SUSTAINABLE DEVELOPMENT AND TRENDS IN THE PHILIPPINE AQUACULTURE [1/]

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Abstract

This paper discusses and illustrates the institutional changes in policies and management of the government in the aquaculture program of the industry that leads to technical innovations in farming practices tantamount to the bio-safety and quality of products derived thereat for domestic and export consumption. Brief historical events in the development of aquaculture are highlighted relevant to the social and economic growth of the country particularly the industry stakeholders. Given emphasis is the equity in resource use for the poor sector of the industry and the various laws, rules and regulations implored to sustain balance in the ecological and environmental management of the resources. Food quality and safety in aquaculture are elucidated consistent to and compelling with the trade requirements of the importing countries. Future needs are described and research and development directions were recommended.

Keywords: Sustainability, pro-poor, HACCP, food safety, aquaculture management, policies, legislations, code of practice, trade and marketing

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I. Introduction

Over the last three decades, the global aquatic systems have been subjected to massive pressures from fishing and other types of fishery resources exploitation with indicative fall of the marine capture production and an evident growth in aquaculture (FAO, 2001; Fig.1). Worldwide per capita fish consumption nearly doubled from about 8 kgs in the early 1950s to about 15.8 kgs in 1999. Fish exports from developing countries have surpassed traditional export crops such as sugar, beverages, and meat. According to FAO, net foreign exchange earnings from fisheries by developing countries rose from $5.1 billion in 1985 to $16.4 billion in 1996 (FAO,1999). At present, the fisheries sector in most developing countries continue to exhibit steady growth in production, consumption, and trade. Technological advances in aquaculture, changes in legal and institutional regimes, and market demands have contributed to the changing structure of supply and demand patterns for fisheries products in both developing and developed countries.

In the Philippines, the fisheries sector is vital to the economy in providing substantial employment and income, contributing export earnings and meeting local demand for the protein requirement of the populace. While there is a positive growth rate in fisheries production from the year 2000, which is steadily increasing, the sector still needs to maintain a delicate balance between the requirements of increased production to contribute to food security against the need to conserve and protect the fishery resource for long-term sustainability.

Critical are the questions of social equitability and food safety in the fisheries industry as to who is benefiting from the resources: the rich investors using modern fish farming technologies or the common fisherfolk relying only on the traditional low input–

low output kind of farming. The bio-safety and food quality measures on the other hand, are most often than not regarded only for those products intended for exports. The net effect of continued growth in production and the changing structure of supply and demand for aquatic products are unknown especially for those local and domestic producers of farmed fishes and the poorer segment of the population who derive a substantial amount of their food and income through participation in small-scale production, consumption, and sale of fish.

There is, therefore, a need for a more focused, specific, and comprehensive analyses of production, farming systems, aquaculture technologies, and markets to guide policies and ensure benefits for the resource-poor fish farmers and the assurance of food safety and quality. The much needed policy reforms that will support and improve environment-friendly fisheries technologies albeit resource-poor fish farmers can help increase their welfare through sustained production, globally competitive, and safe for human consumption.

Addressing these pressing needs to meet the local and global demands in aquaculture production, the Philippines over time have initiated policy and management changes to adapt with the ever changing market demand driven trends. Owing to the long experience from the past, the paradigm shift from resource exploitation to sustainable production paved way in the innovative transformation of eco-friendly fish farming technologies suited to meet the socio-economic, environmental-ecological, trade and food safety requirements of the end-users and consumers.

II. Current Situation of Aquaculture in the Philippine Economy

Aquaculture has a long history in the Philippines, starting with the traditional, low density culture of milkfish in ponds and evolving into more sophisticated technology-based systems for the culture of various species of fish, shrimps, mollusks and seaweeds. Aquaculture in the Philippines, began as early as the 14th century, though its importance was recognized only in the 1940s, when it produced about 20,000 tons (Yap, 1999). The sector has since grown dramatically and continued to show a rapid growth during the last decade (Figure. 2). From 1997 to 2003, fish production from aquaculture grew at an average of 8% per year. In 2005, aquaculture production continued to improve, with the volume of aquatic products reaching 4.16 million t (BFAR, 2006).

In terms of commodities, seaweeds contributed 70.17% to aquaculture production in 2005, followed by milkfish (15.93%), tilapia (8.5%) and tiger shrimp (2.09%). The rest are shared by minor commercially farmed shells and finfishes. It involves fish pens, cages and ponds in fresh and marine waters and the mariculture of oysters, mussels and seaweeds (Fig. 3).

The Philippines ranks amongst the top fish producing countries in the world (FAO, 2005). In 2001, it ranked 11th with a total production of 3.17 million metric tons of fish, crustaceans, mollusks, and seaweeds. The Philippines is the second biggest producer of seaweeds contributing to 0.7 million tons or 7.4% of world production of 10.5 million ton, second to China in the world production of tilapia and first among the Asian producers of milkfish (Figure 4). In 2002, the fisheries industry contributed to 2.2% and 4.1% of gross domestic product in current and constant prices, respectively.

