AN OVERVIEW OF AQUACULTURE SECTOR IN VIETNAM

Nguyen Thanh Phuong and Truong Hoang Minh
Cantho University, Vietnam

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1. Characteristics, Structures and Resources

1.1. History and general overview

The General Fisheries Department was under the management of the Vietnamese Ministerial Council since its establishment in 1960. There are two main developing stages of the sector: the first period from 1960 to 1980 and the second from 1981 up to date. During the preliminary period, marine and brackish aquaculture along with rice-cum-fish farming attracted great attention of farmers and aquaculturists. Typical marine aquaculture was first practised in Kien An commune, Hai Phong city in 1962 and the first artificial fish seed production was of success in 1963 (Chu *et al.* 2003). Several aquaculture farming systems such as rice-cum-fish, lake, riverine and earthen pond was also developed. The rice-cum-fish farming became increasingly popular at that time with over 100,000 ha. During the time of Vietnamese war (1963-1975), the aquaculture sector was awarded and promoted because of its importance in providing food for people and militarists. In 1965, around 15,000 cooperatives of aquaculture and state-run enterprises were established from the central to localities. Some localities such as Hai Phong and Thanh Hoa had significant aquaculture development, especially in the field of shrimp farming for exportation. In addition, aquaculture was also considered as a major career at district level in these locations (Chu *et al.* 2003). After Vietnamese reunification, fisheries sector including aquaculture was identified as a key economic sector of the nation. The total aquaculture production gradually increased from 59,000 m.t. in 1976 to 160,000 m.t. in 1980. The export turnover of aquaculture and capture fishery reached 11,2 million USD in 1980 (MoFI., 2003). However, during this stage, the fisheries sector rised in fall in years 1977 and 1978 of its history due to the cutting down of the state's subsidiary supports.

In the second stage, shrimp farming for export has dominated in aquaculture since 1981. Aquaculture has been encouraged to develop in many localities at household-scale. There were three representative aquaculture farming systems in Vietnam, which are inland, marine and brackish water. The rapid export growth has created a major motive for a sharp increase in aquaculture over the last two decades. Aquaculture farmers have started to diversify their farming practices by adapting exportable species, of which black tiger shrimp (*Penaeus monodon*), catfishes (ca tra - *Pangasius hypophthalmus* and ca basa - *Pangasius bocouti*), lobster (*Panulirus* spp), groupers (*Epinephelus* spp*)*, bivalves (*Meretrix lyrata* and *Anadara granosa*), *etc*. are mostly focused. Many aquaculture systems have also been developed in the whole country applying high level of intensity and integrated systems. The period from 1999-2001 witnessed a peak growth of aquaculture. At present, aquaculture lures about 670,000 labors out of 4 million fisheries labors. Aquaculture area reaches nearly one million hectare with total output of one million m.t. and provides about 80% materials for processing and exporting. The total revenue has been obtained over 6,000 billion VND with export turnover of 2.167 billion USD in the first 11 months of 2004. The total turnover is estimated to obtain USD 2.397 million in the whole 2004 (MoFI., 2005).

1.2. Human resources

In 2000, total labor in fisheries sector was 4 millions, of which 670,000 employees belonged to the aquaculture sector. These labors have worked in 714 communes of 28 coastal provinces and cities throughout the country. According to the Labourforce Organization Department of MoFI, 2003), training plan for the period from 2001-2010, aquaculture human resource should consist of 64-80 Ph.Ds, 240-308 masters and 3,400-4,150 graduates from universities and colleges, and 5,700-7,000 intermediate and 57,000-70,000 technical workers. Information on current status of human resources in aquaculture sector of Vietnam is presented in table 1.

Table 1: Current status of human resources in aquaculture sector of Vietnam

Qualification of state-owned workforce	Qualification of non state-owned workforce
Educational qualification - Under elementary: 13.8% - Elementary: 15% - Junior high school: 39.6% - Senior high school: 31.6%	Educational qualification - Under elementary: 10% - Elementary: 70% - Junior high school: 15% - Senior high school: 5%
Major qualification: - Primary: 9.6% - Intermediate: 5.5% - College & University: 1% - Post-graduate: 1%	Career qualification: Mostly inheriting from traditional experience and enjoining any regular training
Numbers of postgraduates until 2000 were 90 Ph.Ds (of theses 1 is professor and 5 are associate professors) and 50 masters.	

