

## Appendix 1:

# THE SITUATION OF THE WORLD'S, VIETNAM'S AND THE MD'S SEAFOOD MARKET

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## I. INTERNATIONAL SEAFOOD TRADE

### 1. Aquaculture and Marine catch situation

In the last two decades, the world's seafood output increased fast. The increase based mainly on aquaculture because marine catch has explored at maximum level. Although aquaculture began very far from now, it has developed since 1970s. In 1999, total aquaculture volume obtained 33.31 million tons with its value of \$US47.8 billion (43.3% of the total value). The indicator was nearly 40 million tons in 2002. Asian countries are leading ones in aquaculture output of the world. Six of ten leading countries in this area are China, Japan, Indonesia, Thailand, Vietnam and the Philippines. Regarding seaproducts, shrimps, fishes and mollusk are main seafood species bred in order to supply of the world's market. Particularly, there are over 20 species of shrimp bred in the world, of which 80% of the volume from Tiger shrimp and Prawn. Three countries where Tiger shrimp bred with the largest volume in the world are Thailand, Indonesia and Vietnam.

In capture aspect, natural seafood source of the world has been explored thoroughly. According to FAO report, 25% of total global seafood source is exhausted, mostly in the Pacific sea. There is approximately 38% explored completely. Over 50% of seafood volume is caught from Asian countries. In 1999, total caught seafood output was 92.9 million tons. Four of 10 leading countries in the region where had the highest volume were China, Japan, Indonesia, and Thailand. This indicator had decline tend in 2002. However, the volume was still over 90 million tons.

Regarding natural caught shrimp, although shrimp breeding has expanded in several areas in the world, natural caught shrimp is still main source for trading (accounting for 75% of the total trade shrimp). From 1989, the shrimp volume from marine catch was about 2 times than that of aquaculture. But since 1997, this indicator was nearly 50%. Tiger shrimp is now over 50% of total bred shrimp. In the period 1991-2000, output of caught shrimp increased 55% (from 2.0 million tones in 1991 to 3.1 million tones in 2000). China had the most caught shrimp volume (1.023 million tones in 2000 accounting for 33%). India is followed with 352million tones and then Indonesia with 225 million tones. Vietnam was in the seventh position (81 million tones) following the US, Canada and Thailand in this aspect.

### 2. International seafood trade

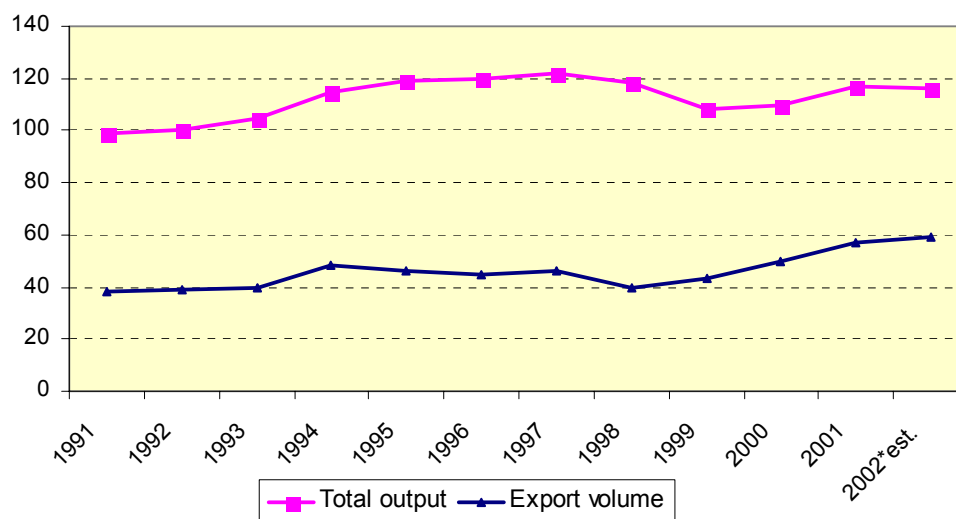
#### 2.1 Trade volume and value of international sea products

According to FAO, trade value of international sea products accounted for \$US115.2 billion in 2000 (up 4.35% from 1999 and 39.6% from 1991). Compared with other agricultural products, trade seaproducts have increased at high level in terms of annually growth rate. In the last decade, there was unstable growth in trade value of international sea products over years. In 2000, trade value had the highest level (\$UD115 billion) but it only increased 4.7% compared to 1996. Especially, this indicator was on the spot – negligible variety in the period 1996-1999.

#### ***The world's seafood export***

The growth rate in exported volume was a few higher than that of total output during 1999-2001 period. Specifically, the total world's seafood volume was approximately 100-120 million tons over the 1991-2002 period. The exported volume was about 35-50% of the total output with annually average export value over \$US50 billion (*figure A1.1 and figure A1.2*). In addition, export value was approximately \$US55.2 billion in 2000, of which developing countries accounted for over 50% and ASEAN countries kept 16%, respectively. Six of 10 leading export countries are from Asian countries. They are China, Chile, India, Peru, Taiwan, and Thailand. Particularly, total export value of the world's sea products estimated approximately \$US57 billion in 2002. Thailand, China, Norway and the US were the largest export countries in terms of export value in the world (over \$US 3 billion for each) although there were several difficulties in shrimp export due to high competition on price and strict inspection on quality of import countries. Thailand is leading country in shrimp export in 2002 (\$US4 billion). Vietnam was also one of ten leading countries in terms of shrimp export at the same time (\$US966.7 million).

**Figure A1.1: Total seafood output and export volume of the world (million tons)**



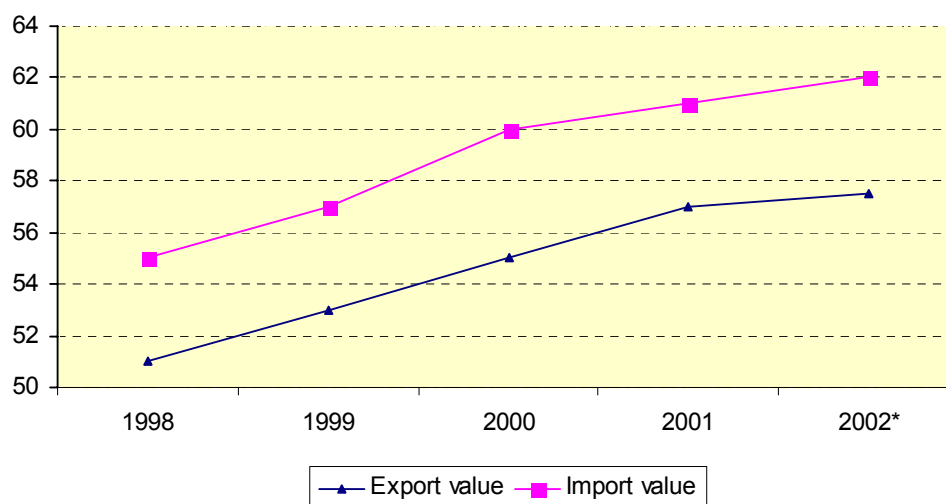
Source: Report of FAO, Dec. 1999, \*2002 estimated and International trade in fishery commodities – FAO – Roma – 7/2002

Regarding export sea products, shrimp and salmon are high trade value products. Particularly, shrimp products have the highest export value in the world market. There are three kinds of exported shrimp products – frozen shrimp, fresh shrimp and canned shrimp. Frozen shrimp is leading product in terms of export value (accounting for 77% of the total exported shrimp value), then canned shrimp (20%) and with a small percentage of fresh shrimp (3%). Shrimp contribution to the world's value of seafood export is approximately 20%.

#### **The world's seafood import**

As the growth rate of export value, seafood import value of the world has increased over 4% in recent years. Asian countries are the largest market to import sea products (accounting for 35%-40%). Following are EU and North American markets. The largest seafood import countries in the world are Japan, the US, Spain, France, and China. These countries import annually over 56% of the total seafood market-share, of which 25% to Japan and 15-16% to the US (76% of total seaproducts consumed in the US from import – FAO 2002). Among imported sea products in 2000, shrimp has the biggest percentage in terms of import value (18.3%), then salmon (13.1%).

**Figure A1.2: Export and import value of the world's sea products (US\$ billion)**



Source: Commercial Information 1/2003, p.30

### 3. Trend of the world's fisheries

The responsibility for food safety and quality will continue to be pushed through the food supply chain. All stakeholders in this chain will be required to share the responsibility for the integrity of the food supply. Those will not be considered unreliable, and are likely to fall by the wayside. People and business that produce, manufacture, store, transport and retail the food we eat accept and acknowledge their individual responsibilities. However, running a business can involve managing other issues such as worker safety, animal welfare, environmental and many others. It also involves making a profit. It is therefore imperative that systems are available that provide the integrity of supply that is essential for consumer confidence, whilst at the same time contributing to the viability of the food industry.

Furthermore, according to the World's Fisheries Center and International Food Policy Research Institute, the global aqua product output has not met demand of consumption in coming years because of decline of fisheries source and increase of population. This leads to scarcity of sea products and increased price – if growth rate of fisheries is lower than that of population 0.4%, price of sea products can increase from 4 % to 16%. In 2003, the economies of sea product import countries, such as the US, Japan and EU are increasing at low level. Specially, consumption of sea products in these countries will increase when the price comes down. Export countries, such as Thailand, China and Norway will have negligible increase in terms of export volume at the same time although they are trying to develop and promote in aquaculture, marine catch and processing. Particularly, shrimp products are still imported at high level in Japan and the US and there is a sharp increase in EU market because Asian export companies have effective measures to improve shrimp quality. However, the price will also increase from 7% to 10% compared to the year 2002. Predictions by FAO (2002 cited by The Ministry of Fisheries, 2002) reveal that the shrimp production of the world will increase by about 3.5% per year for the period of 2002-2005, and 3.2% per year for the period of 2006-2010. The demand for shrimp products is also expected to increase mostly in China, Taiwan, and Korea.

