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TOWARDS CERTIFICATION AND ECOLABELLING: A COMPLIANCE STUDY OF BANGLADESH SHRIMP AQUACULTURE

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ABSTARCT

Responding to increasing market demand for ecolabelled aquaculture product, many shrimp exporting countries have adopted certification for their shrimp aquaculture. Bangladesh is an important supplier of shrimp in the world market. The current situation of Bangladesh shrimp aquaculture was studied in comparison to market requirements and the minimum substantive criteria outlined in the FAO technical guidelines on the way forward to certification. The main issues were animal health and welfare, food safety and security, and environmental integrity and social responsibility. Being produced under extensive or improved extensive culture system, Bangladesh shrimp was found have potential to be ecolabelled though several shortcomings were found that should be addressed prior to certification drive. The most important development needed is the integration among different stakeholders of the coordinated planning and management of efforts. Land zoning to resolve conflict among land users and lessen impact on the environment, use of SPF shrimp in aquaculture, formation of groups or clusters of farms, hatchery and farms registration, responsible use of chemicals in hatcheries and farms, healthy and efficient post harvest handling of shrimp, enforcement of labour laws for welfare of the workers, gender equity among workers and strong and coordinated monitoring of implementation of all the relevant issues should be ensured. Considering the characteristics of an industry where most of the farms are small scale, it was suggested that government of Bangladesh could initiate the certification system and after a reasonable period of time an independent body could carry on the scheme.

Key words: Shrimp, aquaculture, certification, ecolabelling, animal welfare, food safety, environmental integrity, social responsibility.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Bagda	-	Brackish water shrimp, Black tiger shrimp
BAP	-	Better Aquaculture Practice
BBS	-	Bureau of Statistics
BMP	-	Better Management Practice
CBI	-	Centre for the Promotion of Imports from Developing Countries
COFI	-	Committee on Fisheries
DOF	-	Department of Fisheries
EEZ	-	Exclusive Economic Zone
EIA	-	Environmental Impact Assessment
EPA	-	Environmental Protection Agency
EPB	-	Export Promotion Bureau, Bangladesh
EU	-	European Union
FAO	-	Food and Agriculture Organisation of the United Nations
FAO-CCRF	-	FAO Code of Conduct for Responsible Fisheries
GAP	-	Good Aquaculture Practice
GDP	-	Gross Domestic Product
Golda	-	Giant Freshwater shrimp
ha	-	Hectare
HACCP	-	Hazard Analysis and Critical Control Point
ICZMP	-	Integrated Coastal Development Plan
IGO	-	International Non-governmental Organisation
ILO	-	International Labour Organisation
ISO	-	International Standards Organisation
MSC	-	Marine Stewardship Council
mt	-	Metric ton
NACA	-	Network for Aquaculture Centres in Asia and the Pacific
NGO	-	Non-governmental Organisation
PCR	-	Polymerase Chain Reaction
PL	-	Post Larvae
SSOP	-	Sanitation Standard Operating Procedure
SWOT	-	Strength Weakness opportunity and threat
UNCTAD	-	United Nations Conference on Trade and Development
UNEP	-	United Nations Environmental Programme
UNGA	-	United Nations General Assembly
UNIDO	-	United Nations Industrial Development Organization
UNU-FTP	-	United Nations University-Fisheries Training Program
USA	-	United States of America
USFDA	-	United States Food and Drug Administration
WHO	-	World Health Organisation
WSSV	-	White Spot Syndrome Virus
WTO	-	World Trade Organisation
WWF	-	World Wildlife Fund

1 INTRODUCTION

1.1 Background

Bangladesh is a fortunate country in terms of soil fertility and water resources. It is located in the North-Eastern part of South Asia between 20º34' and 26º36' north latitude and 88º01' and 92º41' east longitude. Its land fertility and favourable tropical climate made favourable conditions for the production of various crops and thus the economy is based on agriculture.

The diverse water resources led to fisheries being an important sector of the Bangladeshi economy. Bangladesh has many inland fresh water resources including hundreds of interconnected rivers and canals, oxbow lakes, lakes, reservoirs and seasonal flood-plains covering over 4.0 million ha (Table 1). These open, semi-closed or seasonal fresh water resources provide suitable habitats for numerous wild fish and shellfish species. Bangladesh also has large marine and brackish water resources including coastal plains, tidal flats, estuaries and inshore and offshore waters extending 714 km to the Bay of Bengal and an Exclusive Economic Zone (EEZ) of 164,000 sq km which is not largely exploited yet (DoF, 2007). The coastal zone features several natural mangrove forest ecosystems (eg. world famous Sundarbans mangrove) that support rich aquatic biodiversity.

Table 1: Fisheries resources of Bangladesh and production during the period July 2006-June 2007 (DoF, 2008b).

Resources		**Water area (ha)**	**Production in metric tonnes (mt)**	**(%) Total production**
Inland Capture Fisheries	River and estuaries (with Sunderbans canals)	1,031,563	154,709	
	Beels (large reservoirs)	114,161	75,137	
	Kaptai lake	68,800	8,085	
	Flood plain (Seasonal water area)	2,832,792	768,830	
	Sub-total inland capture	4,047,316	1,006,761	41
Aquaculture	Ponds and ditches	305,025	811,954	
	Baor (oxbow lakes)	5,488	4,698	
	Shrimp farms	217,877	129,160	
	Sub-total aquaculture	528,390	945,812	39
	Inland fisheries & Aquaculture total	4,575,706	1,952,573	80
Marine capture fisheries	Industrial Fisheries (Trawl)		35,391	
	Artisanal Fisheries		452,047	
	Sub-total Marine capture		487,438	20
	Country Total		2,440,011	100%

Fisheries play a vital role in food supply, employment and foreign exchange earning of Bangladesh. It is one of the most productive and dynamic sectors in Bangladesh. About 1.2 million people are directly and 12 million people are indirectly involved in fisheries and aquaculture of Bangladesh. In the fiscal year 2007–2008 this sector contributed 60% of animal protein to the 142 million Bangladeshi citizens and 4.8% of total GDP of the country (BBS 2008).

Bangladeshi fisheries and aquaculture are characterized by high species diversity. There are 260 freshwater and 475 marine fish species, 25 prawn and 36 shrimp species, 4 species of

lobsters, several species of cephalopods, marine mammals and other wildlife species found in Bangladeshi waters. Among them are more than 100 commercially important species. The marine fin fishes include more than 70 pelagic species. Most of them still remain underexploited due to lack of skilled manpower, modern fishing vessels and gears. (DoF 2007 and DoF 2008b).

Aquaculture has been the main fish production activity for several years. Fish production from aquaculture is increasing every year and contributes 40-50% of total production (Figure 1). Carps, catfishes and shrimps are the major groups of species in aquaculture.