(Source: MoFI, 2003)

1.3 Distribution and characteristics

Aquaculture sector has been considered as one of key economic sectors of the nation. According to MoFI (2005), total estimated area of aquaculture in 2004 was 902,900 ha. In 2004, total aquaculture production reached 1,150,100 tons, increased 15.2% compared to that of 2003.

In 2004, the production of coastal and inland aquaculture was 510,400 m.t. and 631,700 m.t., respectively. This year also had a significant increase of black tiger shrimp (*Penaeus monodon*) and catfishes (*Pangasius hypophthalmus* and *Pangasius bocourti*) productions (290,000 m.t. and 315,000 m.t., respectively). These species are mainly cultured in the Mekong River Delta (MoFI, 2005) where makes up a largest coastal aquaculture area (87.2%) of the country.

Distributions of aquaculture systems are typically different from the North, Central and South of Vietnam. The Northern part is dominated by culture systems include freshwater fish ponds, rice-cum-fish and marine cages. The most common aquaculture practices in the Central region are black tiger shrimp farming and marine cage culture of finfishes or lobster. Culture systems are more diversified in the Southern part of the country. These includes pond, fence and cage culture of catfishes and several

indigenous species such as snakehead fish, climbing perch, etc. Shrimp farmings are operated here at either improved extensive, semi-intensive or intensive levels. Furthermore, intergrated farming systems such as rice-cum-fish, rice-cum-prawn and mangrove-cum-aquaculture are broadly practised in this region.

1.4. Culture species

Vietnam's aquaculture has a wide range of species that provide a great potential for aquaculture development. In freshwater areas, catfishes (*Pangasius hypophthalmus* and *Pangasius bocourti*) which are the representative species of the Mekong River Delta have the greatest production. There are other five most popular cultured fish species that have high significant contribution to the total freshwater fish production. Theses consist of species belong to the *Cyprinidae* family such as silver carp (*Hypopththalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Ciprinus carpio*), big head carp (*Aristichthys nobilis)* and major Indian carps including catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigal*) (Le, 2003). Nowadays, mono-sex tilapia (*Oreochromis niloticus*) has also been introduced into inland and brackish water aquaculture. Besides, giant freshwater prawn (*Macrobrachium rosenbergii*), climbing perch (*Anabas testudineus*) and snakehead fish (*Chana micropeltes*) are the most popular cultured species in the Southern part of Vietnam.

In marine water areas, the most popular cultured species consist of lobster (*Panulirus* spp), grouper (*Epinephelus* spp.) and seaweed (*Gracilaria verucosa*) and these species dominate in the Central part of Viet Nam. Whereas, shrimp (*Penaeus monodon*), mud crab (*Scylla* spp) and bivalves (*Meretrix spp* and *Anadara* spp) are the most popular cultured species that have the highest production in brackish water areas, particularly in the South of Vietnam.

A number of high potential cultured species have also been focused in research and development to add more species to the cultured species population. These new species are Cobia (*Rachycentron canadum)*, abalone (*Haliotis* spp), sweet snail (*Babylonia areolata*, Pearl oyster (*Pinctada maxima* spp*)*, white leg shrimp *(Liptopenaeus vannamei)*, seabass *(Lates calcarifer),* etc.

1.5. Culture practices

There are various culture practices in Vietnam's aquaculture due to its ecological diversification. These include integrated aquaculture systems such as rice-cum-fish, rice-cum-prawn/shrimp, mangrove-cum-aquaculture; mono-aquaculture such as semi-intensive, intensive and improved extensive farmings of black tiger shrimp, catfishes and marine finfishes; and poly-aquaculture in fresh and marine water bodies.

The most common culture practices are marine shrimp farming at different level of intensification. According to MoFI (2004), shrimp farming systems in Vietnam in 2003 comprised of 3% semi-intensive and intensive, 22% improved extensive and 75% extensive culture or semi-intensive. Of these, intensive culture shared 10% and extensive culture shared 60% of total shrimp production. The productivity of improved

extensive, semi-intensive and intensive shrimp farming were 0.25-0.30 m.t./ha/crop, 2.5-3 m.t/ha/crop and 5-7 m.t./ha/crop, respectively (MoFI, 2004 and 2005).