## II. THE SITUATION OF VIETNAM'S SEAPRODUCTS

### 1. Vietnam's seafood production

Vietnam's total seafood output grew by over 2.2 times during the 1985-1999 period, of which output of aquaculture increased by over 2.6 times. Specifically, both marine catch and aquaculture strongly developed in recent years – 2,003 tons in 2000 up to 2,227 thousand tons in 2001 and 2,411 thousand tons in 2002 (*table A1.1*). Besides, water surface area devoted to the breeding and rearing of aquatic products rose from 385 thousand hectares (1986) to 630 thousand hectares (1999), 652 thousand hectares (2000), 887 thousand hectares (2001) and 955 thousand hectares (2002). The reasons for these increase are (1) promoted policies related to fisheries development in terms of production and export of the Vietnamese government, (2) increase of seafood demand in the world, and (3) natural potential exploration thoroughly, especially natural grow areas in the MD. Aquaculture output accounted for nearly 50% in average of the marine catch output in the period of 1985-1999. From 2000, the growth rate of aquaculture output is over 65% of caught output in 2001-2002 period. According to the 5-year plan 2001-2005, the indicator of aquaculture volume will be equal to marine catch's.

**Table A1.1:** The output of aquatic production in the period 1980-2001 (1000 tons)

Indicator	1980	1985	1990	1995	1998	1999	2000	2001	2002
Total output	559	808	979	1,344	1,668	1,827	2,003	2,227	2,411
Of which: - Marine catch	399	577	672	929	1,131	1,213	1,280	1,348	1,435
- Aquaculture	160	231	307	415	537	612	723	879	967

Source: *Vietnam Seafood Exporters and Producers Reports*

### 2. Vietnam's seafood export

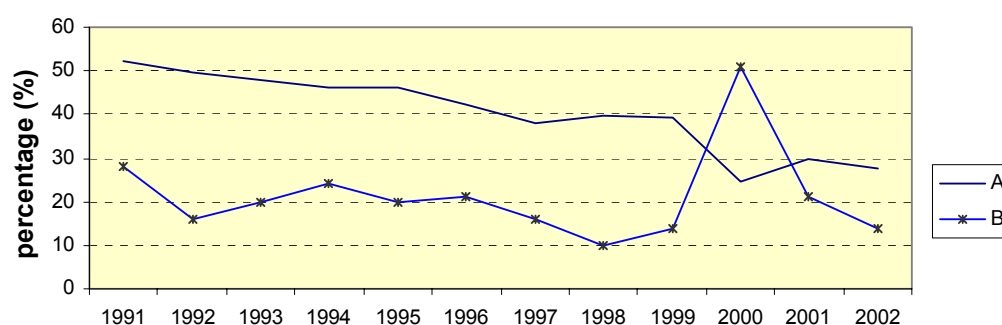
#### 2.1 Seafood export turnover

After a decade development of seafood industry (1990-1999), seafood export value increased 4.63 times. Also, it is a shaped branch in agriculture as well as in Vietnam's economy. Seafood value accounts for average 30%-40% of total agriculture value (*figure A1.3*), and 10%-14% of export turnover of Vietnam. However, the percentage of seafood value in total agriculture value declined in recent years. The reason is that even if the Vietnamese government issued several policies and regulations to promote fisheries

development, bred fisheries mostly shrimp were continuously dead due to polluted environment and different diseases.

In addition, Vietnam's seafood export value has the highest growth rate in the region in recent years (average 20% per year) and higher 100 times than the last two decades itself. Seafood export ranked third position (after petroleum and garments) in terms of Vietnam's export structure in the last two years (2000 and 2001). However, although absolute value of seafood export turnover increased continuously over the period of 1990-2002, its growth rate reduced sharply from 51.4% in 2000 to 20.9% in 2001 and 13.8% in 2002. The reasons were main import markets of Vietnam that were in difficult situation like Sep.11 and the anti-price case on catfish trade mark in the US, Yen depreciation in Japan, technical barriers to trade in EU, the US, Japan and China, other reasons related to quality inspection (e.g. sanitation performance standards), and high competition in the world's market.

**Figure A1.3:** Contribution of seafood value to total agriculture value (A) and the growth rate of seafood export value (B) in the 1991-2002 period



Source: Research of Vo Thanh Thu, Statistical Publishing House, 2002; and VASEP reports

## 2.2 Export market

- **Market structure:** Vietnam's seafood export markets have been continuously expanded and developed. The export market structure has been changed, creating a better and more stable balance, and form better condition for initiatives of the Vietnamese seafood enterprises in the world market. So far, Vietnam's seafood products have distributed to 64 countries in the world. However, 80% of export value concentrates in four main markets – Japan, US, EU, and China (*table A1.2*). From 1990, Japan is the largest import market of Vietnam's seafood. In recent years, the US market is a leading import country in this aspect.

**Table A1.2: The structure of export value by market in the 1999-2002 period (%)**

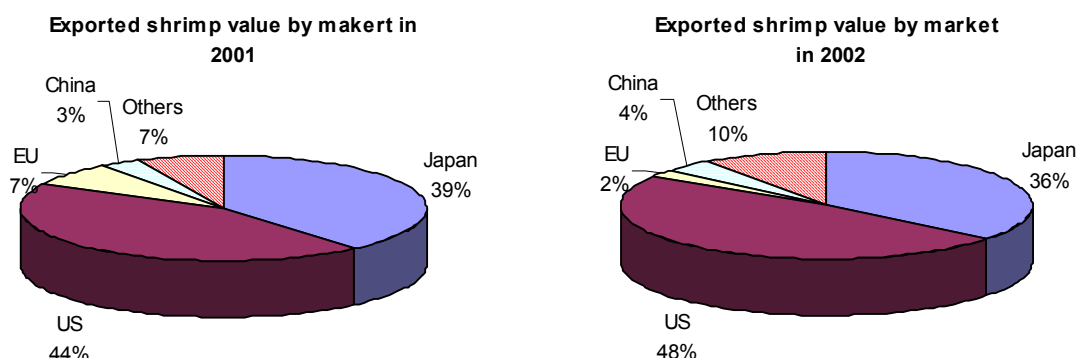
Market	1999	2000	2001	2002
1. Japan	40.9	33.0	30.9	27.5
2. US	14.3	20.6	32.5	33.3
3. EU	9.6	6.2	5.7	5.3
4. China	14.6	19.8	17.4	9.7
5. Others	20.6	20.4	13.5	24.2
Total	100.0	100.0	100.0	100.0

Source: Information center – Fisheries Ministry

Regarding exported shrimp product, most of the marine catch and bred shrimp were exported to Japan (traditional customer) and the US. These markets captured over 70% of total exported shrimp value (*figure A1.4*). In 2002, exported shrimp to the US market particularly accounted for 39.6% in terms of volume and around 48.3% in terms of value. Big-size shrimps are more appreciated by the US's importers along with high quality, safety and hygiene of the products. In this market, Vietnam's export shrimp was in second position in the world in terms of export value only following Thailand, and in terms of export volume in Japan market after Indonesia. Especially, the structure of exported shrimp export to EU decreased in the last two years because of strict quality inspection on zero tolerance of this market.

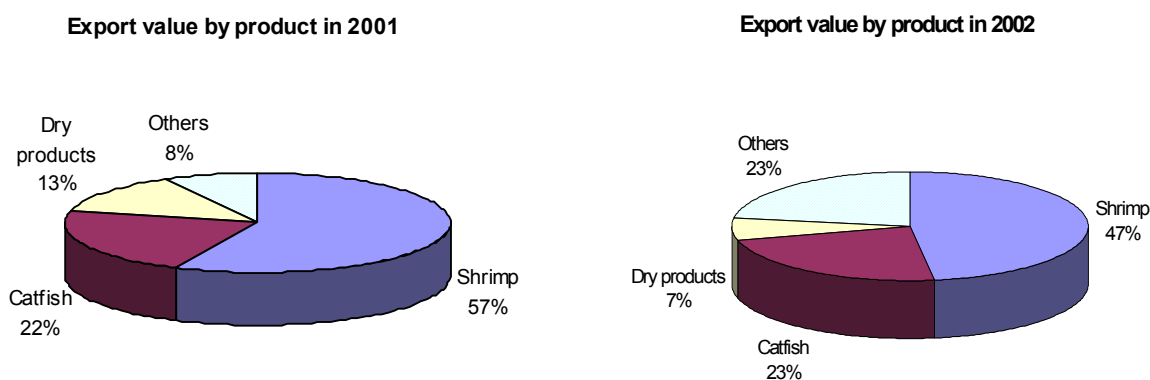
So far, 61 SFCs of Vietnam have been approved to export to EU market with high quality of valued-added products. Eight bivalve mollusks harvesting areas with full hygiene and safety standards are ready to export to EU and nearly 100 units applying HACCP and adequate standards are approved for export to the US and Japan markets. From 70%-90% of exported sea products have inspected by the National Fisheries Inspection and Quality Assurance Centre (NAFIQACEN) before they could be exported to respond market standards.

**Figure A1.4:** The structure of exported shrimp value by market in 2001-2002



- **Export product structure:** There are four main groups of exported aqua products – Shrimp, catfish, dry products, and others (such as mollusk and cuttlefish) (*figure A1.5*). Shrimp is the highest percentage in terms of export volume and value although the percentage is a big reduction in recent years - 61.82% in 1991, 52.1% in 1995, 30.6% in 1999, 22.8% in 2000, and 33.5% in 2001, and 26% in 2002 in terms of volume; 74.6%, 61.1%, 49.7%, 46.4%, 56.6% and 47.8% for the years in terms of export value, respectively. The reason for changing the shrimp export structure among markets was high competition in the world market in terms of price and quality. Besides, the Vietnamese government as well as the Ministry of fisheries have encouraged the SFCs to diversify different aqua products in their export tend instead of focusing only on shrimp.