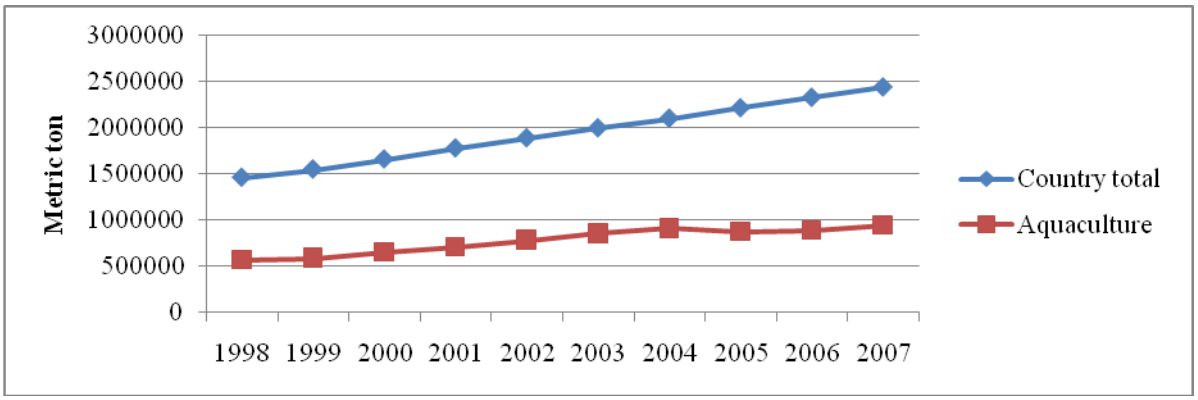

Figure 1: Contribution of aquaculture to national fisheries production (1998-2007)

Bangladesh has emerged as an important country in the aquaculture industry and is a key player in providing shrimp for the global market. Bangladesh has been ranked as one of the top ten countries for aquaculture production (Table 2). In the fiscal year 2006–07, the overall fisheries production of Bangladesh was 2.44 million metric tonnes (mt) of fish and shrimp, of which 0.95 million mt or 39% came from aquaculture (DOF 2008a).

Table 2: Top ten aquaculture countries of the world 2001–2006 (FAO FishStat plus)

Serial no.	Country	Annual aquaculture production (metric tonnes)					
		2001	2002	2003	2004	2005	2006
1	China	34,209,551	36,576,341	38,688,059	41,329,608	43,270,852	45,296,567
2	India	2,119,839	2,187,189	2,312,971	2,799,304	2,966,646	3,127,803
3	Indonesia	1,076,749	1,137,151	1,228,559	1,468,612	2,124,093	2,219,883
4	Philippines	1,220,456	1,338,394	1,448,504	1,717,028	1,895,848	2,092,274
5	Viet Nam	608,098	728,041	967,502	1,228,617	1,467,300	1,687,727
6	Thailand	814,121	954,696	1,064,409	1,259,983	1,304,213	1,385,801
7	Korea Republic	668,022	794,340	839,845	952,856	1,057,725	1,279,163
8	Japan	1,311,394	1,384,666	1,301,578	1,260,810	1,253,963	1,223,953
9	Bangladesh	712,640	786,604	856,956	914,752	882,091	892,049
10	Chile	631,634	617,303	603,485	685,135	713,706	835,996

Shrimp is one of the most important commodities traded globally. In 2004, 2005 and 2006 the global trade amounted to 1531, 1636 and 1596 thousand mt, respectively. The principal shrimp exporting countries are Thailand, India, Vietnam, Indonesia, Denmark, Ecuador, Canada and Greenland (Table 3).

Table 3: Top 15 Shrimp exporting countries and their shares in 2004–2006 (FAO FishStat Plus).

Position	Country	2004	% of world export	2005	% of world export	2006	% of world export
1	Thailand	116,774	7.62	150,611	9.20	163,735	10.25
2	India	146,731	9.58	165,834	10.13	144,198	9.03
3	Indonesia	114,059	7.45	121,328	7.41	135,388	8.48
4	Viet Nam	168,418	11.00	184,162	11.25	131,615	8.24
5	Denmark	112,248	7.33	120,820	7.38	120,709	7.56
6	Ecuador	65,631	4.28	89,563	5.47	117,277	7.35
7	Canada	76,628	5.00	76,336	4.66	82,929	5.19
8	Greenland	54,228	3.54	59,641	3.64	52,107	3.26
9	Bangladesh	39,861	2.60	43,848	2.68	51,705	3.24
10	China	90,584	5.91	72,298	4.42	41,999	2.63
11	Malaysia	42,521	2.78	48,440	2.96	40,485	2.54
12	Belgium	29,660	1.94	31,818	1.94	39,724	2.49
13	Argentina	27,506	1.80	6,955	0.42	39,152	2.45
14	Mexico	30,640	2.00	28,798	1.76	36,791	2.30
15	Brazil	54,358	3.55	44,646	2.73	33,915	2.12
16	Others	361,921	23.63	391,397	23.92	364,926	22.86
	Total	1,531,768	100	1,636,495	100	1,596,655	100.00

Shrimp is the second most important export commodity for the Bangladeshi economy. Bangladesh shrimp export represented 4.2% of the value and 3.24% of volume of global frozen shrimp export in 2006 (FAO 2008a). In the fiscal year 2007–08, Bangladesh earned US$534 million from exporting 53 thousand mt of shrimp (EPB 2008, DoF 2008a). In the fiscal year 2006–07, total shrimp production was 221 thousand mt of which 87 thousand mt were produced by aquaculture. The export of shrimp product increased significantly every year from 2001–2006 (Figure 2).

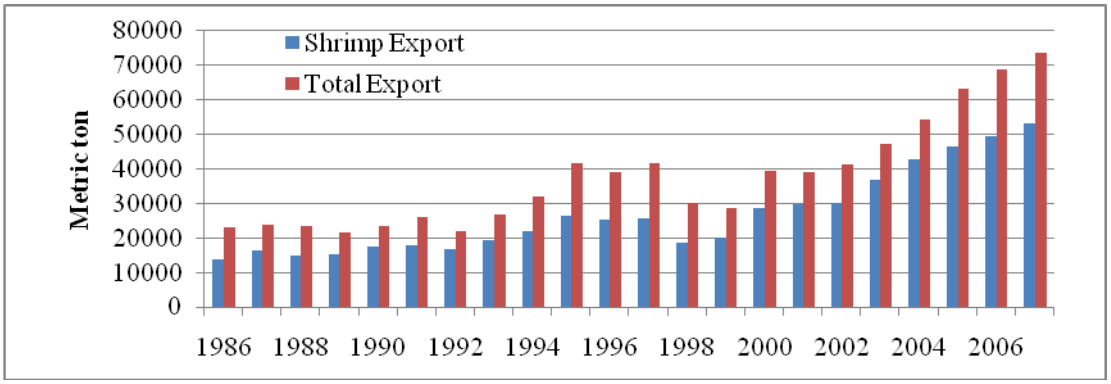

Figure 2: Shrimp export from Bangladesh compared with total exports of fisheries products (1986-2007).

The quality of Bangladeshi shrimp is very good in terms of size, colour, and muscle texture. The demand for this shrimp in the international market is very high (PDO-ICZMP 2003,

Alam *et al.* 2005). Still, there exists price variation among the products of same grade and species on the global market based on the country of origin. Bangladeshi shrimp is reported to be less valuable than the same grade product from other countries (Table 4).