The fisheries industry provides employment to around 1 million people or 5% of country's labor force. Around 26% of these people are engaged in aquaculture, 68% in

municipal and small scale fisheries and 6% in commercial fisheries. Out of the total fisheries production in 2005, aquaculture contributed highest share of 46% followed by commercial and municipal fisheries at 27% each (Figure 5). Amongst all the fisheries sub-sectors, aquaculture registered the highest growth rate of 8.7% in 2003 compared to the previous year. Overall fishery sector growth in 2003 was 7.4% compared to 6.5% in the year 2002 showing substantially higher growth rates than the Medium Term Philippine Development Plan (MTPDP 2001-2004) targets of 4.8% and 3.2 %, respectively. Total fishery production increased at an average annual rate of 2.5% between 1990 and 2002. Most of this increase was brought about by large increases in aquaculture production (more than 6% annual production increase over this period). There have been modest increases in commercial capture fisheries (2.5% per year increase over the period).

The aquaculture sub-sector has been identified in the MTPDP 2004–2010 as a sector for increased growth for job creation and food security in support of the country's drive towards economic development. This growth may be attained by increasing production intensity as well as diversifying existing commodities and fishery farms as well as expanding fisheries production in inland waters. With the current focus on conservation and sustainable management of marine resources, it is possible that the contributions of the municipal and commercial sectors to total fish production will decline in the coming years, leaving aquaculture as the sub-sector to absorb the country's ever growing demand for fish and making it potentially the most important contributor to the country's food security and poverty alleviation agenda.

In recent years, small-scale aquaculture has been introduced in many parts of the country, which made important contribution to income generation and employment of the

rural poor. Based on the 2000 Family Income and Expenditure Survey (FIES) of the National Statistics Office, the highest incidence of poverty (62%) was found among the agricultural, fishing and forestry sector. The income-generating potential created by growing domestic demand and expanding international market for fish are most promising opportunities for rural poverty reduction. The fisheries contribution to the countries Gross Value Added (GVA) in 2004 is shown if Figure 6.

The sector has potential to supply products for both domestic and export markets. However, the full development of the aquaculture sector has yet to be accomplished in view of a variety of problems ranging from the lack of availability of high-quality brood stock/fry/fingerlings, inadequate aquaculture training and extension, limited access of credit by the small farmers, high input costs, data gaps, post harvest support facilities, local and international market access constraints, lack of private sector participation, food safety and quality constraints, lack of aquaculture information management system, inadequate regulatory framework, lack of focused research and protocol, improvement in aquaculture planning, zoning and environmental degradation, etc.

A. Aquaculture Structure and Production

Aquaculture in the Philippines are categorized according to environment, farming system, farming technology and production scale (Lopez et.al, 2005). Below is a discussion of the different classifications of aquaculture with respect to the given categories.

Aquaculture according to Environment

Aquaculture according to environment are classified basically in terms of water type or source categorized into freshwater, brackishwater and mariculture (Table 1).

Freshwater aquaculture utilize the major lakes, rivers, reservoirs, dams, small-water impoundments, catch basins, rice paddies, and land-based ponds. Brackishwater aquaculture utilize inter-tidal zones, mangrove swamps and estuarine areas. Mariculture utilise coastal waters.

Aquaculture according to Farming System

The farming system varies according to the cultured commodity species and the water source. Freshwater species commonly cultured are tilapia, carp, catfish, snakeheads, the euryhaline milkfish and most recently, the freshwater prawn. Ornamental aquarium fish production also falls under this farming category. Farming system varies from fish corrals/pens, fish tanks, fish cages, earthen ponds to hapa net in ponds for hatchery (Table 2).

Mangrove swamp areas along the intertidal zone occupies a huge converted portions into brackishwater fishponds in the Philippines which draws most of the water source both from the sea and rivers The most dominant fish cultured in brackishwater are milkfish and shrimp. Mudcrab and grouper were recently introduced in commercial scale to maximize utilization of the ponds. Aqua-silviculture and fishpen farming system are also done.

Seawater-based farming is mainly categorized into three commodity sectors: shellfish culture, finfish farming and the seaweed culture. Shellfishes such as oysters and mussels are normally grown by stake or hanging methods using bamboo poles and ropes same with the seaweed farming except that the latter utilizes different plot design. Finfishes on the other hand are mostly reared in fixed pen enclosures and floating net cages.

Aquaculture according to Farming Technology

Aquaculture according to farming technology is basically mono-culture based regardless of water source and farming system for the various species cultured. However, polyculture also occurs in freshwater environment (Table 3).

Aquaculture according to Production Scale

Aquaculture according to production scale can be classified as intensive, semi-intensive and extensive production depending on stocking density of fish frys and amount of feeds given to the fish (Table 4).

Philippine aquaculture has strong potential for further expansion and development in view of the availability of vast resources: 338,393 ha of swampland, 14,531 ha of freshwater fishponds, 239,323 ha of brackishwater fishponds, 200,000 ha of lakes, 31,000 ha of rivers and 19,000 ha of reservoirs. The 2005 aquaculture production by culture system and environment are summarized in Table 5.

Philippine aquaculture statistics indicate culture of 18 species, of which 8 species besides seaweeds contribute substantially to the total production (Table 6). The major commodities are seaweed, milkfish, tilapia, shrimp, mussel, carp, catfish, mudcrab and oyster. In addition, there are some other commodities such as crab, siganids, grouper, seabass, etc., that hold potential for development. In 2004, seaweed contributed the most to the aquaculture production in terms of volume (70%), but 11.7% in terms of value.

In summary, there exists some forty one (41) known fish farming techniques which is traditionally and currently being practiced in the country from small to medium scale of investments up to the commercial intensive and modern aquaculture technology.