**Figure A1.5:** The structure of export value by product in 2001-2002



### 3. Introduction of the Mekong Delta

The Mekong Delta region, which lies in the southern part of Vietnam, is one of the seven ecological regions of Vietnam, namely *Northern Mountain and Midland, Red River Delta, North Central Coast, South Central Coast, Central Highland, Northeast South and Mekong Delta*. Its natural land is 39,713 sq. km, occupies about 12% of the total natural area of the country, and 21.1 % of total population in the whole country in 2002. It is bordered in the West by Cambodia, and in the East and in the South by the East sea. The delta accommodates 12 southern provinces of Vietnam, namely, Long An, Tien Giang, Ben Tre, Vinh Long, Cantho, Tra Vinh, Dong Thap, An Giang, Kien Giang, Soc Trang, Bac Lieu and Ca Mau (*figure A1.6*).

**Figure A1.6:** The maps of Vietnam and the South of Vietnam



In recent years, the economy of the MD has reached a higher growth rate than that of Vietnam's indicators - 13.89% and 7.00%, respectively in 2002. However, it remains a less developed economic region. The starting point by any standard is low. GDP per capita was only \$US 352, which is lower than that of the whole country (\$US 439 per capita) in 2002. Average GDP growth rate was 5.6% in the period of 1991-1994 and 7.5% in the period of 1995-2000, which are lower than the average of the whole country - VN (7.9% and 7.4%, respectively). Also, during the period of 1998-2002, the economic structure in the MD has changed considerably. Specially, from 2001 the gross output value of agriculture of GDP went up, meanwhile gross output value of other sectors such as industry, construction, and service increased negligibly because the Vietnamese government offered several policies that encourage local governments to expand areas for aquaculture in this region (*table A1.3*). As a result, the growth rate of the MD's economy stems from agriculture, especially aquaculture. That is also the reason why its economy has depended heavily on agriculture and aquaculture representing a share of 52.7% of the whole economy.

**Table A1.3:** Economic structure of the MD compared to the whole country (1998-2002) (%)

<i>Economic structure</i>	1998		1999		2000		2001		2002	
	MD	VN	MD	VN	MD	VN	MD	VN	MD	VN
1. Agriculture	44.38	25.78	44.03	25.43	42.63	24.29	50.78	23.25	49.55	22.29
2. Industry	22.75	32.49	23.27	34.49	24.38	36.61	19.62	38.12	20.49	38.55
3. Service	32.87	41.73	32.70	40.08	32.99	39.10	29.60	38.46	29.96	38.46
<b>Total</b>	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Source: Statistical year books 1999-2002, vneconomy.com.vn*

Furthermore, the MD accounts for 45.8% of the whole country's agricultural food production. With over 700 km of coastline and a dense network of rivers and canals, the MD is also the biggest potential area of aqua products. Specially, the growth rate of fisheries output increased over 70% in the period of 1995-2001. In agriculture structure in the MD, aquaculture percentage accounts for 30%-35% - twice compared with that of in the nation. It is said that aqua products from the MD make up over 50% of total output of the country, and exported seafood accounts for 58-60% of gross exported sea-product value of the nation, especially export shrimp volume and value. Particularly, gross output of breeding shrimp and culture area in the region captured approximately 75-80% and 85-90% of the whole country in the period 2000-2003, respectively (*table A1.4*).

**Table A1.4:** Shrimp cultured areas and output in Vietnam and the MD

Indicator	1991	1994	1999	2000	2001	2002	2003*
1. Vietnam							
. Cultured areas (ha)	222,000	253,000	203,232	259,688	449,275	478,785	496,975
. Output (tons)	35,600	65,600	65,282	103,845	162,713	193,973	223,895
2. Mekong Delta							
. Cultured areas (ha)	89,605	180,588	173,510	221,066	398,964	417,398	429,114
. Output (tons)	34,386	41,596	49,624	81,875	127,899	153,122	172,136

*Sources: Truong and Tham (1996); Hai et al. (1998); the Ministry of Fisheries (1995-2003).*

*(\*) Planned data.*

Regarding breeding shrimp, there are only eight of twelve provinces in the MD where produce shrimp. Ca Mau is a leading province in terms of breeding, output as well as export value in this region. Following are Bac Lieu and Soc Trang provinces' where have a long coastline. In 2001, the growth rates of shrimp culture area and output in the MD were 80% and 56% compared with 2000, respectively. Similarly, this indicator was 4.6% and 19.7%. There was a sharp increase of shrimp culture area and shrimp output in 2001 because approximately 110,000 ha of rice fields in Soc Trang, Bac Lieu and Camau provinces were converted into rice-shrimp areas. Moreover, the growth rate of culture area was higher than that of the output due to 50-70% of these areas lost the first crop of the year.

## Appendix 2:

### SURVEY RESULTS OF THE SFCs' QUALITY MANAGEMENT IN THE MEKONG DELTA

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#### **1. Company's general information**

Of the total 52 SFCs in the region 32 were interviewed (accounting for 61.3%), of which 28 whose exported products include shrimp (accounting for 94% of total exported shrimp companies) and 4 sea product companies without shrimp export answered the questionnaire. Interviewed companies are located in the twelve provinces of the MD. Their average business time was approximately 10 years at the time of the interview. The SFC's product structure included shrimp (87.5%), fishes (46.9%) and others 40.6% (mollusc, cuttle fish). There was 87.5% of the SFCs whose products were exported to the US (87.5%), Japan (78.1%), EU (59.4%) and Korea (25%).

In the interviewees' opinions, so far their business success has resulted from good quality control and a stable source of shrimp materials – from fixed agents and farmers (93.8%) and from their investment (46.9%). Nowadays, some large SFCs invest their capital to the farmers to improve shrimp breeding procedure. Besides, they also participate in quality management by providing technicians to observe and control as well as guide the farmers how to manage in order to obtain good materials. However, there were approximately 38% of the interviewed companies whose products were refused by the customers due to contamination by antibiotics (chloramphenicol) and other substances. Also, their export value was limited due to non-diversification of products to export – lack of value-added products.

Regarding business result, most of the SFCs (68.8%) gained over US\$2 million, and the remaining 21.9% gained from US\$1 million to under US\$2 million of profit per year. Major advantages in the SFCs' business operation are stable raw materials and managers who are knowledgeable about quality. In contrast, they have also faced many difficulties, such as lack of capital, low investment of processing technology as well as other investments to improve product quality (e.g. limited application of quality standards – HACCP, ISO, etc.).

#### **2. Supplier's shrimp quality**

As mentioned above, most of the companies have their loyal sources of shrimp supply. However, only 56.3% of supplied shrimp were assessed in good quality thanks to good source of raw shrimp and spot buying. In general, the companies did not satisfy quality requirements of shrimp materials because their plants are located far from sources of shrimp materials. As a result, it is difficult for them to control the quality of the sources. The SFCs realized that quality of shrimp materials is a very important factor that affects the quality of finished products. Therefore, a company's reputation in terms of business success and flexible policies on price (43.8%), quick payment (50%) are important elements that the SFCs have used to maintain suppliers' loyalty. In addition, almost all SFCs (93.8%) in the MD have to compete at high level of buying shrimp materials with internal and external SFCs of the region.

#### **3. Quality in manufacturing processes**

According to the interviewees, the factors that affected shrimp quality in processes are (1) the quality of shrimp materials from the sources (81.3%); (2) the purchasing process (46.9%); (3) the storage process (50%); (4) the transportation process (40.6%); (5) processing technology (56.3%); (6) processing techniques (68.6%) and (7) inventory time of finished products (53.1%).

Regarding the hazards occurring throughout the production chain, 25% of the companies said that their products were infected by micro-organisms (E.coli, coliform, and salmonella). Similarly, 15.6% and 9.4% answered that products were affected by chemical (Chloramphenicol and sulfite) and physical (pieces of metal) hazards, respectively. Particularly, in the process of purchasing shrimp the companies have established a good level of control for temperature and hygiene of equipment but they could not control and audit the level of antibiotic contamination as well as ice hygiene although they have good relations with the suppliers. Both the company and suppliers lack equipment to discover the infection. In processing process, almost all of SFCs (96.9%) have controlled the hazards actively and effectively in shrimp procedures, such as shrimp material receiving, handling, classification, frame, freeze, ice-plating, metal check, packaging and storage. However, although the companies have established good storage conditions for finished products, storage time has affected product quality.

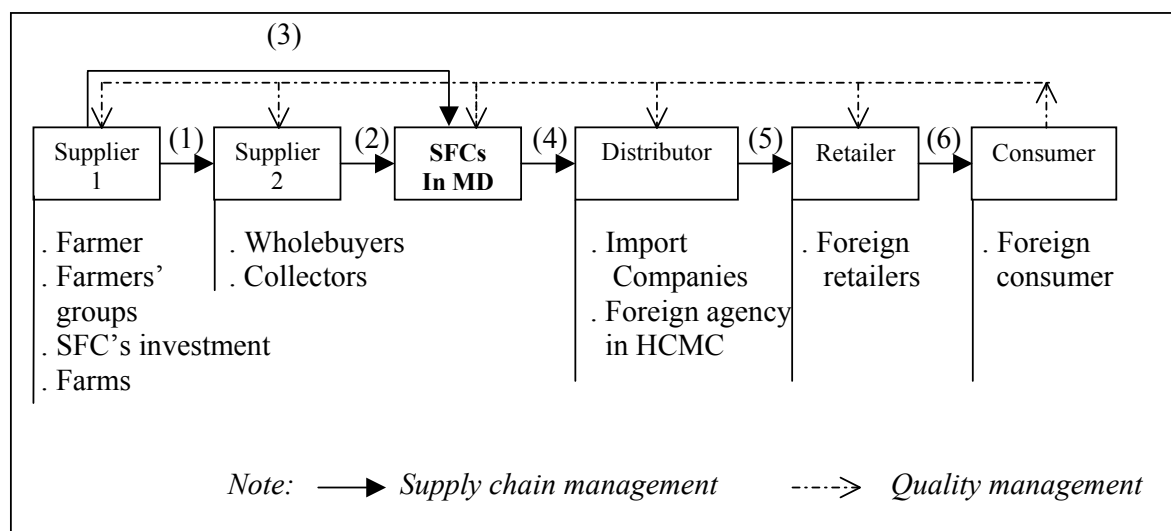
#### **4. Shrimp supply chain in the MD**

The following figure shows the SFC's supply chain in the MD. Actually, approximately 17% of the total SFCs in the region have large scale in terms of capital and employees (more than 1500 employees per company).