Table 4: Price variation of penaed shrimp observed in USA market. The price of same grade shrimp differs according to its origin of production. Shrimp from Bangladesh is sold at a lower price than shrimp from Vietnam, India or Thailand. (Anderson *et al*. 2005)

Size (Shrimp counts/Lbs.)	**Price (US$/Lb.)**			
	Thailand	Bangladesh	Vietnam	India
13/15	-	6.1	6.4	6.25
16/20	6.15	5.7	5.9	5.8
21/25	5.35	4.7	4.95	4.8
26/30	4.8	4.55	4.65	4.65
31/40	3.6	3.3	3.45	3.45

The price list of tiger shrimp *(Penaeus monodon)* of Triton Foods, an importer and seafood trader in southern California, USA, published on The Shrimp News International on 31 October, 2008 shows that the price of Bangladeshi shrimp is lower than that of Vietnam (Manfredi 2008) (Table 5).

Table 5: Price discrimination of Triton Foods, California, USA between tiger shrimps from Bangladesh and Vietnam (HLSO = Headless Shell-on. PTO = Peeled and Deveined, Tail-on).

Size (Shrimp counts/ Lb.)	**Price (US$/Lb.)**			
	HLSO Vietnam	HLSO Bangladesh	PTO Vietnam	PTO Bangladesh
8/12	7.95	7.85	9.30	
13/15	6.10	5.95	7.10	
16/20	4.95	4.65	5.60	
21/25	3.95	3.50	4.70	4.45

The price inequity of Bangladeshi shrimp as compared to shrimp from other countries may be due to weak marketing strategies and the negative image that Bangladeshi shrimp aquaculture may not be environmentally sustainable. The culture system is still extensive with very little inputs (eg. supplementary feed) used in few cases so the shrimp is a nearly natural product. During the 1990's several national and international media sources, a few researchers and non-government organizations asserted that Bangladeshi shrimp farms destroyed mangrove forests, degraded natural habitat of fish and other aquatic fauna, and threatened biodiversity (Deb, 1998). There were conflicts between the rice farmers and shrimp growers regarding the use of land as rice field or shrimp ponds. Subsequently, the EU imposed a ban on importing shrimp from Bangladesh in 1997. To overcome the disaster in the shrimp farming sector and to comply with EU demands, Bangladesh adopted several measures immediately after the ban in order to rebuild trust in the EU. This was successful and after five months the ban was lifted, upon satisfactory progress in the safety and quality assurance system.

Since the improvement drive started soon after the ban of 1997, the total process, planning and strategies have been developed in such a way that there was no serious deviation reported by the EU and the USA for the last 10 years. Bangladeshi shrimp farmers are now

implementing the accepted HACCP method throughout processing; traceability of product through the aquaculture operation, and they have facilitated quality assurance by having modern instruments installed in quality control laboratories. Many social problems also have been overcome (Alam *et al.* 2005). But still there are claims of discrimination against women workers, use of child labour, and some other health, environmental and social issues. Antibiotics and pesticide residues are also found in some shrimp products.

Consumers in the developed world are increasingly becoming more conscious about the environmental and social responsibility of production process as well as food quality and food safety. They want to know such details as the origin of the shrimp, the environments in which it was produced, who produced it, how safe it is, and if the harvesting and management process are detrimental to the environment. In fact, they want environmentally and socially responsible and safe products. The demand for environmentally friendly or ethical products was inspired by environmental groups and NGOs and governments are formulating rules regarding it. Recent legislation in both Europe and the USA require mandatory identification of the source of the product, in terms of whether it is from capture or aquaculture (FAO 2007b).

In recent years, many different types of products are coming to market that bear environmental labels that have indications of the production process and producer's environmental and social policies for the consumers. Certification and ecolabelling was introduced to capture fisheries several years ago. A number of ecolabelling schemes are prevailing for marine fisheries management. The Marine Stewardship Council (MSC) is the pioneer scheme in fisheries management. It is likely that aquaculture producers have adapted to consumers concerns on environmental issues regarding aquaculture production. In several countries, aquaculture producers are introducing environmental certification and labelling of aquaculture products in order to assure the consumer that their production practices are environmentally and socially responsible. Some countries are attempting to introduce state-mediated certification procedures to certify that aquaculture products are safe to consume and farmed in accordance with certain environmental standards (FAO 2007b).

The major shrimp exporting countries like Thailand, Vietnam, India, Ecuador, Brazil, and China (Table 3) have introduced certification systems for their shrimp aquaculture. The Thai government introduced a certification system in 2004 and label their shrimp as Thai Quality Shrimp, the Brazilian Shrimp Farmers Association (ABCC) established a certification program in 2005 called the Integrated Program of Farmed Shrimp Certification (PICC). Vietnam has adopted a certification system called Global Aquaculture Alliance (GAA) and China has a certification and accreditation department that covers good aquaculture practice (GAP), HACCP, food safety and organic and green food (FAO 2007b).

It may be important for Bangladesh to develop a certification and labelling system for its shrimp aquaculture. This could help in several ways. For instance, it could create a fresh image to replace the negative one and it could also be instrumental in getting a competitive price and complying with new market trends. The development of a certification and labelling system would help in creating new market positions against the competitors in the international market and creating a sustainable resource base that could be used for years in an environmentally friendly manner.

The certification process needs to comply with the FAO Code of Conduct for Responsible Fisheries (FAO-CCRF), international principles for responsible shrimp culture developed by

FAO and other prevailing regulations regarding food safety, environmental and social sustainability (FAO 2008a). All these guiding documents are concerned with the environmental, ecological and social responsibility of fisheries and aquaculture operations. The recent and most related document is the Technical Guidelines for Aquaculture Certification developed by FAO and NACA. These guidelines describe the minimum substantial standard regarding animal health and welfare, food safety and quality, environmental integrity and social responsibility for aquaculture certification.

However, before Bangladesh decides on going for certification of shrimp aquaculture, it is necessary to analyze how its current aquaculture status complies with the requirements stated in the guiding documents for certification.

1.2 Scope of the study

The study is to analyse the prevailing status and conditions of shrimp aquaculture in Bangladesh considering socio-economic and environmental aspects. The scope of the study includes:

- Theoretical or philosophical overview of aquaculture certification.
- Overview of the international shrimp market, its requirements and trends.
- Understanding the acceptable standards for certification of aquaculture regarding aquatic animal health, quality and safety for human consumption, impacts on natural environment and social responsibilities.
- Analysis of the status of Bangladeshi shrimp aquaculture comparing it with the FAO standards.
- Put forward recommendations for Bangladesh.

1.3 Goal and Objectives

1.3.1 Goal of the study

To support the Bangladeshi government and private sector in planning and undertaking measures to mitigate the environmental, social and food safety related problems in shrimp farming and developing a certification and labelling system.

1.3.2 Objectives of the study

To analyse the real situation of shrimp aquaculture operations in Bangladesh in terms of aquatic animal health, quality and safety for human consumption, impacts on natural environment and social responsibilities for these operations.

To put forward recommendations that could be used as tool for the government, industry or individual farms to understand the ecological and social situation of Bangladesh shrimp aquaculture and undertaking measures the address the shortfalls and thus they could adopt certification and labelling system.