Marine finfishes such as groupers are cultured in small cages in Quang Ninh and Hai Phong provinces in the North and in Nghe An, Khanh Hoa and other coastal provinces in the Central regions. Large cage culture of Cobia has been introduced from Norway. Lobters (*Panulirus* spp*)* is farmed mainly in the Central coastal provinces with small cage using wild collected seeds.

Catfish culture is a representative for intensive practice in freshwater bodies. Under diverse habitats of the Mekong River Delta, catfishes are cultured in cages, ponds, and fences with high intensity management. Pond culture area of catfishes is increasing rapidly, while cage culture is decreasing. Though fence culture is a new system in the delta, practice of this system is increasing gradually. The productivity of cage culture reached over 100 kg/m^3/crop. The productivity of pond culture varied from 183-582 m.t./ha/crop depending on stocking density (Nguyen *et al*. 2004 and Le, 2004) and productivity of 345 m.t./ha.crop is obtainable from fence culture. The fish yield from rice-cum-fish farming varied from 482-808 kg/ha whereas yield from livestock-fish polyculture ranged form 467-1,456 kg/ha which is also depending on stocking densities (Nguyen *et al*. 2005).

Culture of giant freshwater prawn is a new practice in the country and mainly operated in the Mekong River Delta. This species is cultured in ponds fences and integrate or alternate with paddy rice. Alternative culture of rice and prawn has been considered as a high potential practice. The productivity of prawn varied by culture practices ranged from 100-887 kg/ha/crop for integrated rice-prawn culture system, 384-1,681 kg/ha/crop for alternative rice-prawn culture (Nguyen *et al*. 2005), and from 140-160 kg/m^2/crop for fence culture (Vu *et al.* 2005).

2. Sector Performance

2.1 Production

In 2004, the total aquatic production of Vietnam reached 3,073,600 m.t., in which aquaculture production shared 1,150,100 m.t. or 37.4% of total national production. Freshwater production was 639,700 m.t. and marine and brackish water production was 510,400 m.t. (MoFI, 2005)

Shrimp and catfish have been considered as two major aquaculture products of Vietnam and these products are mostly produced in the Mekong River Delta. In 2004, the production of shrimp (*Penaeus monodon*) reached 290,000 m.t., made up 56.8% of total coastal aquaculture production. Likewise, production of catfish (*Pangasius hypophthalmus* & *Pangasius bocourti*) was 315,000 m.t., made up 51.3% of total fresh water aquaculture production (Fig. 1 and Fig. 2). The production of giant freshwater prawn was estimated about 7,000 m.t. in 2003 (Le, 2004).

The remaining aquaculture production is produced in the Northern and Central regions. In the North, freshwater aquaculture production mainly comes from the Red River Delta which reached 124,253 m.t. in 2003. Marine aquaculture, however, is dominant in the Central part of Vietnam focusing mainly on shrimp farming and cage culture of marine species. There are totally 40,159 cages are operated in this area in 2003, of which 32,706 cages culture of lobster (MoFI, 2004). Total production from marine cage culture reached 2,327 m.t., in which lobster production was 1,830 m.t. Bivalves are mostly farmed in the coastal provinces in the South with total production was 130,474 m.t (MoFI, 2004).