Therefore, they can participate in quality control of their shrimp materials by investing capital and technicians or researchers to guide the farmers in production of safe products. In this case, the procedure of breeding shrimp is controlled strictly by the technicians/researchers and the officers from the companies in order to protect infections to shrimp products as well as shrimp products sold to other companies by the farmers. However, the companies have not also eliminated hazards completely from their products in this process because they lack modern equipment to discover the hazards on one hand, quality of shrimp products are also affected by quality of shrimp seed, banded residues in feed and veterinary on the other hand. Moreover, most of the SFCs in the region have small-medium sizes, they are not enough capital and equipment to invest to shrimp farms, so they could buy shrimp materials from sources of uncontrolled quality. As a result, they have had difficulty in making their final products meet import market quality standards on hygiene and safety.

**Figure A2.1:** The SFCs' supply chain quality management in the MD



Specifically, the figure A2.1 is explained as follows:

- (1) Supplier 1 includes both farmers who culture and capture shrimp. The supplier 2 is wholebuyers and collectors who directly buy raw shrimp from the supplier 1. Most of the raw shrimp are bought by this channel (approximately 90% of total shrimp production).
- (2) Supplier 2 sells raw shrimp to the SFCs.
- (3) Besides, supplier 1 who cultures shrimp, can directly supply raw shrimp to the SFCs if their farm is located near the companies. Specially, some companies having suitable conditions for developing their production capacity, are widening their investment into farming to assure a steady supply of raw shrimp with high quality.

On the supply side, there are many problems in terms of not purchasing at the right time and quality and fluctuation in price of raw shrimp (high competition with the SFCs from HCMC or other regions) because of uncertain supply – seasonal supply, grading standard, shrimp maintenance, storage, transportation, classification of shrimp material, cheating by the farmers, etc.

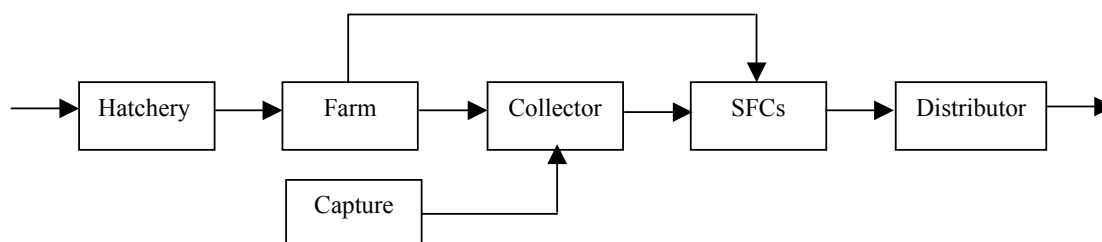
- (4) Almost all SFCs in the MD directly export their finished products to foreign import companies or foreign distributors, then agency distributors remark and re-export the products to other distributors or retailers, then to final consumers (stage 5 and 6).

In short, the quality of Vietnam's seafood products in general and shrimp products in particular is nowadays a great concern of the importers. The barriers on seafood safety and hygiene are very strict. Antibiotics (chloramphenicol, nitrofurantoin), micro-organisms (salmonella), and other contaminants (pieces of metal) have to be eliminated from the products. Therefore, to find ways of producing seafood product of high quality in order to meet international quality standards (ISO, HACCP, GMP, SSOP, SQF and BRC) is an urgent task of Fisheries Industry in general and the SFCs in particular today.

#### 4. Quality problems in supply chain of the MD's shrimp products

The shrimp supply chain is described generally in the figure 3. However, one of the quality problems in shrimp culture from shrimp seed is related to the life cycle of shrimp - from shrimp eggs in the hatchery, then to the farmers to grow and to the companies to process, and distribution. Figure A2.2 describes shrimp supply chain and its quality problems in details.

**Figure A2.2:** The shrimp chain in the MD



**4.1 Marine catch:** After raw shrimps are caught, they are maintained on boat offshore. The average time they are kept offshore is 5-7 days (minimum 3 days, maximum 15 days). Then they are bought by the collector/wholebuyer. The collector/wholebuyer sell them to the SFCs in one day only. Generally, shrimp from marine catch is seldom infected by micro organisms and antibiotic originally. However, they are still infected by the hazards because captured shrimp spend a lot of time from their capture in transport before getting onshore. The factors that can affect the original quality of raw shrimp are methods and techniques to maintain raw materials offshore as well as means to store in the process of transportation.

**4.2 Aquaculture:** There are many factors that affect shrimp quality in primary production. They are described below:

##### **Shrimp seed (SS):**

For the whole country, there were 2,757 shrimp hatcheries providing about 10.837 billion of SS in 2000. By the year 2002, shrimp hatcheries had been established and were operating in 27 of 29 coastal provinces in Vietnam. The number of hatcheries had risen to 4,774 and production of SS to 19.088 billion by 2002. The Central provinces from Quangnam to Baria-Vungtau played essential roles in both the number of hatcheries (72.6%) and the production of post larvae. Also in 2002, a total of 10,919 shrimp brood stock were imported from Singapore, China, Myanmar and Australia. From 2003 on, production of about 3 billion post larvae of this species is expected per year, of which 2 billion in the Central region, and 1 billion will be produced in the Mekong Delta (*Ministry of Fisheries, 2003*).

There were about 900 hatcheries in the MD which provided 3,877 million post larvae in 2002, but the number of SS only amounted to 18.9% of the total number of shrimp seed purchased by the shrimp grow-out farms in the MD. In addition, post larvae were imported from the Central region for nursing for several days in 1,312 nursery sites around the coastal areas of the region before being resold to the grow-out farmers. However, the management of post larvae quality and trading has not been improved. There is a lack of 'high-tech' checking methods and facilities in association with the problems caused by a special transportation network (*Ministry of Fisheries, 2000-2003*). Specifically, approximately 40-45% of the total SS are obtained from free source without any quality control. Moreover, the inspection method is very simple (based on perceptible-signal only). As a result, shrimp diseases are widespread (42.3%), such as fungal disease, white spot disease and MBV disease (*Penaeus Monodon*-type Baculovirus disease). In order to prevent and cure the diseases, the farmers have used over 35 kinds of different antibiotics without control (*Sinh, 2001*). So far, this scenario is the same. Therefore, shrimp materials are easy to infect chemical residues that are not accepted by importers.

In short, quality problems of SS in the hatchery include:

- (1) **Pollution of water sources for hatcheries** caused by poor design and high density of the hatcheries, and sea water contaminated by pathogens, as well as discharge of systems without treatment from hatcheries and grow-out ponds and other activities of the community causing pollution.
- (2) **Pathogen infection:** after shrimp disease outbreaks, most of the shrimp seed was infected by *Monodon baculovirus* (MBV), white spot disease (WSD) and yellow head disease (YHD). In 2002, some 69.5% of the total number of hatcheries was infected with diseases. In detail, 52.2% of the total number of

hatcheries had the brood stock infected, and 53.9% of the total number of hatcheries had larvae infected. As well, these diseases infected about 27.6% of the total number of shrimp grow-out farms.

- (3) *Inappropriate application of chemicals and antibiotics*: Lack of suitable government regulations and a poor understanding by technicians about chemical and antibiotic use have led to an inappropriate use of antibiotics. This can damage not only shrimp health and water quality but also increases the resistance of pathogens to antibiotic drugs.
- (4) *Cheating in the marketing of shrimp post larvae* by shrimp seed producers and middlemen or nursery site owners occurs due to strong competitive pressures on the supply of shrimp seed, and a lack of information provided to the grow-out farmers about the shrimp seed. In addition, there are also difficulties related to transportation of shrimp.
- (5) *A rush to buy shrimp seed without sufficient care*. Because of a high demand for shrimp seed, a lot of grow-out farmers try to buy shrimp seed as soon as possible with not much concern about the size of shrimp and testing of quality.

**Culture techniques:** Quality problems in this aspect could be caused by

- (1) The level of water pollution is very high in the MD due to environment pollution and high intensive level of culture.
- (2) The farmers suffer very heavy cost for buying shrimp seed (39.4% of the total costs), shrimp food (19.9%) and the use of antibiotic to protect against and cure shrimp diseases (4.2%).
- (3) Food for bred shrimp in the MD is supplied by retailers. Therefore, the authorities do not concern themselves with food inspection. Besides, food for bred shrimp contains some banned antibiotics and various types of medicine for weight gain as ingredients.
- (4) Methods of control and management of the farmers: The farmers lack managerial and quality knowledge. These lead to free use of food and antibiotics for shrimp. As a result, shrimp materials are not clean and of good quality.
- (5) Harvest time: Food infection occurs frequently in Vietnam because the farmers do not know when they can harvest their products in order to have safe food after using pesticides or other chemistry or medicines. Particularly, shrimp culture needs a lot of food, antibiotics and other medicines, so timely harvesting to prevent pool pollution and infection as well is very important.