B. Major Production Organizations

At present there four strong group of national organizations representing the major commercial commodities produced from the aquaculture industry. The Bangus Council of the Philippines (BCP) which is a recent alliance of the Bangus Association of the Philippines represents the coalition of eight major stakeholders of milkfish producers in the country composed of the hatchery subsector, fry gatherers and importers, freshwater fishpen producers, mariculture subsector, brackishwater subsector, feed millers/suppliers subsector and the processing subsector.

The tilapia sector on the other hand has organized themselves into one association known as the Philippine Tilapia, Incorporated (PTI) mostly composed of small-medium and large-scale producers of tilapia including the hatchery and post-harvest processing sectors. Among the major coalition members in the association is the GIFT Foundation and the GENOMAR producers together with the GET-Excel BFAR accredited operators.

The tiger shrimp producers in the country has on its own the PHILSHRIMP allied with the SHRIMPEX and PHILFRY respectively representing the *monodon* grow-out farm producers, the shrimp exporters and the fry hatchery operators. On the seaweeds commodity counterpart, the Seaweed Industry Association of the Philippines (SIAP) has organized themselves into a farm-producers group, the traders subsector and the processors who are also the major exporters of the Philippine Natural Grade (PNG) carageenan products.

C. Government Organizations and Support Services for Aquaculture

The Bureau of Fisheries and Aquatic Resources (BFAR) as lead fisheries agency in the Philippine government has a general mandate to protect, conserve and sustain the management of the country's fishery and aquatic resources (RA 8550, 1998). It is also tasks to optimally utilize the off-shore and deep-sea resources and upgrade post-harvest technology. Its social and economic commitment is to alleviate poverty and provide supplementary livelihood among municipal fisherfolk while the assurance of an improve productivity in the aquaculture industry is within the ecological limits. BFAR vision is "*a modernized fisheries that is technologically advanced and globally competitive and whose transformation is guided by sound management practices of resource sustainability, the principle of sound social justice, and strong private sector participation*."

Although there are numerous Non-Government Organizations (NGOs) and People Organization (POs) in the Philippines, their contribution to aquaculture development has been minimal. However, the field provides more areas for their involvement especially now that there is an increasing pressure on the government and civil society to play an active role on poverty alleviation in rural areas. There are three points in which the fishing and aquaculture industries should meet to further develop the industry, which are:

- Improvement and development of export markets to be globally competitive;
- Observance of best aquaculture practices (BAPs) following HACCP system principles (Hazard Analysis and Critical Control Point);

- Regulation and monitoring of domestic market products to prevent production glut and flooding of the market, competition among producers and traders, and price destabilization

To comply with the above requirements for both domestic and export market and to further improve the product quality from the farm level, there is a need to strengthen the extension services and research capability of the of the government and other support services for the aquaculture industry. At present, the extension services in aquaculture are carried-out by three distinct service institutions which includes the Local Government Units (LGUs) through its Agriculture Technicians (ATs), the BFAR aquaculture technicians and the various fisheries academic institutions nationwide.

Research and development on the other hand are handled by several fisheries agencies, institutions and the academes under a national aquaculture research network coordinated by the National Fisheries Research and Development Institute (NFRDI) which is the research arm of BFAR.

In support to the government, there are international and regional institutions and organizations who are committed to serve industry's development in aquaculture. In November 2002, a "Regional Donor Consultation on the Role of Aquaculture and Living Aquatic Resources: Prioritizing Support and Networking" was held in Manila and attended by well-known international and regional institutions and donors, such as the WorldFish Center, UNDP, FAO, Mekong River Commission, SEAFDEC, Network of Aquaculture Centers in Asia-Pacific, Australian Center for International Agricultural Research, ADB, United States Agency for International Development, Australian Agency for International Development, Japan International Cooperation Agency, European Union, Directorate General for international Cooperation (DGCI) of Belgium, Deutsche

Gesselschaft Fuer Technische Zusammenarbeit (GTZ), and Norwegian Agency for Development Cooperation (NORAD). The following priorities were identified during the consultation:

- Productivity of smallholder livestock and aquaculture
- Techno-policies for fishery product quality and food security requirements
- Development of sustainable fisheries and aquaculture systems
- Consolidation of available research knowledge for use of smallholders, extension workers and educators
- Policy-making awareness
- Access to rural credit
- Governance issues in inland fisheries/access to water resources
- Assessing impacts of projects against some poverty indicators
- "Demand-Supply" prioritizing pro-poor projects

Majority of the above issues are now presently addressed through specific projects with the government in collaboration with the industry stakeholders.

D. Legal Framework for Aquaculture

Aquaculture in the Philippines are governed by three major laws of the land: the Republic Act (RA) 8550 (Fisheries Code of 1998), RA 7160 (Local Government Code of 1991) and RA 8435 (Agriculture and Fisheries Modernization Act of 1997). These major laws are intricating and often results to conflicts of interpretation and implementation by the agencies concerned mostly affecting the stakeholders. While the laws itself addresses to particular concerns of the sectors in the aquaculture industry, several provisions and

implementing guidelines within the context of each law are either interpreted as a duplications or contradictory with each other.

The Philippine Fisheries Code of 1998 (RA 8550) highlights conservation, protection and sustained management of fishery and aquatic resources, poverty alleviation and provision of supplementary livelihood, improvement of aquaculture productivity, optimal utilization of offshore and deep-sea resources, and upgrading of post-harvest technology, It is primarily intended for management and utilization of fishery resources by Filipinos, that is, toward maintenance and sustainability of the resources and their productivity for local use and consumption. It is only partly concerned with industrialization or modernization, and concentrates on the establishment of a regulatory and administrative structure for the sector.