1.4 Rationale

The purpose of the study is supported by several international rules, conventions and guidelines. The FAO code of conduct for responsible fisheries, Agenda 21 and some

documents from the WTO, UNEP, and UNCTAD emphasised the environmental aspects of fisheries and aquaculture and such certification.

In Agenda 21, there is an agreement to encourage the expansion of environmental labelling and related product information programmes to inform consumers about the product and help them to make informed choices (UNGA 1992). Eco-labelling was one of the ten issues addressed by the Committee on Trade and Environment (CTE) on the WTO agenda of trade and development. The CTE was instructed to pay special attention to the issue of the effect of environmental measures on markets and ecolabelling in Doha Ministerial Declaration (WTO 2001).

Responding to the increasing awareness of consumers about environmental and social responsibility, many countries have adopted (or are in the process of adopting) ecolabelling for their products. The output of the present study may be used as a base for planning programmes in developing a certification system for shrimp aquaculture in Bangladesh.

2 MATERIALS AND METHODS

Information and data were collected mainly from secondary sources through review of books, reports, journal articles, government and private sector publications, internet etc. An open-ended questionnaire (Appendix 1) was developed to assess the present status of Bangladeshi shrimp aquaculture with the minimum substantial criteria for certification. The questionnaire was sent to several informants including the key personnel in the shrimp sector of Bangladesh: farmers, hatchery operator, government officer, researcher, NGO professional and anthropologist (Annexure 2). The respondents sent back the questionnaire through email. Information was also collected by interviewing the contact persons over telephone. Analysis of Bangladeshi shrimp aquaculture is done by SWOT analysis method.

3 OVERVIEW OF AQUACULTURE CERTIFICATION

3.1 Certification and registration

Certification is the act of assessing and verifying information to standards. It is the outcome of an assessment process that verifies and confirms that a product complies with the sustainability standard and a set of criteria established by the incentive program (Ward and Phillips 2008). Certification is a procedure through which assurance states that a product, process or service conforms to specified requirements or standards (Chaffe *et al.* 2003). The International Standards Organisation (ISO) uses the term registration, for example ISO (Quality assurance) and ISO (Environmental management).

Certification was first introduced in the USA by underwater laboratories in 1894. Now almost everything we use, from services to the food we eat, is certified. There are hundreds of certification programmes for everything we use or get around us (Chaffe *et al.*, 2003). Certification is mostly meant for quality and safety of the product or service.

Environmental certification started in 1978 with the foundation of the Blue Angel environmental labelling program in Germany. It was a government-sponsored ecolabelling programme on products of very wide range (FAO 2001, Philips *et al.* 2003, The Blue Angel

2008). Japan's Eco Mark is the second oldest ecolabelling program after the Blue Angel and was introduced in 1989. In 1998, the number of environmental certification programs was around 50 (EPA 1998).

Environmental labelling programs can be classified primarily as first-party or third-party certification. First-party labelling is performed by the owner himself to promote the positive environmental attributes of his products. Third-party verification is carried out by an independent agency or auditors. Certification can be further classified as positive, negative, or neutral. Positive labelling programs certify that the products possess one or more environmentally preferable attributes. Negative labelling warns consumers about the harmful or hazardous ingredients contained in the products. Neutral labelling programs simply summarize environmental information about products. Environmental labelling programs can be further classified as either mandatory or voluntary. Mandatory programs include hazard or warning labels, and information disclosure labels. Voluntary labels are typically positive or neutral (EPA 1998).

3.2 Certification as a market based incentive system

A certification award (or a label) indicates whether a product, process or service complies with certain standards, or was produced in compliance with a specific set of standards or regulations. Ecolabels inform buyers about the ecological and social impacts of the product during its life cycle. The purpose of environmental labelling is to help buyers to make a distinction between products based on the environmental implications that the product/service has (Figure 3). The ecolabel "translates complex scientific information into a simple message that can be understood by the consumer so that the consumer can choose a product that has minimum impact on the environment" (May *et al.* 2003).

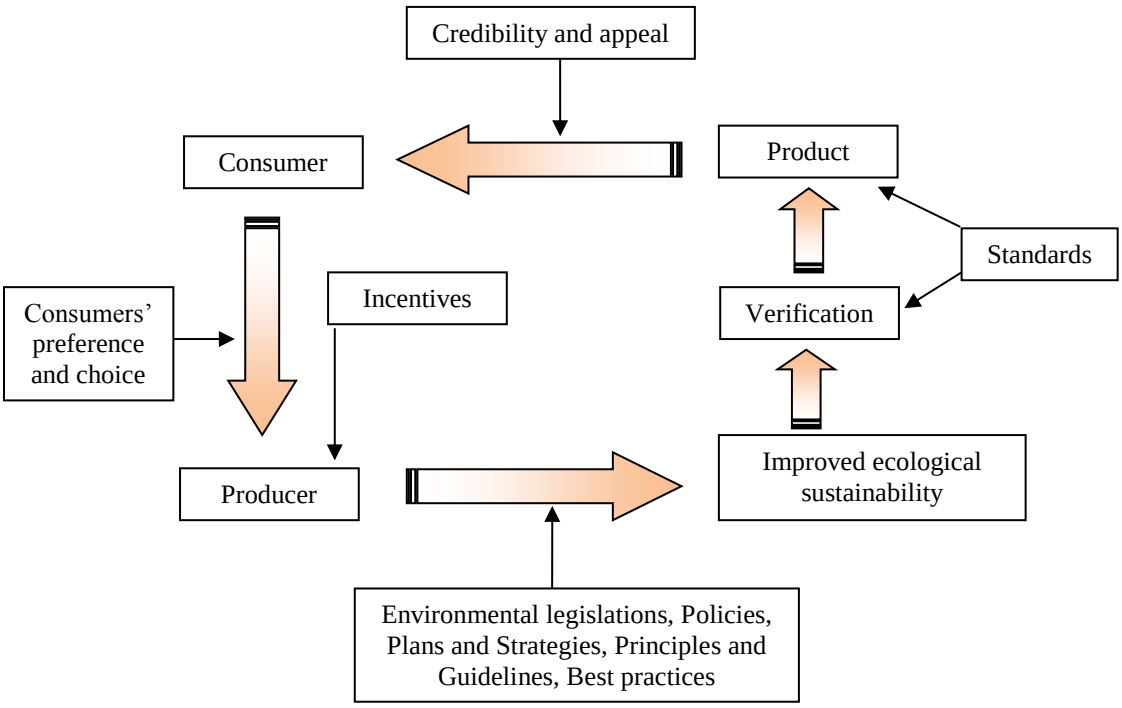

Figure 3: The market based incentive system for encouraging improved environmental practices and sustainability in aquaculture. The figure shows the main features of an ecolabelling or product recommendation system with the flow of the incentive to act and the supporting or modifying elements (Ward and Phillips 2008).

3.3 Certification Process

Certification is the result of an audit by an independent body which is not associated with producer or consumer. In the process of certification, various activities are involved such as the producer's declaration, association's assessment or governmental conformation (when association or government are involved). The overall certification process was characterised by Flavio *et al.* (2007) as follows:

First Party Certification. Producers or producer organizations report on their compliance to a set of standards.