#### **5. Quality problems related to shrimp processing**

- Lack of control equipment to check shrimp materials and finished products: Almost all SFCs in Vietnam now lack equipment to test shrimp input (from suppliers) and shrimp finished products before exporting.
  - + *Processing time*: Total time from receiving shrimp materials to finished product (input-output process) lasts several days (shorter is better). Too long a time in the input-output process leads to reduction of shrimp weight and quality.
  - + *Processing technology*: Backward technology made for long processing time and reduced product quality (changing shrimp colour and decreasing shrimp weight). Moreover, it is easy to get into trouble with physical hazards with very old technology.
  - + *Simple processing techniques*: This is a very important stage for high quality of the products. In the processing procedure, shrimp materials are cleaned by hand in a wet environment. Chemical hazards may easily occur in this process, such as antibiotics that workers use to clean their hands, or to prevent or cure fungal diseases of their hands. Besides, unqualified and unskilful workers make for bad product quality.
  - + *Inventory time*: long inventory time leads to bad product quality – colour change, weight reduction, bad taste. Microbiological hazard (salmonella) may easily occur in conditions of bad facilities.
- Lack of practical knowledge and application of HACCP standards in food safety and hygiene from managers and workers: Almost all SFCs managers are trained in the principles of quality management, such as ISO, HACCP, SQF. But, it is not easy for them to pass this training on to their workers and to apply it in the right way because of the following reasons (focusing on HACCP standards):
  - + High investment cost for developing new technology
  - + Lack of knowledge and methods to identify and describe the hazards, find the critical control points, maintain documents for observation, and keep files as well as lack of knowhow for solving the hazards.
  - + Lack of standard conditions in manufacturing process such as required by e.g. GMP, SSOP, and BRC.

#### **6. Leadership**

Stemming from the result of data collection (*table A2.1*), top management themselves actively have participated in QC activities as well as improvement of quality management. Top managers are reported quality relevant issues by the quality control members. They involve decision making to all quality activities of the company, but they are not included in quality team. Besides, empowerment of the employees to solve

quality problems is rather limited because these things were only solved by responsible people. Regarding quality and yields, 78.1% of the companies have focused on product quality than yields.

**Table A2.1:** Leadership related to QM of interviewed companies

Statement	% of the answers
1. Top management actively participates in QM* activities	96.9
2. Top management learns quality-related concepts and skills	93.7
3. Top management strongly encourages employee involvement in QM activities	96.9
4. Top management empowers employees to solve quality problems	75.0
5. Top management arranges adequate resources for employee education and training	93.8
6. Top management discusses quality-related issues in top management meetings	93.8
7. Top management focuses on product quality rather than yields	78.1
8. Top management pursues long-term business success	96.9

### **7. Supplier quality management**

There was approximately 93.8% of the SFCs established long-term good relations with their suppliers and gave feedback on production of suppliers' shrimp. Nevertheless, 25% of them did not regard shrimp quality as the most important factor in selecting their suppliers - they concerned other relevant factors, such as management, reputation, loyalty, capital, knowledge as well as awareness. The limitations of the SFCs are that they were not informed about supplier's performance in details and did not audit suppliers' quality regularly.

### **8. Quality control and improvement in processes**

Almost all SFCs (96.9%) are kept neat and clean. Process capacity has met production requirements. Production equipment is well maintained to maintenance plan and implement various inspections effectively (e.g. process and final products).

### **9. Quality system improvement**

The quality standards that the SFCs followed are GMP (93.8%), SSOP (93.8%), TQM (6.2%), ISO (34.4%), SQF (31.3%), BRC (6.3%), and HACCP (96.9%). The TQM and ISO standards are applied to a few large companies because they have enough finance to cover the costs to apply, and BRC standard is very new for them. There is 87.5% of the answers showing that their quality systems are continuously being improved. They have a clear quality manual (90.7%), clear procedure documents (93.8%) and clear working instruction (93.8%).

### **10. Employee participation**

93.8% of the SFCs have cross-functional teams but only 72% of them has several QC circles (within one function). However, there is a small percentage of the employees actively involved in quality-related activities and their suggestions are concerned at an average level because of their education level and quality knowledge.

### **11. Education and training**

The interviewees mentioned that their employees are encouraged to accept education and training on quality management and specific work skills with free of charge. However, only a small percentage of them who were trained on how to use quality management tools because the companies want to focus on managers at each process.

### **12. Customer focus**

All of the interviewed companies have had extensive complaint information from the customers. Quality-related customer complaints are treated with top priority because they have provided warranty on their sold product to customers and have been customer focussed for a long time. However, the SFCs could not conduct a customer survey every year as well as market research in order to collect suggestions for improving the products due to financial situation. They have received customer's information from the agencies, importers who orders the shrimp products. As a result, the companies embarrassed in production and processing related to quality to meet customer's satisfaction when they change their consumption behaviour continuously.

### 13. HACCP procedure and implementation at the SFCs

Almost all companies in the MD (96.9%) established an HACCP team. According to organizational structure of each company, the team includes a QC specialist (78.1%), a production specialist (71.9%), an engineer (71.9%), a member of the management (43.8%), and one of other specialists (buyers, operators, packaging experts, distribution experts, hygiene manager). Responsibility of the team is describing of the product and its distribution, such as composition and physical features of final product (87.5%), process information (production methods used – 81.3%), method of packaging (78.1%), required shelf life (87.5%), storage and distribution conditions along the chain (81.3%), legislative product requirements (71.9%), and instructions for use and storage by consumers (68.8%). Besides, only 10% of the SFCs have identified intended use and customers.

In addition, there is approximately 87.5% of the companies that have developed process flow diagrams. They have saved typical data to draw the diagrams on internal computer system. The data included (1) all raw materials/ingredients and packaging used (65.6%), (2) time/temperature history of the chain (71.9%), (3) process conditions (68.8%), (4) storage and distribution conditions (68.8%), (5) product loops for recycling or rework (37.5%), (6) routes of potential cross-contamination (62.5%), (7) high/low risk area segregation (62.5%), (8) overview of floors and layout of equipment (62.5%), (9) features of equipment design (46.9%), (10) efficacy of cleaning and disinfection procedures (65.6%), (11) personal hygiene practices (75.0%), and (12) consumer-use instructions (65.6%). However, there is only 87.5% of the SFCs that have inspected the process and verified the flow diagrams.

#### **Determination of Critical Control Points (CCPs)**

The CCP that 71.9% of the SFCs have concerned the most is input shrimp materials. Next is shrimp processing (59.4%), and packaging process (56.3%). The reasons for determining CCPs are the hazards have often occurred at these processes. In addition, the companies have also established critical limits for these CCPs – 71.9% of the SFCs have established critical limit to control microbiological hazard. Similarly 84.4% and 81.3% for chemical and physical limits, respectively. However, the companies have established their procedures to monitor critical limits simply – They did not have clear procedures in the contents “what to monitor? why to monitor?, how to monitor?, where to monitor? who monitors? and when to monitor?”. Especially, these procedures are only managed by a quality controller. As a result, corrective actions after monitoring were only concentrated in some main processes. These are only completed in large companies where have enough conditions for applying quality systems.

**Table A2.2:** The percentage of SFCs determined CCPs

Contents	% the SFCs determined CCPs
1. Purchase of raw materials	71.9
2. Shrimp material receiving and handling	43.8
3. Shrimp processing	59.4
4. Packaging	56.3
5. Storage	18.8
6. Distribution	3.10

Moreover, most of interviewed companies have established effective record keeping systems, such as CCP records (96.9%), critical limit records (96.9%), records associated with deviations (90.6%), records and verification (100%), records review and retention (90.6%), and regulatory access (93.8%). Particularly, establishing procedures for verification that HACCP system working correctly has depended on each SFC's conditions. The results of the interviews showed that 81.3% the SFCs have applied prevention procedure, CCP verification (87.5%), and HACCP program verification (87.5%). Beside HACCP standard, 93.8% of the companies have applied at good level of GMP, SSOP. However, other quality standards such as TQM, ISO, SQF and BRC have a low percentage of good implementation at the SFCs with only 6.2%, 34.4%, 31.3% and 6.3%, respectively.

## Appendix 3:

### **APPLICATION OF HACCP IN THE SEAFOOD COMPANIES IN THE MD**

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#### **I. Before applying HACCP**

##### **1. Prerequisite programmes**

According to the revised document of NACMCF (1998), an HACCP system should be built on a solid foundation of prerequisite programmes. These programmes are often accomplished through application of e.g. Good Manufacturing Practice codes (GMP) or Food Hygiene codes (FH). These programmes should provide basic environment and operating conditions that are necessary for the production of safe, wholesome food. Prerequisite programmes include facilities, cleaning and sanitation programme, training, traceability and recall and pest control. All these prerequisite programmes must be documented or audited on a regular basis. In fact, almost all SFCs in the MD have performed prerequisite programmes (GMP, SSOP, SQF) with different levels depending on each company's conditions in order to ensure enough conditions to apply HACCP.

##### **2. Training and education**

The success of the HACCP system depends greatly on a proper understanding of the HACCP principles by both management and employees. Therefore, education and training on the importance of HACCP, the role of people in producing safe food, and how to control food borne hazards in all production stages is required (Barendsz, 1994; Codex Alimentarius, 1997; and NACMCF, 1998).

In Vietnam, training and education have been a concern for the Vietnamese government and Ministry of Fisheries. They have organized many training courses on the prerequisite programmes and HACCP principles and procedures for SFCs' leaders for free. Moreover, the VASEP and the NAFIQACENT, who cooperate with foreign quality organizations, are responsible for organizing and helping the SFCs to train their top managers with cost, especially training and guidance for quality controllers on the HACCP programmes, anytime they need. But, the SFC's employees are not supported by these organizations on quality training. The SFCs themselves retrain their employees. In fact, the employees have a limited understanding and awareness on the HACCP and other quality standards.

##### **3. Management, organization and human resource**

*Management* is a broad concept that encompasses activities such as planning and control, organizing as well as leading. Leadership, on the other hand, is focused almost exclusively on the "people" aspects of getting a job done, i.e. inspiring, motivating, directing, and gaining commitment to organizational activities and goals. Leadership accompanies and complements the other management functions, but it is more concerned with coping with the dynamic, ever-changing market place, rapid technological innovation, increased foreign competition and other fluctuating market forces. In short, management influences the brains, while leadership influences the heart and the spirit (Gatewood, 1995).