The Agriculture and Fisheries Modernization Act of 1997 (AFMA) on the other hand is geared toward "industrialization and full employment based on sound agricultural development and agrarian reform" and promotes the utilization of national resources "in the most efficient and sustainable way possible by establishing more equitable access to assets, income, basic support services and infrastructure,". It is directed toward the modernization of the fisheries sector by transforming it into a technology-based industry with a high degree of horizontal and vertical integration and able to compete in the global market by producing more and better value-added products.

While the Fisheries Code and AFMA hold in priority the attainment of food security, rational use of resources, and sustainable development, the Local Government Code of 1991 is primarily aimed at devolving the legislative powers of national government in favour of the local cities and municipalities who administers and do the

actual management of their own resources. The LGU code is designed to implement national laws and regulations at the local levels by virtue of ordinances. They were also granted the licensing jurisdiction granted them over all fishery privileges within their territorial jurisdiction, particularly in cases of aquaculture with the use of fish pens, cages, traps, and other structures for the culture of fish and other fishery products.

In addition and corollary with the above mentioned laws, there are other national related laws enacted by regulatory agencies affecting the aquaculture policy governance, such as the National Integrated Protected Area System (NIPAS) RA 7586 of 1992 by the Department of Environment and Natural Resources (DENR) and the Comprehensive Agrarian Reform Program (CARP) of the Department of Agrarian Reform. All other implementable laws and regulations governing the Fisheries Code of the Philippines are expressed in a series of Fisheries Administrative Orders (FAOs) duly promulgated by BFAR as lead fisheries regulatory agency of the government .

III. Technological Developments in Farm Management and Production of Safe Aquaculture Foods

A. The Mariculture Parks and Hi-ways

The Philippines as an archipelagic country endowed with a vast potential of coastal marine resources has recently drawn a resource map establishing potential areas for mariculture development along the Pacific and China Sea side boarders. The concept of having a landmark of development in mariculture has a two-tier objective in meeting the country's domestic market requirements by way of providing access of marine commercially farmed products from source to major capital cities linking the market through maritime routes providing the transshipments of primary production and

ancillary services (i.e. feeds, refrigeration, fresh and processed products, etc.) to and from the production source to market.

The other purpose of mapping the mariculture hi-ways is to link easy access of the products to neighboring countries along the west mainland provinces of China and on the northwestern regions of Hongkong and Taiwan and the south-southwestern Asian regions of Singapore, Malaysia and Indonesia. These countries are notably importing countries of live, processed and frozen aqua-farmed products from the Philippines where trade in aquaculture has been traditionally established.

Complementing the Mariculture Hi-ways in the Philippines are established Mariculture Parks where breeding and grow-out production of commercially important species are grown in zonified marine cages. Mariculture Parks are in concept the same as the land-based industrial state in land areas where raw lands are made accessible by putting up the basic infrastructure such as roads, power, water, communications and other basic facilities to spare interested entrepreneurs the high cost of land acquisition and preparation. Instead, it only has to pay for an annual lease which amount is only a fraction of what it would have cost to acquire and develop raw lands for its use. This project was in principle established with the concept that if such infrastructure can be established on land for entrepreneurs and large companies, then there is even more reason to provide similar infrastructure for the poor, small fishers and other investors in demarcated zones of municipal waters.

At present, there are eleven (11) well established and operational mariculture parks all over the country catering to local, national and foreign investors. These are mostly engaged in milkfish and other variety of farming highly commercial valued species such as groupers, siganids , cavallas, etc.

B. Technological Developments in Production of Safe Aquaculture Foods

The Philippines as a matter of policy, follows a general rules in complying with both the domestic and foreign product requirements in terms of quality and bio-safety procedures which are outlined and prescribed in guidelines under the Fisheries Administrative Order (FAO) No. 214, otherwise known as the Code of Practice for Aquaculture. The Code lays down the generic guidelines in adapting the Best Aquaculture Practices (BAPs) in the country which also serves as reference point to Total Quality Management (TQM) in aquaculture farming practices. The BAPs concept as provided for in this Code of Practice was equivocally and derived mainly from the provisions of the FAO Code of Conduct for Responsible Fisheries as interpreted and unanimously adapted under the Regional Code of Conduct for Responsible Fisheries (RCCRF in Aquaculture) by the SEAFDEC member countries in 2002 (FAO, 1999/1999b).

Implementation of this code in the local industry, however, takes a hard time due to arbitrary issues and claims that the code is equitably designed for pro-poor but for those commercial operators who are engaged in the export trade who could afford to re-design and meet the international demand of the industrialized countries, in a way as what is required in the Hazard Analysis Critical Control Points (HACCP) in fishery products has become a compulsory commitment of the country. These present standards in aquaculture are even oftenly treated by the local operators and fishery product exporters as a “trade barriers” (NACA, 2003).

Since HACCP has been implored not only by the federal states of the US but also by the EU communities, Japan and other importing industrialized countries, apart from

the Philippines being a signatory to the GATT-WTO agreements, the country has nothing left but to abide by the FAO Codex guidelines in adopting both the CCRF and its latest provisions in observing the Aquaculture HACCP guidelines in fisheries (FAO, 2004). This turn out of events leads to the improvement of fishery products handling and processing to address food safety and quality assurance in the post-harvest sector which recently passed the current regular inspection conducted by the European Commission-Fisheries Veterinary Officer (EC-FVO) Mission in the country.