Second Party Certification. Conformity assessment is performed by a person or organization e.g. traders, retailers or consumers and their organizations that has a user interest in the products.

Third Party Certification. An entity independent from both supplier and consumer organizations conducts the auditing based on certain environmental criteria or standards and issues certificates stating that a product or process complies with a specific set of criteria or standards.

Fourth Party Certification. The government or multinational agency issue additional certificates. The usage of this type of certification is very limited.

The Marine Stewardship Council (MSC), the first ecolabelling scheme for marine fisheries, follows the steps for certification shown below (May *et al.*, 2003):

Step 1: the client prepares a pre-assessment

Step 2: if the client wishes, a full assessment is then done

Step 3: the certifier prepares a draft scoring guideposts and indicators

Step 4: the certifier evaluates the fishery against the guideposts and indicators

Step 5: the draft report is peer reviewed and a determination is made by the certifier regarding whether or not a certificate should be issued

Step 6: prior to a final decision about whether or not a certificate should be issued, the determination may be subject to a formal objection

Step 7: once any and all objections have been fully considered a decision about whether or not to issue a certification is made.

3.4 Elements of Certification

The certification process involves four key elements: governance, accreditation, certification and standards (FAO 2008c). International principles and practices are also considered important elements of the certification process. The table below describes briefly the elements of certification.

Table 6: The elements of the certification process (FAO 2008c)

Element	Description
Governance	The certification scheme could be initiated by a government, an intergovernmental organization, a non-governmental organization, a private industry association or a consortium or partnership of one or more of these. The owner or must have a formal arrangement with a separate independent specialized accreditation body.
Accreditation body	An authoritative body that gives a formal recognition of competency of a certification body to carry out certification.
Certification body or Certifier	An independent body, usually a third-party other than the owner of the product or the consumer that conducts certification process. The certification body conducts assessment upon request from the aquaculture unit against the standards or criteria and recommends whether certificate will be issued or not.
Standards	Specific requirements set according to laws, regulations and principles. Standards provide the necessary requirements, the quantitative and qualitative criteria and the indicators. Standards can be either mandatory or voluntary. Mandatory standards are set by governments through rules and regulations. Voluntary standards are generally designed to specific farms or commodities based on quality aspects. For aquaculture certification it should address the issues of animal health and welfare, food safety and quality, environmental integrity and social responsibility.
Principles	Statements that describe the philosophical basis, for example, Codes of Conduct for Responsible Fisheries and International Principles for Responsible Shrimp Farming, Codex Alimentarius etc.
Practice	The principles are generally implemented through practices such as Better Management Practices (BMP), Good Aquaculture Practices (GAP) etc.

3.5 Codes and Principles Guiding Aquaculture Certification

Aquaculture certification schemes address the issues of animal health and welfare, food safety and quality, environmental integrity and social responsibility. Various documents are used as a reference while setting up standards for aquaculture certification. The main documents are described briefly below (Flavio *et al.* 2007, WWF 2007):

Table 7 : Examples of principles and codes of conduct relevant to aquaculture certification

Document	Description
FAO Code of Conduct for Responsible Fisheries	The CCRF was developed by the FAO in 1995. It is considered a fundamental framework for national and international efforts towards the sustainability of the fisheries and aquaculture sector. Article 9 and 11 describe the sustainable aquaculture development and certification matters (Annexure: 3).
International Principle for Responsible Fish Farming FAO, NACA, UNEP, WWF and World Bank	This document was developed in 2006 through a consortium formed by the FAO, NACA, UNEP, WWF and World Bank. The purpose of these principles is to provide guidance on the implementation of the FAO Code of Conduct for Responsible Fisheries in the shrimp aquaculture sector. It considers the technical, environmental, social and economic issues associated with shrimp farming and provides a basis for improving the overall sustainability of shrimp farming .There are eight principles within (i) site of farms, (ii) design and construction of farms, (iii) minimizing the impact of water use (iv) responsible use of broodstock and postlarvae, (v) efficient use of feeds and feed management, (vi) good health management, (vii) ensuring food safety and the quality of shrimp products, and (viii) social responsibility (FAO/NACA/UNEP/WWF 2006).
GAA Code of Good Practices	This Code of Good Practice was developed in 1999 by the Global Aquaculture Alliance (GAA) based on the FAO Code of Conduct. It has been further developed in recent years. It serves as the basis for th e Good Aquaculture Practices (GAP) certification scheme of the Aquaculture Certification Council (ACC).
FEAP Code of Conduct for European Aquaculture	This code of conduct was developed by FEAP (Federation of European Aquaculture Producers) in 1999. The objective was to promote the responsible development and management of the European aquaculture sector in order to assure production of a high standard of quality food addressing environmental considerations and consumers' demands (Consensus, 2008).
Codex Alimentarius	The Codex Alimentarius is a collection of food safety standards, codes of practice, guidelines and other recommendations developed under the guidance of the Codex Alimentarius Commission. Codex provisions concern the hygienic and nutritional quality of food, including microorganisms, pesticides and veterinary drug residues, contaminants, labelling and presentation, and methods of sampling and risk analysis. There are about 200 Codex Standards, of which several are applicable to fisheries commodities, and over 100 other documents including Codes of Practice and guidelines.
ISEAL Code of Good practice	The ISEAL (International Social and Environmental Accreditation and Labelling Alliance) Code of Good Practice is the international reference for setting credible voluntary social and environmental standards. It is referenced by a range of governmental and inter-governmental guidelines as the measure of credibility for voluntary social and environmental standards.
FAO Guidelines for Ecolabelling of Fish and Fishery Products from Marine Capture Fisheries	The guidelines are applicable to ecolabelling schemes that certify marine fisheries. The guidelines refer to principles, general considerations and minimum substantive requirements and procedural and institutional aspects of ecolabelling schemes.
FAO Guidelines for Aquaculture certification	Recently, the FAO in collaboration with NACA (Network for Aquaculture Centres in Asia and the Pacific) has developed the guidelines for aquaculture certification. The guidelines describe governance process and principles, general considerations and minimum substantive requirements for setting standards for certification schemes.
The UN Global Compact Principles	The UN Global Compact has set principles to promote issues of human rights, labour standards, the environment and corruption. It comprises ten principles on (i) human rights (ii) labour standard (iii) environment and (iv) anti-corruption

3.6 Classification of Aquaculture certification Schemes

Flavio *et al.* (2007) found at least 30 schemes and eight key international agreements relevant to aquaculture certification in 2007. They grouped certifying schemes as follows (Table 8) on the basis of promoting organisation.

Table 8: Classification of certification according to its promoter.

Governor/ promoter	Examples
Governments	Thailand's Thai Quality Shrimp, China's Safety agri-food certification, ChinaGAP and Green food standard; Vietnam GAP and CoC programme; Hong Kong Accredited Fish Farm Scheme, Australia's Ecologically Sustainable Development, shrimp certification in Brazil etc
Retailers	GLOBALGAP, a certification program of 22 large-scale retail chains in Europe, the Euro-Retailer Produce Association (EUREP). Others are Safe Quality Food, Carrefour etc.
Aquaculture industry	Global Aquaculture Alliance & Aquaculture Certification Council, SIGES – SalmonChile, Scottish Salmon Producers' Organisation Code of Good Practice.
NGO	Marine Aquarium Council, International Standards Organization etc.