*Motivation* is the inner state that causes an individual to behave in a way that ensures the accomplishment of some goals. In other words, motivation explains why people act as they do. The better the manager understands the behaviour of organization members, the more able the manager will be to influence their behaviour to make it more consistent with the accomplishment of organizational objectives. Since performance is the result of the behaviour of organization members, motivating them is a key to reaching organizational goals.

*Organization* is a process of arranging people and other resources to work together in order to accomplish a goal. Organizing involves creating a division of labour, assign tasks to be performed and then co-ordinating the results to achieve the common purpose (Schermerhorn, 1999). An organization is a collection of people working together to achieve a common purpose. People are coming into action when they have decided about objectives and ways to accomplish them. Organizing creates conditions for these decision-making processes in terms of:

- People: it includes attracting, developing and maintaining a quality workforce
- Information: it involves ensuring information at the right moment and place
- System: it comprises providing resources to collect, organize and distribute data for decision support
- Organization structure: it includes defining tasks, responsibilities and authorities, rules and procedures

Today it is generally recognized that there are two prerequisites for a “quality organization”. The first is a quality attitude that is spread through the entire organization. Quality is not just a special activity supervised by a high-ranking quality director. The second prerequisite is an organizational structure to support this attitude. People must be aware of the importance of quality and they must be trained to accomplish the necessary tasks (Ross, 1999). In one sentence: the organization is a condition for quality behaviour.

*Human resource* in quality management is very important. For instance, how the company enables to employees to develop and utilize their full potential, aligned with the company's objectives. In human resource management much attention is paid to work systems; education, training and development; and employee well-being and satisfaction.

*Information* is critical enabler for quality management. More and more successful companies agree that information technology and information systems serve as keys to their quality success. Three categories of information are mentioned to be critical for quality management: (1) *Operational information* with emphasis on process management, action plans and performance improvement; (2) *Comparative information* related to comparative position and best practices, both having an operational and strategic value; and (3) *Information* that relates to process management and to business performance providing insight in cause/effect relationships (Ross, 1999).

Information technology has many effects, including improving performance and affecting organizational structure. It helps firms to retrieve information faster and more conveniently, which serve decision-making.

*Organizational structure* is a formal system of relationships that both separates and integrates tasks. Separation of duties makes it clear who should do what. Integration of duties tells people how they should work together. The SFC's organizational structure in Vietnam is a functional structure. Members of functional departments share technical expertise, interests and responsibilities. Major advantages of the functional structure include efficient use of functional resources and high-quality technical problem solving capacity, but major drawbacks are a lack of communication and co-ordination between different functions and loss of the total system perspective.

Last but not least, for a successful implementation of an HACCP system, management must be committed to the HACCP approach and indicate awareness of the benefits and costs of HACCP (NACMCF, 1998). Furthermore, in order to perform the HACCP study, management must provide necessary team members for a number of periods and financial support. In addition, Barendsz (1994) mentioned that priority for implementing HACCP, quality policy and objectives, as part of the companies' policy, should be clearly established.

So far, the SFCs in the MD have not successfully implemented the HACCP system yet because they lack financial conditions as well as specialists to implement sufficiently the HACCP system. Their employees have only followed top-down decision making and are not responsible for finished product quality. They lack quality awareness and management due to low education. Moreover, there is not any regularly trained leader included in HACCP team. Although the SFCs' leaders understand the importance of the HACCP standard for their products sold in foreign markets, they lack awareness of the benefits and costs of HACCP.

## **II. The 12-stages procedure for the development and introduction of an HACCP plan**

Several articles have been published, which describe the HACCP principles and procedures for development and implementation of an HACCP plan (ICMSF, 1989; MFSCNFPA, 1993a,b; European Commission, 1996; Codex Alimentarius, 1997; Early, 1997; Leaper, 1997; NACMCF, 1992, 1998). An HACCP plan is the written document that is based on the principles of HACCP and that delineates procedures to be followed. The HACCP system is defined as the result of the implementation of the HACCP plan. Furthermore, the HACCP as a systematic approach to the identification, evaluation and control in food manufacturing that are critical for product safety. It is also an analytical tool that enables management to introduce and maintain a cost-effective, ongoing food safety programme. The basic objectives of the HACCP concept are assuring the production of safe food products by prevention instead of by quality inspection (Leaper, 1997; NACMCF, 1998). Furthermore, HACCP is basically designed for application in all parts of agro-food production, ranging from growing, harvesting, processing, manufacturing, distribution and merchandising, to preparing food for consumption (NACMCF, 1998).

According to the survey results, almost all SFCs in the MD have not yet applied the HACCP programme sufficiently, but only applied some parts of the HACCP principles and procedures. Therefore, HACCP is mentioned in the research as a main subject for developing hygiene codes at the SFCs based on the HACCP principles and procedure.

- (1) Assembling the HACCP team
- (2) Describing the product and its distribution
- (3) Identifying intended use and the consumer
- (4) Developing a flow diagram
- (5) Verification of the flow diagram
- (6) Conducting a hazard analysis (*principle 1*)
- (7) Identifying CCPs (*principle 2*)
- (8) Establishing critical limits for each CCP (*principle 3*)
- (9) Establishing a monitoring system for each CCP (*principle 4*)
- (10) Establishing a corrective action plan (*principle 5*)
- (11) Establishing a verification procedure (*principle 6*)
- (12) Establishing record keeping and documentation (*principle 7*)

Several procedures, which facilitate the development and introduction of a HACCP plan, have been described. The Codex Alimentarius (1997) described a 12-stages procedure. Similar procedures have been proposed by Leaper (1997), Early (1997) and the National Advisory Committee on Microbiological Criteria for foods (NACMCF, 1998). The latter proposed some additional requirements, before applying HACCP. These requirements and the 12-stages procedure are explained below.

### **1. Assembling of an HACCP team**

An HACCP study requires multidisciplinary skills and all relevant departments involved in food production should be represented. This means individuals and specific knowledge and expertise appropriate to the product and process, but also people directly involved in daily activities, as they are familiar with variability and limitations of the process. The team should, at least, have the following constitution:

- A quality assurance/quality control specialist, who has knowledge on microbiological and/or chemical hazards and associated risks for the particular product group.
- A production specialist, who is responsible, or is closely involved with, the production process under study.
- An engineer, who has knowledge on hygienic design and engineering operation of process equipment under study.
- Other specialists can be added to the team, like buyers, operators, packaging experts, distribution experts, and a hygiene manager.
- A member of the management to ensure management commitment.

Often, in small and medium-sized enterprises like SFCs in the MD, not all expertise is available and it is recommended to involve external support or information to ensure that the team meets all required skills. In fact, each SFC in the MD has a department of quality control or a technical department. In general, members of the HACCP team are from this department, not from a combination of the others. In particular, top managers are not included in the team. As a result, there is a limitation of the multidisciplinary skills and all relevant departments involved in food production.

### **2. Description of the product and its distribution**

The team should make a full description of the product and its distribution. The description should include:

- Composition and physical features of the final product (pH, gas tension)
- Process information (e.g. production methods used)
- Method of packaging
- Required shelf life
- Storage and distribution conditions along the chain (e.g. frozen, refrigerated, shelf-stable)
- Legislative product requirements
- Instructions for use and storage by consumers

In case of the SFCs in the MD, almost all of them (96.9%) have teams who describe their products and distribution. This is a major step showing that the companies are doing their best. There is no complaint from the customers about what is relating to the description of products and the distribution so far. However, process information and information on the packaging method have not been described in details in the introductory brochures for the customers.

### **3. Identification of intended use and consumers**

To encompass any special considerations, the intended use of the product by consumers should be defined, e.g. is the product intended for special groups, which are putting higher demands on food safety, like babies or people with reduced resistance? Likewise, intended use should be established when applying HACCP in production. Particularly, the SFCs in the MD have focused on intended use of their products by customers in



each foreign market – frozen or value-added seafood products with hygiene and safety. The companies have recognized the customer's needs in terms of the intended use of the products through agencies, importers or customer's orders. However, the SFCs lack equipment to control the quality and inspect the hazards in production.

#### 4. Development of process flow diagrams

Prior to the actual hazard analysis, it is necessary to examine the production process thoroughly. Therefore, a process flow diagram must be drafted, which provides a unambiguous, simple outline of all steps involved in the process. There are no rules for preparing flow diagrams, except that each process step and the sequence of steps should be clearly outlined. In the process diagram, sufficient technical data for the study must be provided, such as all raw materials/ingredients and packaging used (including relevant microbiological, physical and/or chemical data); time/temperature, process conditions; storage and distribution conditions; efficacy of cleaning and disinfection procedures; personal hygiene practices. In fact, the SFCs in the MD have perfectly performed this step. They developed process diagrams with all the steps from receiving materials to packaging and storing finished products.

#### 5. On-site verification of the flow diagram

In case of an existing line, the HACCP team should inspect the operation process to verify that each step in the flow diagram is an accurate representation of the actual situation. Inspections of night- and weekend shifts should also be carried out. In case the analysis is being applied to the proposed line and verification will not be possible, the team must ensure that the flow diagram represents the most likely processing options. Actually, the companies in the MD have only focused on the process procedure diagram in general. However, the typical data to draw the diagrams on the internal computer system is limited, such as the data for all raw materials/ingredients and packaging used, time/temperature history of the chain, process conditions, storage and distribution conditions, product loops for recycling or rework, routes of potential cross-contamination, high/low risk area segregation, overview of floors and layout of equipment, features of equipment design, efficacy of cleaning and disinfection procedures, personal hygiene practices, and consumer-use instructions.