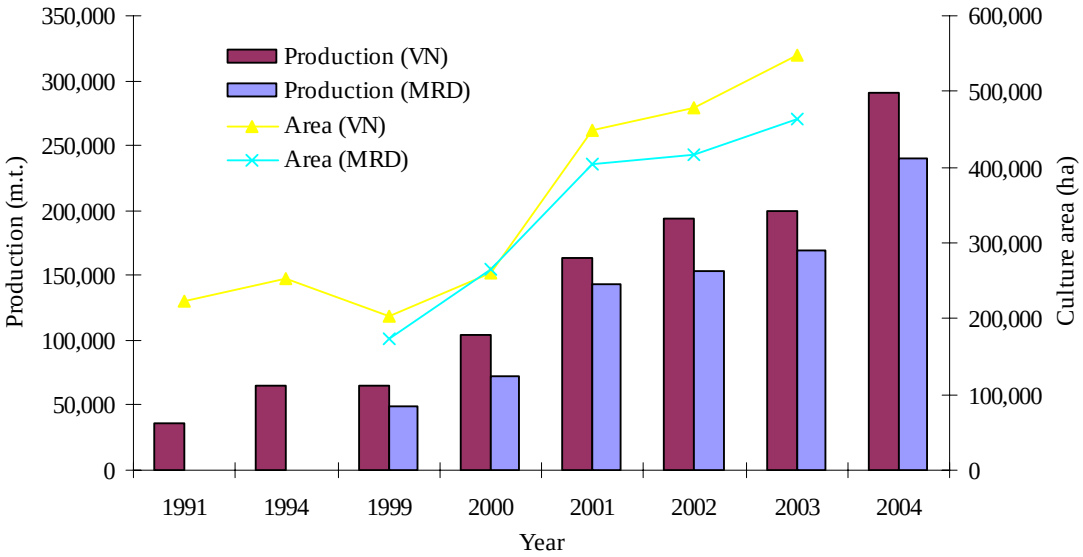


Fig. 1: Changes in marine shrimp culture area and production during the period from 1991 to 2004 (VN: Viet Nam and MRD: Mekong River Delta) (MoFI, 2003, 2004 and 2005)

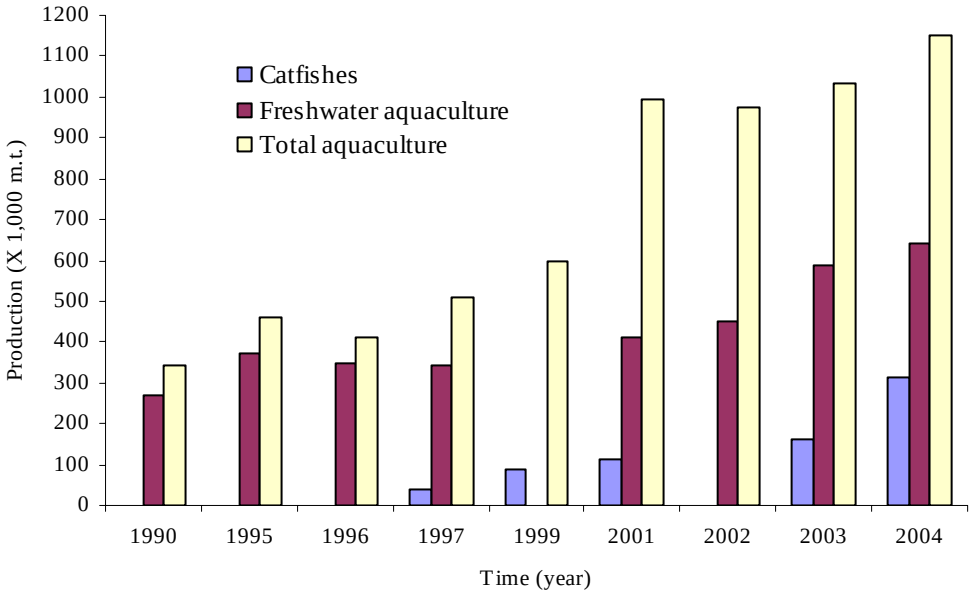


Fig. 3: Changes in production of catfishes, freshwater aquaculture and total aquaculture of Viet Nam during period from 1900-2004 (Tran, 2004; Nguyen *et al.*, 2004; MoFI, 1999 and 2005)

2.2 Market

The aquatic products of Vietnam are provided to domestic and export markets, of which export market is considered as major market. These products are exported to 80 countries and regions around the world (MoFI, 2005). The major markets of Vietnamese aquatic products are the USA, Japan, China, Hong Kong and other countries. The USA market shared the biggest amount of the aquatic products from year 2001 to 2003. In 2002, markets of the USA, Japan, China-Hong Kong, EU and other countries shared 32.8%, 26.8%, 15.2%, 3.5% and 21.7% of total Vietnamese exported aquatic products, respectively (Chu *et al.* 2003) (Fig. 3). However, due to the dumping price event issued by the USA for Vietnam's aquatic products in 2004, USA market share reduced to 24.1% and became the second in the export market range (MoFI, 2005).