To promote the HACCP system in the fish farming level of production which contributes some 30-40% of the export commodities in fisheries in the Philippines, the BFAR has launched similar program to the post-harvest sector in capacity building by re-introducing the BAPs as an essential tool to observance and adopting the HACCP in aquaculture approach, quite different from the post-harvest procedures but the same in principles. This is because HACCP in aquaculture has to be treated differently by commodity species of the farmed products, its management and the production inputs which are the keys to identify the most critical control points (CCPs) so as to produce a quality and safe products from aquaculture (Lopez, 2004).

The HACCP program in aquaculture in the Philippines constitute mainly of the National Residue Monitoring Program and most recently the information and education campaign (IEC) conducted to fisheries technicians, planning officers, aquaculture centers, extension officers and health/quarantine officers as prospective farm inspectors. This program aims in a bid to comply not only as trade requirements with the FAO/WTO, but as a measure of preparedness and compliance for BFAR being recognized as a competent authority (CA) by the European Commission (EC).

Other than the CCRF and HACCP in aquaculture, the Philippines is also a signatory with an active participation to the Quarantine International de Epizootics (QIE) agreements which restricts through a proper screening the inflow-outflow of domestic endemic species and imported live species for aquaculture use.

C. Successful Cases of Technology Utilization and Adoption in Fish Farms

To address the ever-growing poverty alleviations, hunger and malnutrition issues of the rural fisherfolks in the fish faming and fishing communities, the government has also shifted its policy program focused from aquaculture development to aquaculture for rural development giving emphasis on identifying projects in aquaculture which are dubbed as "pro-poor" (Lopez, 2005b) and promoting livelihood projects to rural communities which are low in investments, less in inputs with high yields of productivity in terms of the resources utilized. Among these projects are the aquisilviculture in the mangrove protected areas, skyponds in the upland areas and the ornamental fish breeding and hatcheries in backyards, Small Water Impounding Project (SWIP) in inland areas and the family enterprise seaweeds nursery-grow-out projects in coastal marine waters

Also in order to maximize the use of unutilized parcel of idled lands in the cities and municipalities, the BFAR launched the "Urban Aquaculture Program" consisting mostly of elevated tanks set-up in communities, stocked with GET-Excel tilapia, catfish and other marketable freshwater species.

One of the most recent but controversial technology adoption that was lately introduced in the country is the entry of *Penaeus. vannamei* which has drawn criticisms in the farming community due to its acceptability, but was well screened through the Import Risk Analysis (IRA) process. The introduction of this species which followed

mostly the trend and experience of other Asian countries passed the most stringent importation procedures, observance of international and regional protocols, local quarantine and health screening, series of public consultations, and research and development (R&Ds) to successfully breed and grow the individual under domestic conditions to produce an "Specific Pathogen Free" and "Specific Pathogen Resistance" (SPF and SPR) strains intended for local and export markets. To date, the acquisitions of the broodstock, seedlings, and the hatchery, nursery, grow-out management on its commercial production are guided by a specific fish farming protocols.

III. Emerging Needs and Future Directions

Among the priority thrusts that the aquaculture sector needs to be addressed by the government are:

1. Aquaculture HACCP standard requirements of importing countries which were not only found to be too much stringent and costly for an ordinary fish farmer to comply but that the standards imposed to farm level management kept on changing over time. HACCP in aquaculture is a new process with an old principle but that the way it has to be implemented as far better more complicated than what is now being imposed in the post-harvest HACCP system. It does not only simply start with the traceability in the maximum residual limits (MRL) but has to follow traceabilities in the feeds and other farm inputs administered from the hatchery to the grow-out period, the quality of seeds and stocks which should be SPF/SPR and disease free, properly eco-labeled and following certification and accreditation procedures based on existing BAPs guidelines;

2. Environmental Management of Aquaculture Resources which is a key to mitigating the continuous degradation and self-pollution of the farmed resources resulting to massive fish kills of cultured species affecting both the quality of the farmed fishes and the production areas;
3. Pro-poor Aquaculture and Sustainability in order to provide more jobs and avoid migrations of the poor sector of the industry and to sustain the balance of resource exploitation in traditionally farmed areas, there is a need to address poverty alleviation and sustainability in equal manner as credit facilities and carrying capacities;
4. Hatchery Development and Commercial Production of High-value Species is a step forward to augment scarcities and assurance of continuous production of quality seed supply rather than relying to the wild stocks. Development of hatchery technologies is in fact an indicator of a progressive aquaculture development in commercial scale operation. Targeting high-valued species as Taiwan and Indonesia are currently engaged in is one factor in aquaculture that has to be addressed to support commercialization and aquaculture product line enterprising; and
5. The increasing cost of production and farm inputs are among the current and perennial issues in all forms of aquaculture practices besetting the industry. Compared to the production cost in Thailand, Taiwan and other Asian aquaculture producing countries, the Philippines has the highest ratio of cost of inputs versus the product outputs in its farm gate price.

The emerging issues as above elucidated are the focus of future interventions as expected to be addressed by the present aquaculture strategic studies under the ADB

technical assistance (ADTA, 2006), and as further drafted in the proposed Comprehensive National Fisheries Integrated Development Plan (CNFIDP) for the next ten (10) years (BFAR, 2005) as follows:

- Research and development in aquaculture centered on polyculture and production of hatchery bred high value-species;
- Institutional management, policy and economic studies;
- Review and amendments to the Fisheries Code and relevant Fisheries Administrative Orders;
- Involvement and governance of the Local Government Units;
- Strengthening capability building and Information and Educational Campaign (IEC) thru training and extension;
- Adherence to the code of practice for responsible aquaculture;
- More jobs generated (forward and backward support services)
- Observance to aquaculture HACCP on food safety and quality.