In addition, based on its scale, the company can organize two or three shifts per day and night. Each line is managed by a manager. After finishing the shift, managers of the lines have to write a report to the quality controller who inspects and observes the shift. But, the managers of the lines are people who have fisheries awareness but not quality awareness. Moreover, the flow diagram is seldom adjusted in the short term, except for changes in technology and production or product lines.

#### 6. Conducting of HACCP analysis *(principle 1 – potential hazards along the production chain must be identified and analyzed)*

In this stage the HACCP team must perform the hazard analysis. The result of this step is a list of significant hazards, which must be controlled in the process. Hazard analysis consists of hazard identification, hazard analysis (evaluation), and listing of relevant preventive measures. Practically, the SFCs in the MD have recognized microbiological, chemical and physical hazards and listed relevant preventive measures. Specifically, the following figure shows the hazards that can mix into shrimp materials and final products in the supply chain.

##### 6.1. Physical hazard

Hazard	Reason for infection	Harmful	Prevention method
Metal pieces	<ol style="list-style-type: none"> <li>1. From marine catch and culture process, storage and transportation process to the company.</li> <li>2. From processing tools and equipment.</li> <li>3. From cheating of the farmers and wholebuyers.</li> </ol>	- Prejudicing digestible system to human	<ol style="list-style-type: none"> <li>1. Shrimp material Suppliers' insurance</li> <li>2. Maintenance of processing tools and equipment.</li> <li>3. Using means to discover metal pieces</li> </ol>

## 6.2 Chemical hazard

Chemical hazards that can infect the shrimp product through the supply chain, are environment pollution, antibiotic residues, pesticides, various types of cleaning medicines, chemical substances for product maintenance, sterilization, adjuvant, etc.

Hazard	Reason for infection	Harmful	Prevention method
1. Residues of pesticides and antibiotics.	Shrimp materials catch and culture comes from polluted water.	- Causing Cancer - Prejudicing digestible system to humans	- Shrimp materials supplied of controlled area by authority or from loyal suppliers - Use of Elisa equipment to discover infections
2. Infection of sulfite	Use for maintaining shrimp materials	- Causing allergy	- Guarantee not to use sulfite of suppliers. - Use of test paper

## 6.3 Biological hazard

Shrimp products can be infected by chemical hazards, such as bacterium, virus, parasite and protozoan.

Hazard	Reason for infection	Harmful	Prevention method
1. Coliform, Staphylococusaureus, and E.coli	From shrimp food, water, and processing tools.	Prejudicing digestible system to humans	GMP*
2. Salmonella (SPP)	From water, and processing tools.	Causing typhoid	Cooking

In addition, other hazards related to shrimp quality are changes of shrimp colour, taste, smell, level of incorrect ingredients, worker's hairs and fly foots. According to the FDA (Food and Drug Authority) of the US, the companies, in order to have a successful HACCP programme, have to pay special attention to: (1) identifying and describing the hazards, (2) determining critical control points, (3) critical limits, (4) documents for observation and (5) keeping files. Companies can be approved to perform a HACCP plan when the three following aspects are done well – observing, keeping files and acting for solving the hazards.

Most SFCs in the MD have not built or planned sufficiently according to the above-mentioned five or three aspects to control the shrimp quality according to FDA indicators or the market requirements. The reasons for this are (1) high infrastructure investment costs – costs of improving processing technology, means and tools, costs of controlling quality, and costs of training. (2) Lack of suitable conditions to apply these standards (finance, management, qualified managers and workers, methods, professional equipment and means, and materials).

## 7. Determination of Critical Control Point (*principle 2 – CCP's must be identified, which must be monitored and avoid or minimize occurrence of hazards*)

A Critical Control Point (CCP) is a step (i.e. point, procedure, operation, or stage in the food production system) at which a control can be applied, and where control is essential to prevent or eliminate a food safety hazard or to reduce it to an acceptable level. CCP's are unique for each process at each facility. There is no such thing as a standard CCP returning in every food production process. There is no limit on the number of CCP's that may be identified in the flow diagram.

In practice, the SFCs in the MD have focused on six important points in the chain that are controlled. They are (1) buying raw materials, (2) material receiving and handling, (3) processing, (4) packaging, (5) storage and (6) before transporting to export. The hazards can easily occur during these steps. The companies have used different methods and points of time to observe, such as at the beginning of the shift, each block of the products, a period of time or frequency. Nevertheless, there is around 50% of the SFCs that determine above six CCPs and control them.

**8. Establishment of critical limits of each CCP** (*principle 3 –the hazards should be controlled at each CCP*)

Each CCP will have one or more preventive measures that must be controlled in order to assure prevention, elimination or reduction of hazards to an acceptable level. For each preventive measure, critical limits (target plus tolerances) must be established. Critical limits can be set by legal and/or other requirements, or can be based on information from hazard analysis or quantitative risk analysis.

The SFCs have established critical limits for the CCPs to control microbiological, chemical and physical hazards. These limits are based mainly on Vietnam's quality standards that resulted from internal hazard analyses provided by VASEP and NAFIQACEN, and external quality standards (quality requirements of import markets). In fact, the companies lack equipment and specialists who can control the critical limits.

**9. Establishment of a monitoring system for each CCP** (*principle 4 – surveillance systems for regular monitoring or observation of CCPs*)

Monitoring is the scheduled measurement or observation of a CCP relative to its critical limits. It is required to assess if the CCP is under control and to provide written documentation for verification. For monitoring purposes usually physical and chemical tests and visual inspection are applied. Microbiological testing is seldom an effective means of monitoring because of the time required to obtain results ((NACMCF, 1998).

Regarding procedure to observe and monitor critical limits, the SFCs in the MD have not clearly established monitoring procedures. For instance, there is no specialist who is responsible and monitors the critical limits. Other problems relate to what is monitored, why, how, where and when. As a result, monitoring data is not recorded sufficiently and frequently.

**10. Establishment of a corrective action plan** (*principle 5 – Corrective action must be established including measures which should be taken whenever an inadmissible deviation is recorded at CCPs* )

If monitoring data reveals that the process has deviated from the critical limit, then a corrective action must be taken. Actions must ensure that the CCP has been brought under control. The corrective action plan must provide information about which actions should be taken when the process exceeds critical limits, and who is responsible for implementation and recording of corrective actions.

From the results of step 7 to step 9, there are some main points in the processes that are controlled and monitored by the quality controller at the company. Most of the SFCs in the MD have no basically corrective action plan. When they discover something wrong, they will suggest adjustment and correct with given measures. Therefore, corrective action is still limited. However, there is approximately 18% of the SFCs in the MD (six of ten leading companies in seafood export in Vietnam) who have enough capacity to apply quality systems. They established critical limits and corrective action plans.

**11. Verification of the HACCP plan** (*principle 6 – verification procedures must be established for verification of functioning of the HACCP system* )

Verification is defined as those activities, other than monitoring, that determine validity of the HACCP plan and that the system is working according to plan (NACMCF, 1998). In fact, all relevant records and documentation from basic input for verification of the HACCP system must be established.

Establishing procedures for verification that the HACCP is working correctly, depends on the capabilities of each company. Of the SFCs in the MD, 87.5% have applied HACCP and also have HACCP programme verification – from prevention to finishing product testing, records and writing report. However, a big limit to all of the companies is that the verification is not done frequently and continuously.

**12. Establishment of record keeping and documentation** (*principle 7 – record keeping and documentation relating to the HACCP plan must be developed for effective management*)

Documentation and record keeping are essential for the HACCP system. The approved HACCP plan and HACCP procedures must be documented, whereas relevant data obtained during operation must be recorded. Examples of documentation are process flow diagrams, conductance of hazards and CCP analysis. Record examples include information about used ingredients, processing data, specifications of packaging materials, temperature records of storage and distribution, deviation and proceeded corrective action records and employee training records.

All of SFCs in the MD, that have applied the HACCP, established record keeping and documentation. Their record keeping and documentation relates to CCP records, critical limit records, records associated with deviations, records and verification, records review and retention and regulatory access. Because these are

not observed and monitored frequently and continuously, data in documents and record keeping are still updated little.

