Therefore, the markets are segmented by medium/large species and small type species. Recently, due to the decline of migratory fisheries resources with medium/large size, such as tuna, tuna-like, toothfish, etc., the catches for those species are limited (Joseph, 2003). Since the supply from capture fisheries has decreased, there is a need to find their substitutes. Aquaculture of medium/large species becomes the goal of aquaculture sector endeavors. Aquaculture for medium/large species is difficult, because problems related to facilities, fry, technology, feed, management, disease, or cost, have to be solved. Many countries have working on these problems for a long period of time. There have been some success cases, but only the salmon culture has expanded substantially and becomes a significant industry in the international market (Hu and Chiang, 2003).

The development of any aquaculture species relies on its environment, technology, costs, influence upon local community, acceptance by consumers in terms of meat texture, quality, price, and convenience. Having the aforementioned conditions, farmed fishes, such as tilapia and cobia, are expected to develop to satisfy the market demand in the near future.

Take tilapia as an example, nowadays, it has become one of the important protein sources for many developing countries. However, because of tilapia can adapt easily to new environments and it needs few technical requirement for aquaculture, many new countries have entered the market and the competition for tilapia export market is keener than ever before. Under this global trend, exporting countries should rapidly develop their own strength so that their competitiveness could be strengthened. In addition, it is necessary to focus on the following

points:

1) Increasing production and trade,
2) Great development potentials in Africa, Central and South America,
3) Sustainable fish farming management,
4) Stricter food safety standards,
5) Fast developments of genetically modified (GM) fish and fish products, and
6) Taiwan's experience could be a key factor in helping the worldwide aquaculture development.

VI. Concluding Remarks

Drucker (2002) predicted that aquaculture and the bio-technology will be the new industry in the next 50 years. Consequently, four important issues are necessary to bear in mind: 1) aquaculture will become the main source of animal proteins, 2) new value-added farmed fish products will be introduced to replace wild fishes, 3) genetically modified techniques will apply on fries and feeds, and 4) issue of consumer acceptance toward GM fish and fish products will become an important evaluation (Chiang, Chern, and Lu, 2002b).

The responsible and eco-friendly aquaculture production practices are the only way to ensure aquaculture foods' safety and traceability and the sustainability of the fish farming sector from now on. The GAP or best aquaculture practices are the effective tool to start with.

References:

Chiang, Peter, Fu-Sung Chiang, and I Chiu Liao, 2001, Building Competitive Edges of Tilapia and Cobia for Taiwan's Aquaculture Industry during the Transition Period, Seminar on Aquaculture Management, Asian Productivity Organization, Tungkang, Pingtung, Taiwan, Dec. 3-8, 2001.

Chiang, Fu-Sung, Wen S. Chern, and Lee-Jung Lu, 2002b, Public Communication: Consumer's Perspective of GMO/GM Foods, *Proceedings of the Study Meeting on Use and Regulation of*

Genetically Modified Organisms, Asian Productivity Organization, Taichung, Taiwan, November 18 - 23.

Drucker, Peter F., 2002, Managing in the Next Society: Beyond the Information Revolution, St. Martin's Press.

FAO, 2000, Aquaculture in the Third Millennium, Technique Proceeding of the Conference of Aquaculture in the Third Millennium.

FAO, 2000, The State of World Fisheries and Aquaculture.

FAO, 2006, FISHSTAT Plus, Food and Agriculture Organization, The United Nations. http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp

Fisheries Agency, 1978-2006. Fisheries Yearbook in Taiwan Area, Fisheries Agency, Council of Agriculture, Taiwan: Republic of China, Various issues.

Hu, Sing-Hwa and Fu-Sung Chiang, 2003, Farmed Cobia: The Next Tilapia? - The Taiwan Experience, the 2003 International Boston Seafood Show, the Hynes Convention Center Boston, MA, USA, March 11, 2003.

Joseph, J., 2003 Managing Fishing Capacity of the World Tuna Fleet, FAO Fisheries Circular, No. 982, Rome, FAO.

National Marine Fisheries Service, 2004, Foreign Trade Information, The Fisheries Statistics and Economics Division of the National Marine Fisheries Service. http://www.st.nmfs.gov/st1/trade/index.html

U.S. Department of Agriculture, 2001, Aquaculture Outlook, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., United States.

Worm, Boris et al., 2006, Impacts of Biodiversity Loss on Ocean Ecosystem Services, Science, 314(3): 787-790.