SUMMARY

The aquaculture sector is a fast growing industry in the Philippines which is projected to led the overall fisheries production in the next decades with an average growth increment of 7.6% annually. While aquaculture production in the country are not all intended for the export market, products for domestic consumption are also subject to HACCP food safety and quality standards. Just as the resources for aquaculture are intended not only for commercial producers, equity in the utilization of water resources are also prioritized to the poor sector of the industry. Policy and institutional changes necessitates a long term agenda which are confined both at the CNFIDP and MTPDP.

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APPENDIX A. Lists of Figures

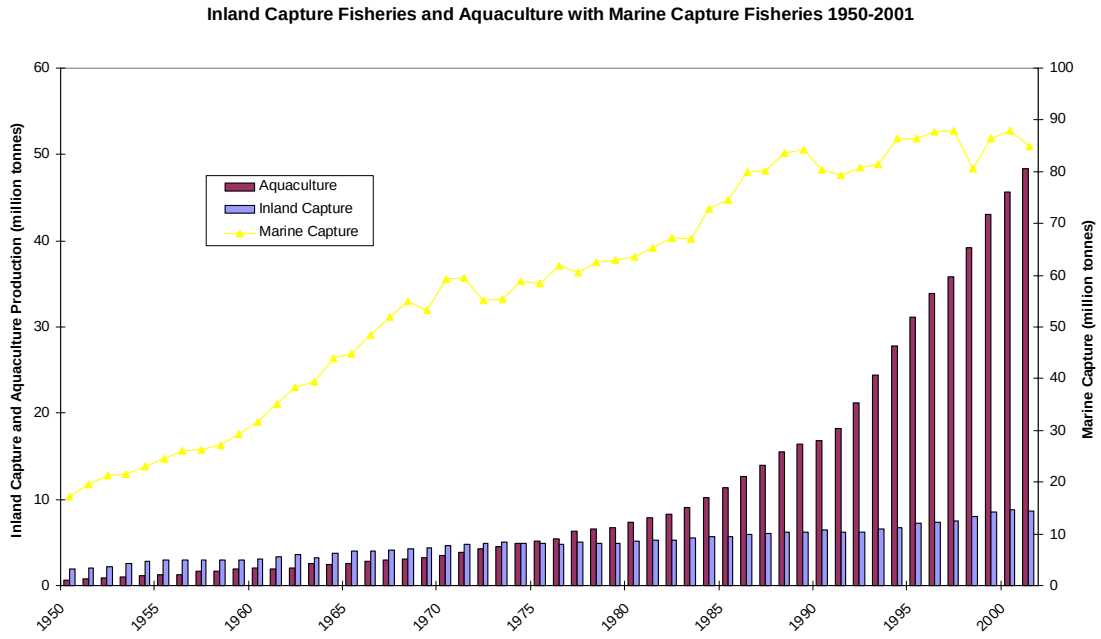
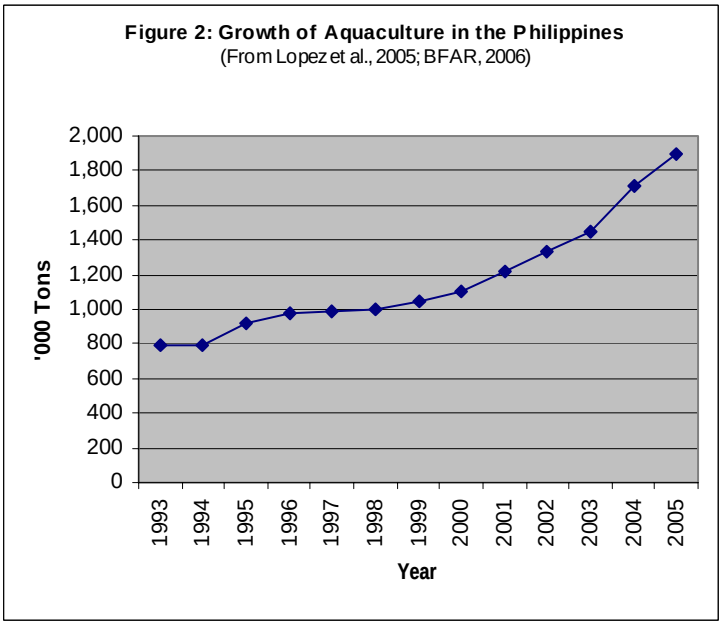


Figure 1. FAO statistics on the comparative production from Inland, Aquaculture and Marine fisheries (1950-2001)