**Figure A1:** Shrimp problems in hatchery and farm productions

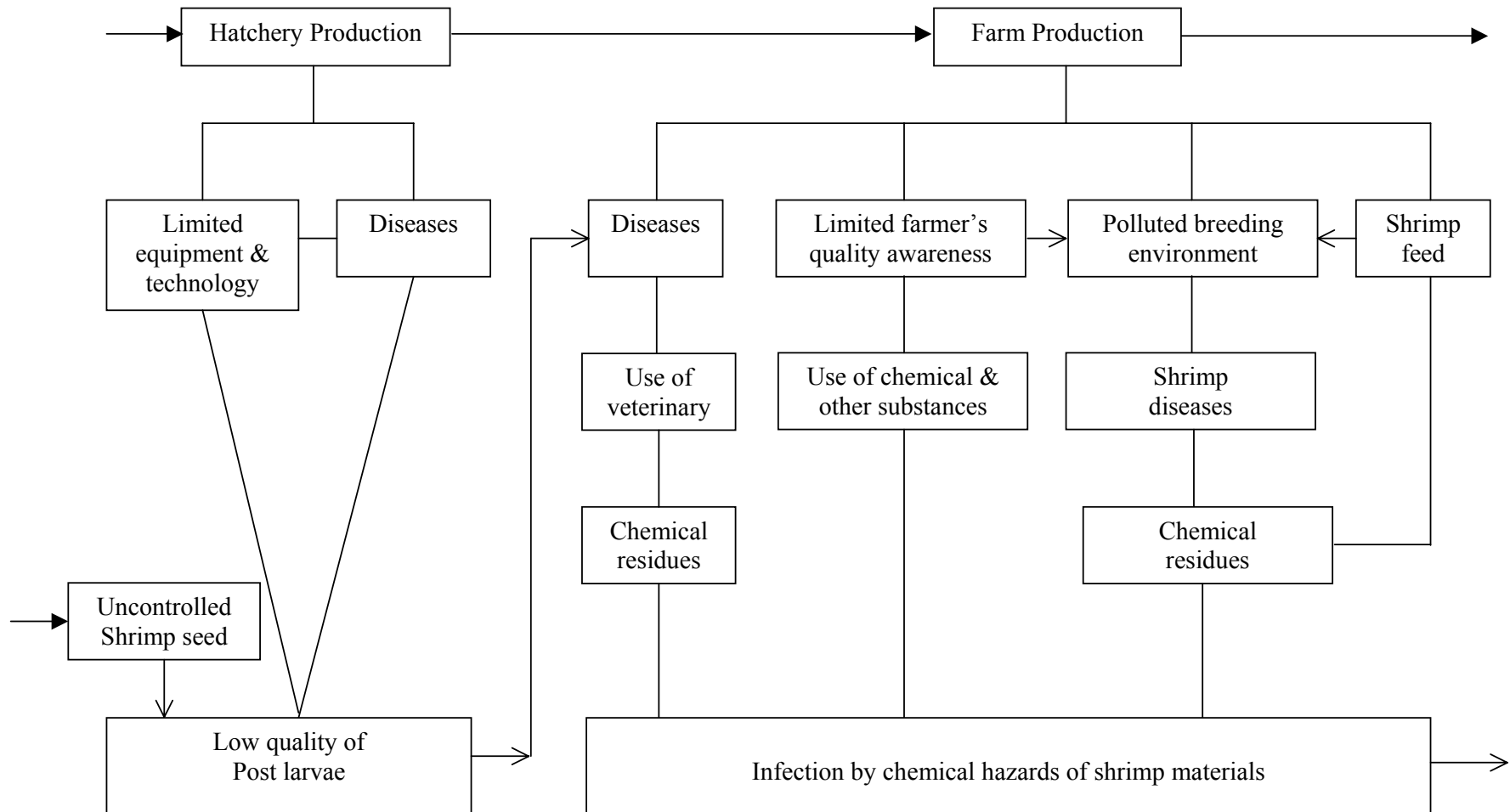


Figure A2: Shrimp problems in Collector stage

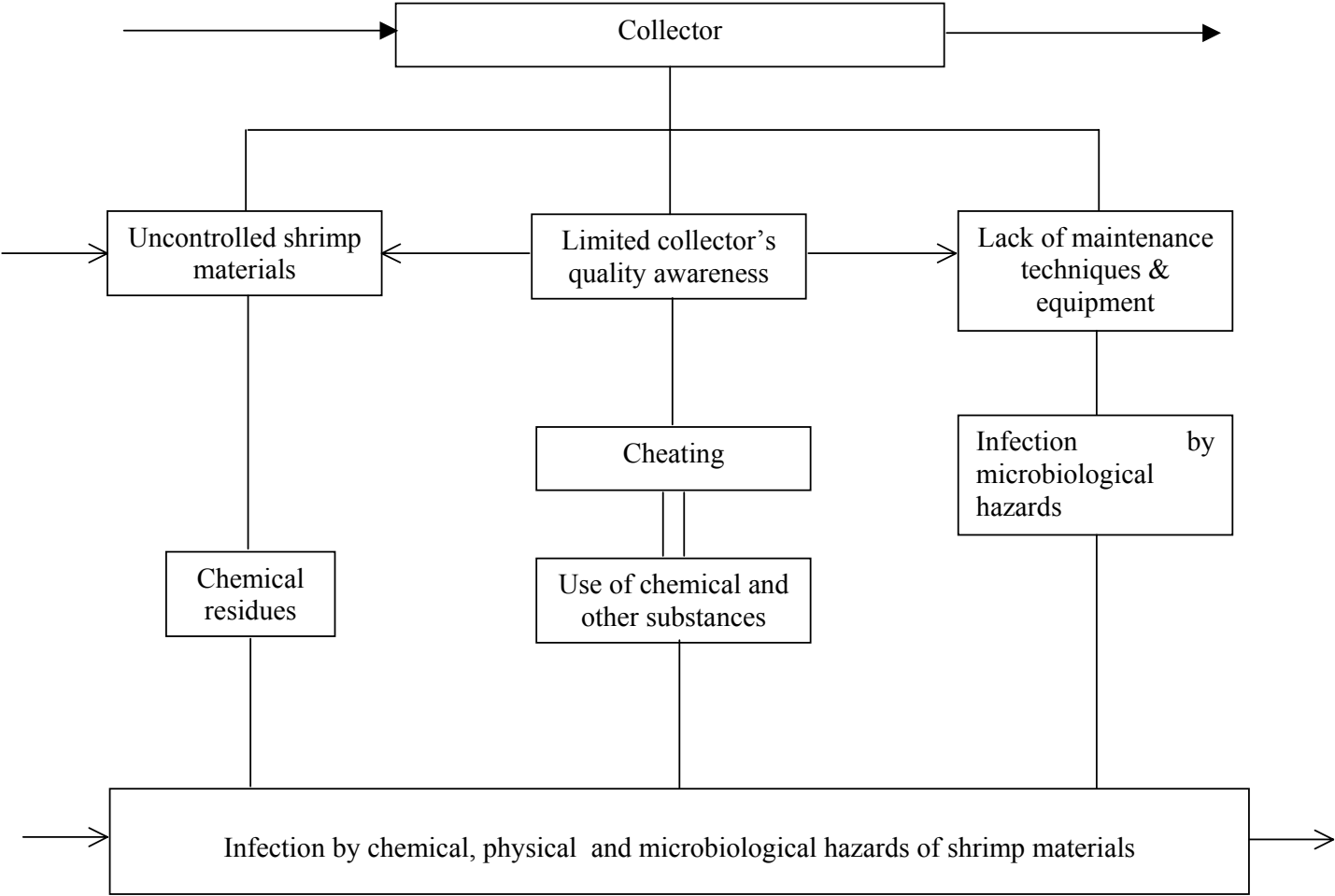
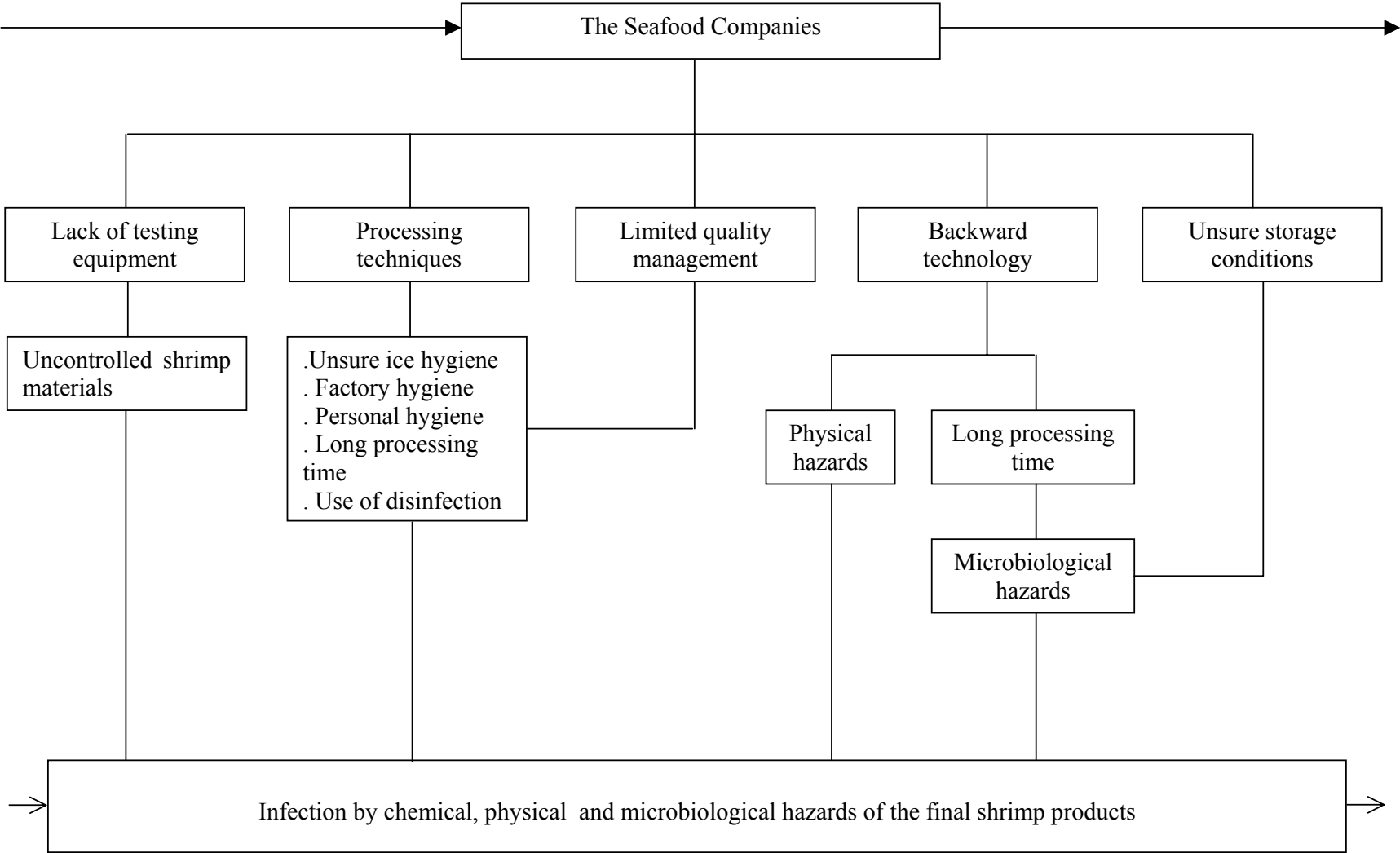


Figure A3: Shrimp problems in manufacturing process



**Figure A4:** Shrimp problems in Distribution stage