Total exported aquatic products by November, 2004 was 79,265 m.t. Japan market was the top among export market range sharing 31.4% (consumed of 106,610 m.t.). The share of the EU market has increased and reached 9.9% of total national exported aquatic products in 2004. The exported aquatic products to EU market in 2004 were 67,251 m.t. China and Hong Kong markets imported 42,999 m.t. of aquatic products from Vietnam. Korea consumed 63,386 m.t and ASEAN markets shared 38.322 m.t.(MoFI, 2005). Shrimp product made up 52% of total national exported aquatic products.

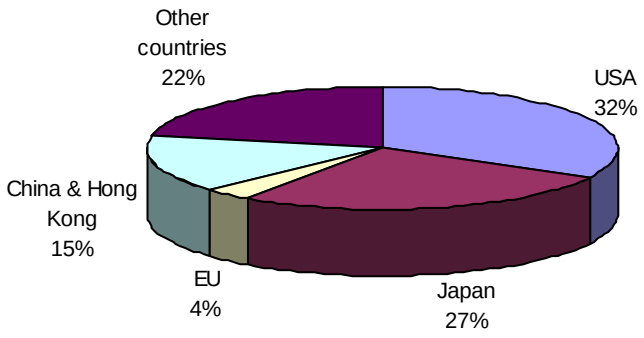


Figure 3: Market shares of Vietnam's aquatic exported products in 2002 (Chu *et al.*, 2003)

2.3 Contribution to the economy of Vietnam

Fisheries sector (including aquaculture) has been playing an important role in the economy of the country. The sector has been ranked at the third range of the key economic sectors of Vietnam. The total exported turnover value reached 2.397 billion USD in 2004, increased 8.9% compared to the value in 2003. (MoFI, 2005). The exported turnover has been increasing annually (Fig. 4).

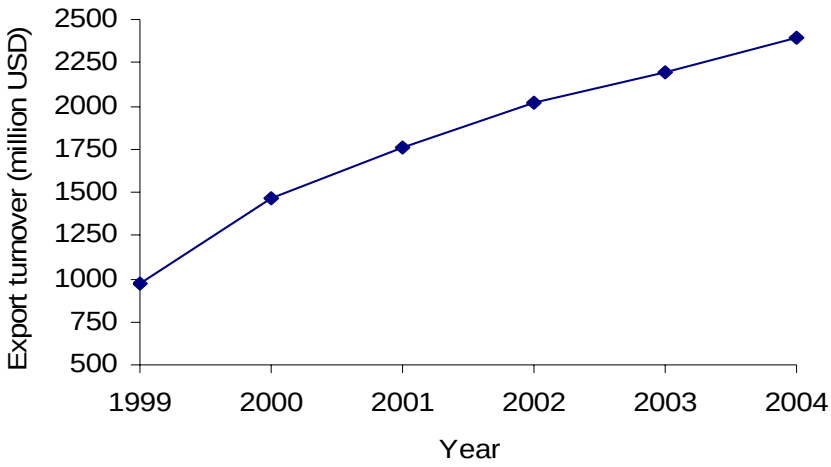


Figure 4: The aquatic exported turnover from 1999 to 2004

In 2004, the exported turnover to USA market was only 523 million USD, decreased 27.7% compared to that of 2003. In contrast, the exported turnover to Japan market was the highest (680 million USD), increased 31.4%. EU markets contributed 215 million USD of the exported turnover of Vietnam, increased 88.1% compared to year 2003. The exported value of China and Hong Kong markets reached 117 million USD. ASEAN countries and Korea markets contributed 152.9 million USD and 125.7 million USD, respectively. Among six major Vietnamese aquatic products, shrimp and catfish products have been the key aquatic products and contributed significantly to Viet Nam's exported turnover value. The target of aquatic exported turnover for year of 2005 will be 2.6 billion USD (MoFI, 2005).