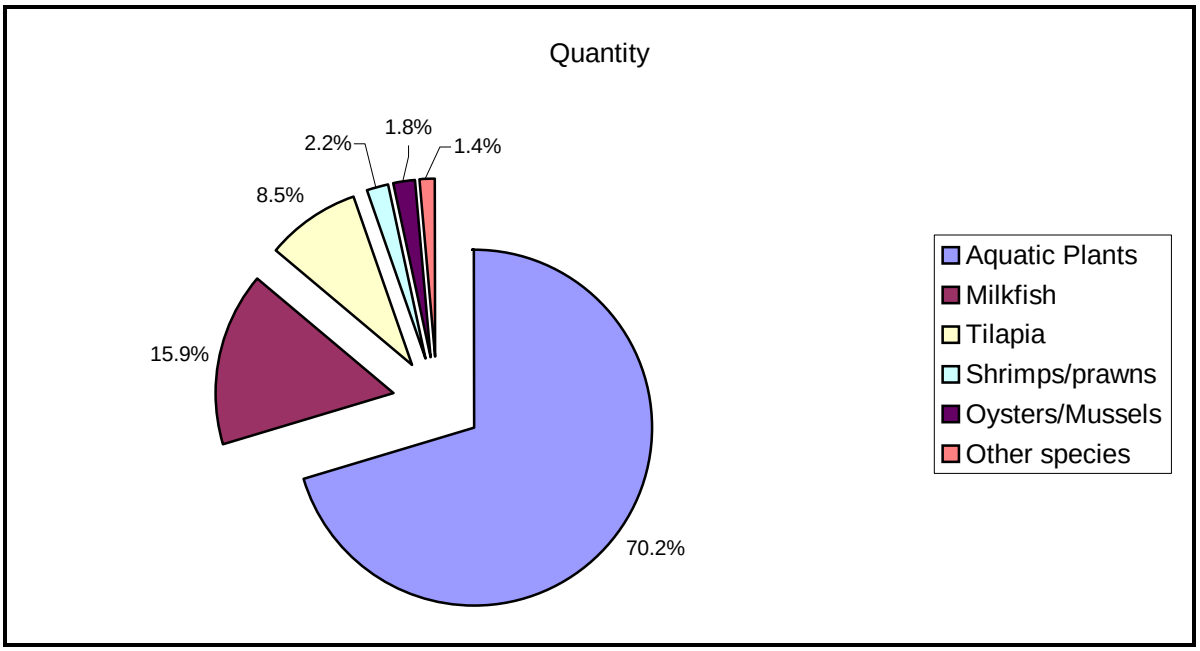


Figure 3: Percent Share of Major Species Produced from Aquaculture, 2004

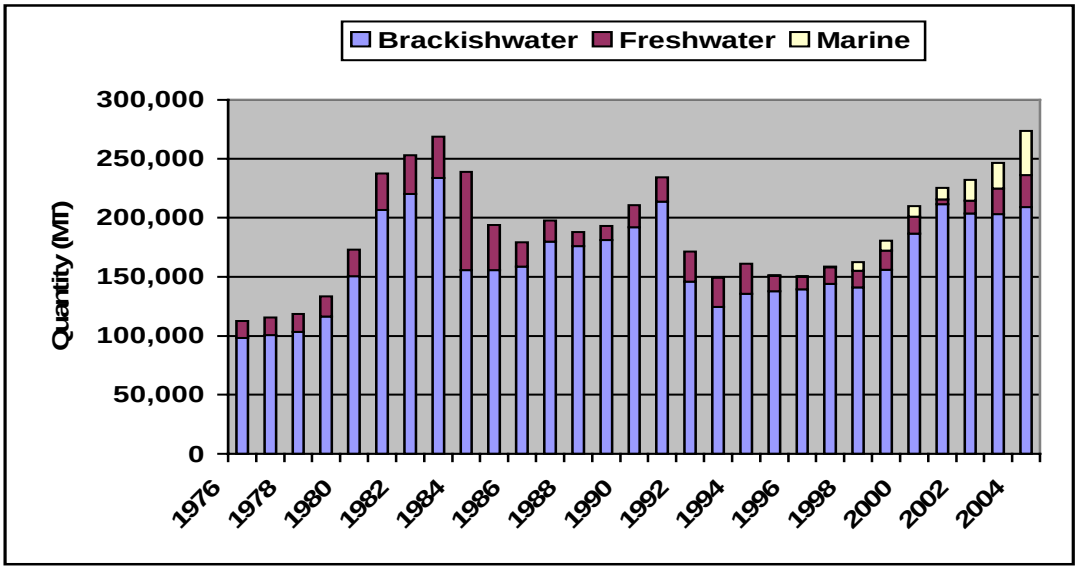


Figure 4: Production of milkfish(*Chanos chanos)*, Philippines, 1976 to 2004

(FAO Fishstat Plus 2006, DA-BAS, 2006

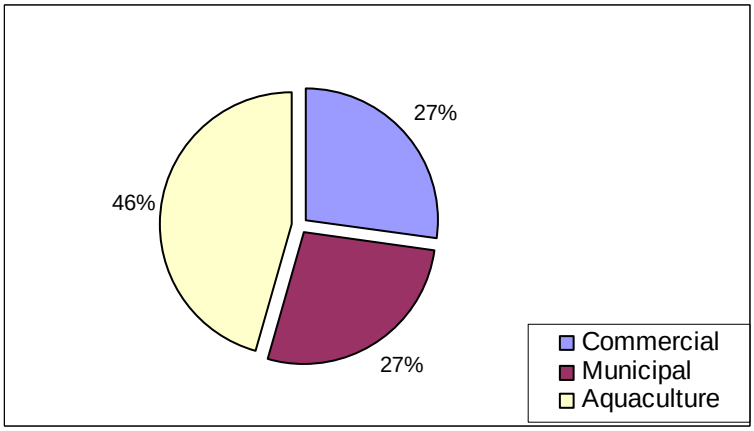


Figure 5: Share of Production by Subsector, 2005 (from BFAR, 2006)