3.7 Trends in Aquaculture Certification and its market response

The number of schemes for the certification of aquaculture products has been increasing over the years. New schemes as well as schemes involved primarily with other sectors expanding also to the aquaculture sector. To allow small-scale producers to access certification, schemes are increasingly including the possibility to certify producers' groups or clusters, in addition to individual businesses (Flavio *et al.* 2007).

Kristin *et al.* (2003) found that certification in general brings significant improvements to environmental management systems such as data recording and use and plant maintenance.

A study by the Seafood Choices Alliance in 2003 found that 72% customers would be more likely to buy seafood bearing an environmentally responsible label (Fliess *et al.* 2007).

A survey conducted in 2005 among European consumers, supermarkets and chefs revealed that 79% said that environmental impact influences their purchasing decisions of seafood. It was conducted by the Seafood Choices Alliance, in partnership with WWF, Greenpeace, the Marine Conservation Society and the North Sea Foundation in the United Kingdom, Germany and Spain. They found that 86% of consumers would prefer to buy ecolabelled seafood and 40% of consumers were willing to pay a higher price for such products. The study also identified that 95% of the consumers wanted more information on how to buy sustainable seafood, 62% said fish caught in an environmentally responsible manner is of higher quality and 84% of consumers say one should refuse to purchase seafood that is overfished or caught in a way that damages the ocean environment (WWF, 2005).

Imkamp (2000) compared two survey reports on consumer behaviour on ecolabelled products carried out in 1989 and 1998 in Germany. In the first survey (1989), consumers showed considerably less interest in information about ecologically relevant product attributes than in the second survey (1998). In particular, there was evidence that in comparison to common

product quality information, on average consumers rate the relative importance of ecological product information higher. He found that the consumers wanted product testing agencies to take into account more aspects of products that are related to ecology and more consumers would prefer reliable standardized ecological information obtainable at the point of purchase. Finally, the results showed that at least for some products, the scope of perceived ecological risks seems to have increased and that consumers generally are becoming concerned with harmful effects of the production and distribution of a product.

Mario *et al.* (2002) revealed that eco-labelling may alter manufacturer behaviour in addition to changes in consumer behaviour. According to them if a significant portion of the consumer population demands environmentally friendly products, the presence of an ecolabelling program may provide firms an incentive to differentiate and market their products along an environmental characteristic. An increase in supply of these environmentally friendly products may increase consumer purchases through greater availability without changes in individual awareness. They suggest that if providing information to consumers through labelling can alter behaviour it is likely to be welcomed by policy makers because this sort of policy tool may be easy to implement and enforce.

Maria *et al.* (2002) found that farmers and other producers were responding to consumer concerns about pesticides by creating new marketing opportunities for products grown with environmentally sound practices. They assessed the mean willingness to pay for ecolabelled apples using a double-bounded logit model and found that female respondents with children and strong environment and food safety concerns are more likely to pay a premium for ecolabelled apples.

Consumers, according to Makatouni (2002), perceive organic food as a means of achieving individual and social values, of which the most important is their health and safety factor. Values regarding the environment and animal welfare are also considered to be important but the health factor seems to be the most significant motive for choosing organic food.

Responding to the increasing demand for certified products, several retail companies have committed to purchasing only fish harvested from certified sustainable fisheries. Several small and lucrative market niches such as organic aquaculture, fair trade, etc. have also emerged (FAO 2007b).

Josupeit (2007) revealed that the world leading supermarkets were adopting policy to use ecolabelled product from selective schemes (Table 9).

Table 9: Supermarkets adopting policy to sell selected ecolabelled product.

Name of Supermarket	Name of selected Scheme
Wal-Mart	Marine Stewardship Council (MSC) , Global Aquaculture Alliance (GAA)
Sainsbury	MSC
Coop Swiss	Naturland for organic shrimp
Tesco	Partnering with MSC
Metro	EII, MSC
Carrefour	Own scheme for responsible fishing
Ahold USA	Eco-Sound: sustainable fisheries
ICA Sweden	MSC

4 MARKETS OF BANGLADESH SHRIMP AND THEIR REQUIREMENTS

4.1 Global Shrimp Market

The European Union, the USA and Japan are the principal markets for shrimp worldwide. In 2007, the shrimp volumes imported to EU, USA and Japan (Figure 3) were 0.83 million, 0.56 million and 0.28 million metric tons respectably (Josupeit 2008).

The EU as a whole is the largest importer of fishery products in the world. Among the EU, the main fish importing countries are Belgium, UK, Germany, Spain, France and Italy. Imports in 2007 amounted to 8.8 million tonnes with a value of €29 billion (CBI 2008). The total import of fishery product of EU in 2005 & 2006 were 5.9 and 6.2 million tonnes respectively (Eurostat- pocket book of fishery statistics).

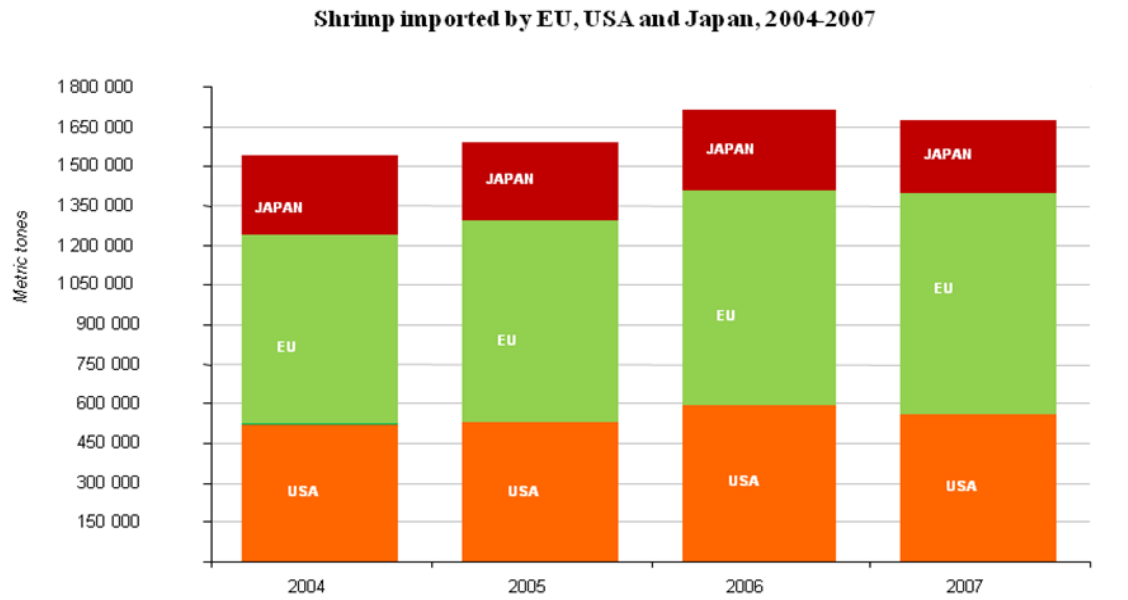

Figure 4: Shrimp import to the main markets the EU, USA and Japan (Josupeit, 2008)

4.2 Export market of Bangladeshi Shrimp and the Competitors

The European Union is the biggest market for Bangladeshi shrimp. For several years the major share of Bangladeshi shrimp exports went to EU countries. In the fiscal year 2007–08, frozen food export to the EU accounted for 260 million US$; that represents 49% of total export from Bangladesh (Table 10). The principal EU countries were Belgium, UK and Germany. Bangladesh is an important shrimp supplier to EU countries. It constituted 4.1% of total shrimp import in EU in 2007 (CBI 2008).