3. Promotion and Management of the Sector

3.1 The institutional framework

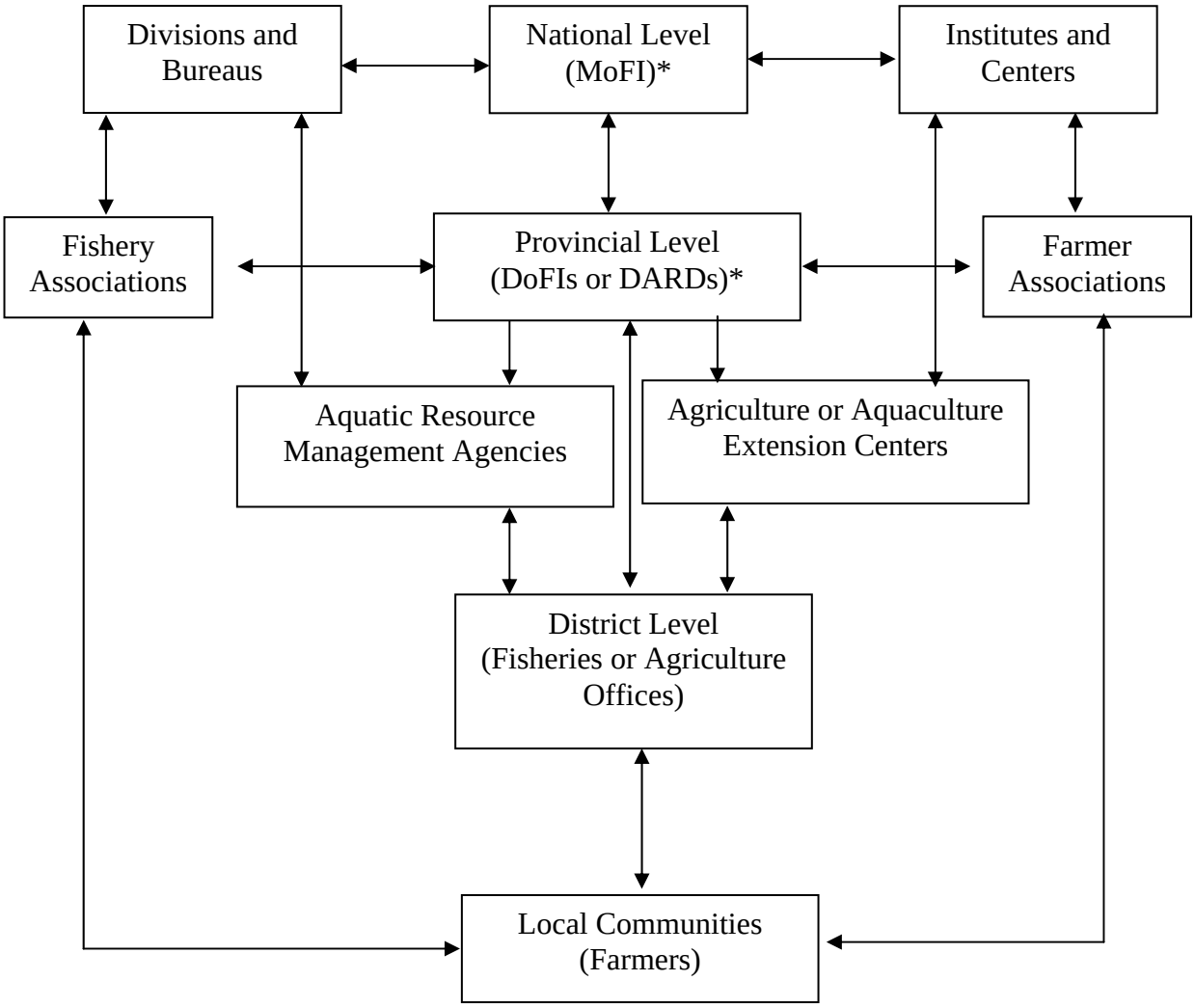
The Ministry of Fisheries is a governmental organization which fulfills functions of the state management and under administration of the Government. There are three administrative levels of fisheries sector including central (national), provincial and district levels. The institutional organization of the fisheries sector includes undered divisions and specialized institutions and associations (Fig. 5).

The supportive divisions assist the Ministry to fulfill its state management function. They are division of aquaculture, division of collective and individual economic sectors, division of plan and finance, division of science and technology, division of international relations, division of legislation, division of personnel organization, bureau of capture fishery and aquatic resources management, bureau of quality management, sanity safety and fisheries veterinary and ministerial inspectors and ministerial offices.

The specialized institutions support the Ministry in terms of research and development. They are Research Institute for Marine Fisheries, Institute for Fisheries Economic and Planning, Research Institute for Aquaculture No. 1 (based in the North); Research Institute for Aquaculture No. 2 (based in the South), Research Institute for

Aquaculture No. 3 (based in the Central) and National Fisheries Extension Center and Information Center.