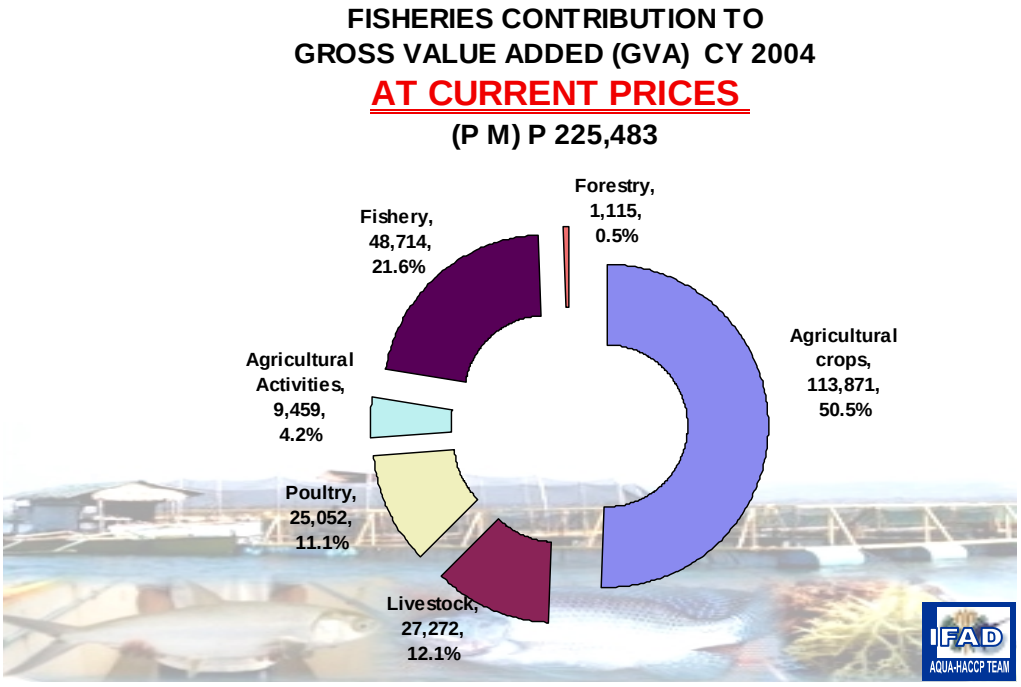


Figure 6. Fisheries contribution to gross value added (GVA) CY 2004

APPENDIX B. List of Tables

Table 1. List of aquaculture according to environment.

Freshwater	Brackishwater	Mariculture
Lakes	Inter-tidal flats	Shallow Coastal
Reservoir	Mangrove swamps	Deep Coastal
Dams	Estuarine areas	
Rivers		
Streams		
Creeks		
Ponds		
Swamps		

Table 2. List of aquaculture according to farming system

Freshwater	Brackishwater	Mariculture
Freshwater Hatcheries	Aqua-Silviculture	Marine Hatcheries
Earthen Ponds	Earthen Ponds	Floating Net Cages
Fish Pen	Fish Pen	Fish Pen
Floating Net Cages		Mussel/Oyster Beds
Concrete Tanks		Seaweeds Farm
Integrated Fish Farming Ornamental Fish Production		Ornamental Fish Production

Table 3. List of aquaculture according to farming technology

Freshwater	Brackishwater	Mariculture
Mono-culture in pond/cage	Mono-culture in pen	Mono-culture in pen/cage
Poly-culture in pond/cage	Mono-culture in pond	Poly-culture in cage
Mono-culture in pen	Poly-culture in pond	

Table 4. List of aquaculture according to production scale

Freshwater	Brackishwater	Mariculture
Intensive	Intensive	Intensive
Semi-intensive	Semi-intensive	Semi-intensive
Extensive	Extensive	Extensive

Table 5. Philippine aquaculture production by culture system and environment, 2004. (DA-BAS, 2005)

	Freshwater	Brackishwater	Marine	Total
Fishpond	75,484.37	253,848.52		329,332.89
Fishpen	49,994.61	4,499.50		54,494.11
Fishcage	55,396.10	4,205.71	23,542.36	83,144.17
Sub-Total				466,971.17
Oyster			15,914.73	15,914.73
Mussel			15,038.22	15,038.22
Seaweed			1,204,807.56	1,204,807.56
Grand Total	180,875.08	262,553.73	1,259,302.87	1,702,731.68

Table 6. Philippine Aquaculture Production By Species, 2004 ranked according to Quantity (DA-BAS, 2005)

	Quantity		**Value**	
Species	**Volume (mt)**	***Percent of Total***	**Amount ('000 P)**	**Percent of Total**
ALL SPECIES	1,717,026	100.00%	44,822,257	100.00%
Aquatic Plants	1,204,808	70.17%	5,261,401	11.74%
Milkfish	273,593	15.93%	16,238,558	36.23%
Tilapia	145,868	8.50%	7,734,562	17.26%
Tiger Prawn	35,917	2.09%	12,854,974	28.68%
Mussel	15,038	0.88%	88,849	0.20%
Oyster	15,915	0.93%	111,038	0.25%
Carp	13,724	0.80%	344,396	0.77%
Mud Crab	6,245	0.36%	1,590,523	3.55%
Other Species	2,129	0.12%	239,714	0.53%
Catfish	1,930	0.11%	114,712	0.26%
White Shrimp	1,471	0.09%	145,028	0.32%
Grouper	220	0.01%	77,301	0.17%
Siganid	169	0.01%	21,201	0.05%