The USA is the single largest market for Bangladeshi shrimp. In the year 2007–08, Bangladesh earned 150 million US$ from exporting frozen food to USA that constituted 28% of total frozen food export (EPB 2008). U.S. shrimp import from Bangladesh was 21 thousand metric tonnes in 2006, representing 3.3% of total U.S. shrimp imports (Hedlund 2007).

Table 10: Bangladesh Frozen food export to different countries and their percentage in the fiscal year 2007–08, more than 70% of this export comes from shrimp. The EU is the biggest market followed by the USA, Russia, India, Japan and a few other countries (EPB 2008).

Country		**Export (thousandUS$)**	**%**
U.S.A		149870	28.06
EU countries		260982	48.87
	Belgium	*134541*	*25.19*
	U.K	*65602*	*12.28*
	Germany	*24625*	*4.61*
	Other EU countries	*36214*	*6.78*
Russia		32953	6.17
India		29117	5.45
Japan		17942	3.36
Saudi Arabia		8372	1.57
China		6209	1.16
Other Countries		28621	5.36
Total		534066	100

4.3 General Market Access Requirements

The market access requirements, which are demanded by governments or retailers, are based on consumer health, product quality and safety, environmental and social concerns. The requirements may be in form of legislative or non-legislative. According to CBI (2008), both legislative and non legislative requirements can be divided into requirements for three categories: consumer health and safety, environmental, and social.

4.3.1 Consumer health and safety requirements

A number of legislations prevail in the EU and USA to protect consumer health and safety. The present food safety policy of the EU and USA includes many requirements that prohibit the presence of certain chemicals, or prescribe provision of information about conditions of the product or production process. In addition to governmental legislation, programmes or codes initiated by industries themselves make their own production process more transparent in order to ensure their products are safe and healthy.

4.3.2 Environmental requirements

Environmental issues are increasingly considered an integral part of international trade. Various legislation has been developed by governments and standards developed by industries themselves to address this shift in business practice. Requirements may be related to a product or its production process. In both the EU and the USA, legislation has been developed in order to reduce the negative environmental impact of products and to regulate the use of pollutants, such as hazardous substances, in products. All products must comply with these regulations to be exported to the EU. Besides product legislation, requirements have been developed for process legislation. Authorities, mainly in European countries, are instating more and more legislation in order to protect the environment. So, implementing an environmental management system or getting certified and bearing an environmental label may provide competitive advantages to a product. Some companies even demand this type of label from their suppliers.

4.3.3 Social requirements

As social responsibility is becoming more important to consumers choosing products, importers and retailers are including it in their consideration. They are demanding social labels to demonstrate concern for social issues or conformity to codes of conduct and management systems. (CBI 2008). Social issues include labour conditions, minimum wage and maximum working hours, health and safety, women affairs and gender equity, child labour use and other social responsibilities. The importers in developed countries are increasingly demanding minimum social compliance from their suppliers. This is done through social or ethical trading requirements. The requirements demanded by the private sector are an important issue when looking at accessing European markets (ITC, 2009).

4.4 Market Specific Requirements: The European Union

Exporters need to comply with EU legislation and have to be aware of the additional non-legislative requirements that trading partners in the EU might request (CBI, 2008). The animal health situation in the producing country needs to satisfy EU requirements for imports of the animals. National authorities in the exporting country must provide information on the existence of certain infectious or contagious animal diseases on their territory.

On arrival in the EU, the animal products and the certificate given by a competent authority of exporting country must be verified and checked by EU officials. Further checks on the products may also be carried out at the final destination (EUROPA, 2008).

4.4.1 Guiding Laws and Directives

There are several regulations and directives on food related issues applicable for animal food production and food business operation (Figure 5). *Regulation EC 178/2002*, known as the General Food Law describes general principles and obligations for exporting food to Europe. In addition to this, *Regulation (EC) 882/2004* laid down the general procedure for official controls, *Regulation (EC) 852/2004* laid down the general hygiene requirements for all food business operators and *Regulation (EC) 853/2004* laid down additional specific requirements for food businesses dealing with foods of animal origin, including fishery products. *Regulation (EC) 854/2004* had included the official controls for foods of animal origin (Ioannis *et al.*. 2005 and CBI, 2007).

4.4.2 General hygiene requirements:

General hygiene of a food operator is guided by the regulation (EC) No 852/2004), Article 4.1 of, and Part A of Annex I, Article 4.2 and Annex II. According to this rule, the food must be produced in hygienic conditions, the producer must make sure that the premises are kept clean and are properly equipped. Foods must be safely and hygienically handled. Staff must observe good personal hygiene practices.

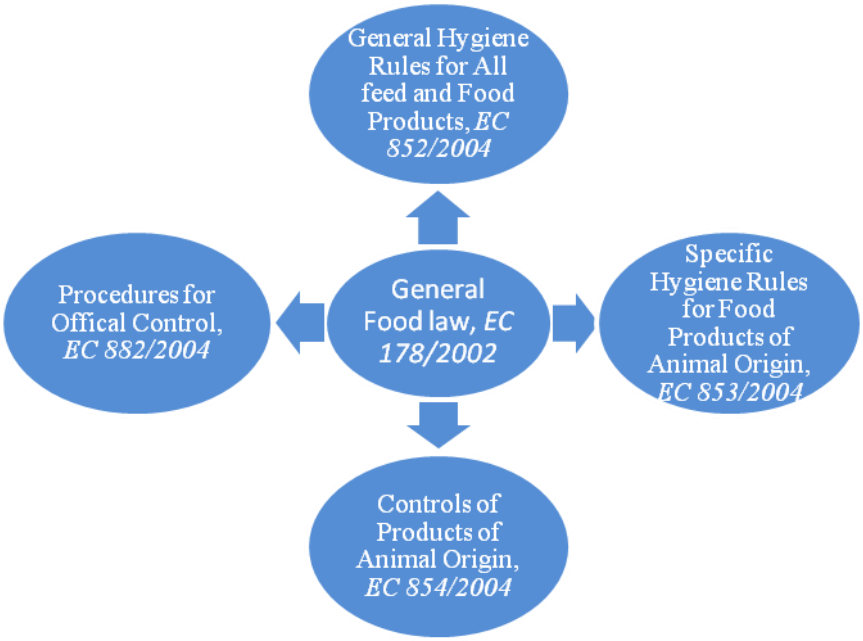

Figure 5: The guiding regulations for food export to EU (adopted from CBI, 2007)