The are union and associations support the development of the fisheries sector which are Labor Union of Vietnam's Fisheries Sector, Viet Nam's Fisheries Association and Viet Nam Association of Seafood Exporters and Producers.



*MoFI: Ministry of Fisheries
DoFI: Department of Fisheries
DARD: Department of Agriculture and Rural Development

Fig. 5: Institutional framework of the Vietnam's Fisheries Sector

3.2. Governing regulation

The Vietnam's fisheries governing law has been adjusted in recent years and it has just been issued in Jan 1st, 2004 by the President of the Socialist and Republic of Vietnam. The fisheries law consists of 10 chapters and 62 Articles. These chapters are about: general regulations; protection and development of aquatic resources; capture fishery;

aquaculture regulations; regulations of fishing boat and fisheries services; regulations on processing, trading, export and import of aquatic products; regulations on international cooperation for fisheries operations; regulations on governmental administration for fishery; regulations on reward and punishments and regulations on clause of implementation. There are also numbers of decrees, decisions, etc issued at governmental and ministerial levels on specific tasks to support the management of the fisheries sector.

3.3. Research, education and training

The research institutes for aquaculture, institute for fisheries economic and planning and others have been assigned by the Ministry of Fisheries to conduct research on national aquaculture development. Besides, universities and local authorities have also carried out several applied research on aquaculture. The researches have focused on aquatic seed production, improvement on aquaculture technology, feeds for aquaculture, and technological improvement on reservation of aquatic products, aquaculture environment, and other urgent issues in aquaculture practices.

The Vietnamese scientists who specialize in aquaculture have studied and perfected the artificial seed production processes for major aquatic species that are important for export. Those species include marine shrimp (*Penaeus monodon*), climbing perch (*Anabas testudineus*), snakehead fish (*Chana micropeltes*), spotted gouramy, mud crab, swimming crab (*Charybdis affinis*), sweet snail (*Babylonia areolata*), Cobia (*Rachycentron canadum*), spotted grouper (*Epinephlidae coioides*), etc. Especially, mud crab seed production process has been reached 15% of survival rate. These achieved artificial seed production processes have become commercial aquaculture technology.

Applied researches on freshwater aquaculture in Vietnam include artificial seed production, fingerling rearing and grow-out of some indigenous species in the Mekong River Delta. In addition, there has been an advanced research on the application of technological advantages in catfishes (ca tra and basa) seed production and grow-out. Likewise, applied research was conducted for artificial seed production and commercial grow-out of giant freshwater prawn (*Macrobrachium rosenbergii*), improvement of yield in the integrated rice-cum-fish and rice-cum-prawn farming systems as well as fish pond culture.

With regard to marine and brackish water aquaculture, besides some economic aquatic species which have been studied and applied such as black tiger shrimp (*Penaeus monodon*), and mud crab (*Scylla spp*), some other new species were also studied and applied in seed production and grow-out culture in recent years. These species include spotted grouper (*Epinephelus coioides*), cobia (*Rachycentron canadum*), Red drum (*Scyaenops acellatus*), seabass (*Lates calcarifer* & *Psammoperca waigensis*), swimming crab (*Charybdis affinis)* and oyster (*Crassostrea* sp.), etc. In addition, seed production techniques for blood cockle (*Anadara granosa*) and brown tiger shrimp (*Penaeus semisulcatus*), broodstock maturation technique of Donkey's ear abalone (*Haliotis asinila*) were also studied and applied in Vietnam's aquaculture.

Technologies for aquaculture feeds have been perfected such as feeds for culture of catfishes, shrimp, spotted grouper, cobia, sweet snail and tilapia by using cheap raw materials which are locally available. This contributed to the reduction of input cost for aquaculture (MoFI, 2005).

Other basic research were also carried out to improve culture environment such as in integrated sea cucumber and black tiger shrimp in pond culture, polyculture of grouper (*Epinephelus fuscoguttatus*) and abalone (*Haliotis asinine*), green mussel (*Perna viridis*), seaweed (*Kappaphycus alvarezii*) in marine cage culture, using seaweeds as bio-filter species in shrimp culture, etc. In addition, application of bio-molecular methods in aquaculture such as RAPD (Random Amplified Polymorphic DNA) and RFLP (Restriction Fragment Length Polymorphism), fish nutrition, diseases, genetic and breed selection have been studied and applied for Vietnam's aquaculture development.

In terms of education and training, according to MoFI (2005), there was 156 staffs who was trained and obtained bachelor degree of aquaculture in 2004; 1,278 staff at intermediate level in fisheries (including aquaculture); and 2,876 skilled workers who were trained in 2004. There are 18 staffs who have participated in master or doctor programs in other countries. Many fisheries staffs took short training courses in Vietnam and abroad.

There are 2,844 training courses for 145,186 farmers in the whole country in 2004. Particularly, the National Extension Center (NEC) (excluded provincial extension centers) organized 216 demonstration farms and 640 training courses for farmers. In addition, several aquaculture extension means have been produced by the NEC including 1,500 newsletters, 50,625 extension materials, 76,200 leflets, 106 distant training by radio and television, and 3,501 videotapes for aquaculture extension (MoFI, 2005).

4. Trends, Issues and future Development

Being considered as a key economic sector of Vietnam, the Fisheries sector development has been pushed at a fast growth, which is connected to environmental and aquatic resources protection, effectiveness and sustainability. Total aquatic production and export turnover value will be increased, especially pay attention in aquaculture. The proportion of aquaculture production has increased in a positive trend, i.e. 31.2% in 1991 and 36.1% in 2000 to 43.8% of total national aquatic production in 2003 (Nguyen, 2005). The value of total production has been maintained at the rate of over 10%. The export turnover is expected to be over 8% annually in the next coming years compared to former years. The targets for the sector development in the period from 2005-2010 are shown in table 2.

Table 2. The target of the fishery sector development in 2006–2010

Items	Unit	2005	2010
Total production	1,000 tons	3,300	4,000
- Capture fishery	1,000 tons	1,940	2,000
- Aquaculture	1,000 tons	1,360	2,000

Export turnover	Million USD	2,600	3,500

Source: MoFI, 2005

Standardization of criteria for safe and clean aquaculture areas will be built and expended for implementation. Monitoring and quality controlling of aquaculture seeds, feeds and chemicals will be fulfilled better. The new approach on community-based management of aquaculture areas will also be further carried out.

According to the MoFI (2005), aquatic seeds are considered as a key factor in aquaculture development. Quality and quantity of aquatic seeds will be paid high attention to supply sufficiently for aquaculture. The key export aquatic species compositions will be formed to meet the need of commercial aquaculture development and exported products. Some major exportable and valuable species consist of shrimp, catfishes (ca tra, ca basa), mono-sex tilapia, marine finfishes, mud crab, sweet snail, and bivalve. Marine and brackish water species will have been still in focus to develop in marine and coastal aquaculture areas.

Besides, export markets and domestic market will be expanded to solve the output problem of Vietnam aquatic products and to stimulate further development of aquaculture. Quality of aquatic products has also been enhancing to meet the demand of export and domestic markets. Diversity of aquatic products will be attached to increase domestic market consume capacity. Building up the trademark of Vietnam's export aquatic products has been still paid attention for expansion of export markets and market share.

Applied research, education and training activities will be fulfilled to meet the need of sustainable and effective development of the fisheries sector, particularly in aquaculture field in the period from 2005-2010.

Besides positive trends and advantages in aquaculture development, the Vietnam fisheries sector (including aquaculture) has faced to several issues, which consist of **(i)** high quality of aquatic products demanded and requested for safe and clean foods by export markets; **(ii)** despite industrial shrimp culture has developed rapidly and contributed significantly to total aquaculture production of the fisheries sector, disease outbreak in large scale is a serious issue of concern for in shrimp farming development in the coastal area of Vietnam; **(iii)** A decline of coastal aquatic resources has occurred in recent years, which causes a high pressure for the livelihood of millions people who live on natural aquatic resources by small scale fishing activities, coastal environment and aquatic resources and **(iv)** aquaculture area development has out off controlled and zoning, infrastucture and canal system has not met the need for aquaculture area, lack of effective solutuion in meeting the need of qualitative and quantitative seeds, lack of environmental protection of aquaculture area, lack of capital for investment of aquaculture infrastructure, limitation on man power, skilled staff and workers, un-sufficiency in administrative capacity for the sector, poor educated level of aquaculture farmers while the oriented targets for the fisheries sector development are quite high such as effective and sustainable development, promoted export and deeper integration into international markets.

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