4.4.3 Hazard Analysis and Critical Control Point (HACCP)

HACCP requirements are set out in article five of Regulation (EC) No 852/2004. According to this rule, all food businesses must have a documented food safety management system that is based upon the principles of HACCP. The processor has to identify and regularly review the critical points in their processes and ensure controls are applied at these points. The producers have to show their environmental, health and hygiene standards and that there is an organized and effective food safety management system in place to ensure that the food produced is safe. Both the producer and processor should have an HACCP plan that includes the following:

- List the food safety hazards that are likely to occur and therefore must be controlled for each fish and fishery product. Consideration should be given to the following: (i) Natural toxins, (ii) Microbiological contamination, (iii) Chemical contamination, (iv) Pesticides, (v) Drug residues, (vi) Decomposition in scombroid toxin-forming species, (vii) Parasites, (viii) Unapproved use of food or colour additives and (ix) Physical hazards
- List the critical control points for each of the identified food safety hazards
- List the critical limits that must be met at each of the critical control points
- List the procedures, and frequency thereof, that will be used to monitor each of the critical control points to ensure compliance with the critical limits
- Include any corrective action plans that have been developed to be followed in response to deviations from critical limits at critical control points
- List the verification procedures
- Provide for a record keeping system that documents the monitoring of the critical control points. The records shall contain the actual values and observations obtained during monitoring.

4.4.4 Registration of establishments

According to article 6 of regulation (EC) No 852/2004), all food businesses and all primary producers involved in aquaculture have to be registered with the competent authority of their home country. Food businesses handling food of animal origin must be approved by the official agencies.

4.4.5 Traceability

The producer and processor shall have a system in place to identify the immediate supplier and immediate customer of its products. In the case of aquaculture, the following data shall be recorded for each pond and each production cycle:

- source of post-larvae (hatchery name and address)
- pond identification number and pond area
- stocking date, quantity of post-larvae stocked
- chemicals used
- manufacturer and lot number for each feed used
- harvest date and quantity
- name of the purchaser or processing plant

4.4.6 General Health Requirements

Imports of fishery and aquaculture products intended for human consumption in the EU market must comply with general health requirements as listed below:

- Country Health Approval: The exporting country must be on a recognised list of eligible and authorised countries to export the concerned category of products or animals to the EU;
- Approved establishment: Products of animal origin can only be imported into de EU if they come from approved processing establishments of the exporting third country;
- Health certificates: Imports of fishery and aquaculture products into the EU must be accompanied by a health certificate signed by a representative of the competent authority of the exporting third country certifying that the products in question are suitable to be exported to the EU.
- Health control: Each consignment is subject to health controls at the designated Member State Border Inspection Post (BIP).

4.4.7 Animal health requirements

A certification of the health condition of the animal products is required when importing into the EU. This is to prevent the introduction of animal diseases into the EU. These requirements derive from Directive 2002/99/EC which lays down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption.

4.5 Market Specific Requirements: USA

The requirements for importing shrimp is governed by the Code of Federal Regulations, Title 21 part 123-Fish & Fishery Products (21 CFR Part 123) and Current Good Manufacturing Practices (21 CFR Part 110). The principal considerations of this market are HACCP and sanitation.

The USFDA performs verification of compliance through foreign inspections at the production, processing and import level and through product testing. When the agency finds non-compliance with regulations, inadequate HACCP plan or implementation or the farm's product is found to have a drug residue, the products of the farm can be placed under import alert. The current drug testing program of the USA tests for chloramphenicol in shrimp, flumequine in catfish and shrimp, malachite green in catfish, piromidic acid in shrimp, oxolinic acid in catfish, salmon and shrimp, and oxytetracycline in shrimp (Young, 2008). Failure of a processor to have and implement an HACCP plan shall render the fish or fishery products of that processor unacceptable. The exporting country's production and processing practices should comply with the Current Good Manufacturing Practices of the USA. This determines whether the facilities, methods, practices, and controls used to process fish and fishery products are safe, and whether these products have been processed under good sanitary conditions.

4.6 Other Markets Requirements

The Russian federation, India, Japan, Saudi Arabia, China and some other countries those import Bangladesh shrimp (Table 9). These markets requirements usually covered when requirements of EU are complied with.

5 SHRIMP AQUACULTURE PRACTICES IN BANGLADESH

5.1 Background

The shrimp aquaculture of Bangladesh has a long history. Hundreds of years ago, the coastal people started using the tidal water within the paddy fields during January to June for aquaculture. There was no fry stocking, no artificial feeding, liming, fertilization or aeration. They used to trap tidal water harvest shrimp and finfish after two to three months time. Only the wild seeds of shrimp and fish carried by tidal water were allowed to grow without any intervention. The production of shrimp was very low at that time. But they got sufficient fish and shrimp for their consumption. By the late 1960's, almost all the canals and small and medium sized rivers were closed by cross dams because of construction of embankments through the coastal belt to protect intrusion of saline water into rice fields.

5.2 Development Phase

After the independence of Bangladesh in 1971, people grew interested in increased shrimp production because of increased price and demand in the international market. Some local people forcibly cut open the embankments in some areas and started shrimp culture in their rice fields. From the late seventies or early eighties, the shrimp culture expanded steadily. In addition to trapping natural shrimp seed, farmers started stocking of *Bagda (Panaeus monodon*) PL caught from the rivers and coast line. Since then there has been a continuous expansion of shrimp farming area and production (Figure 6). Before 1980, shrimp aquaculture area was only 20,000 ha, in 30 years it expanded 10 fold and presently 217,877 ha (Karim, 1986 and DoF, 2008b).

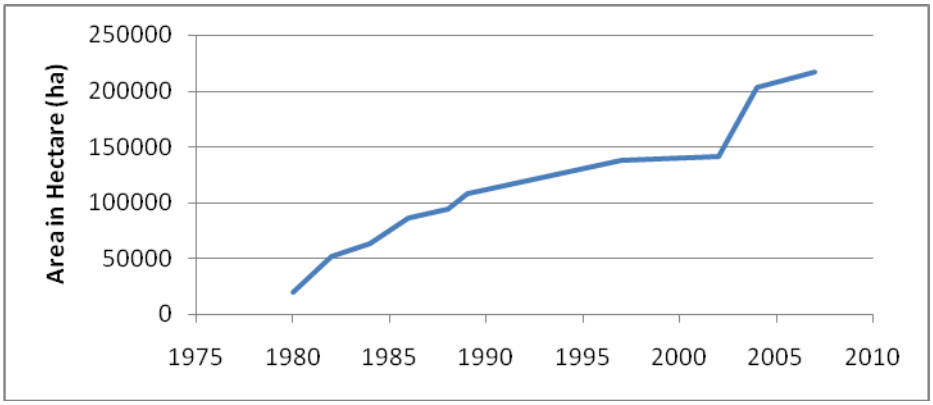

Figure 6: Increase of shrimp farming area of Bangladesh, 1980-2007

Shrimp production before 1980 was low. It started increasing rapidly during the 1990's and it still increasing in a good pace (Figure 7). During the last 30 years, shrimp production from aquaculture has increased more than five fold, from 14773 mt in 1986-87 to 86840 mt in the fiscal year 2006-07 (DoF, 2008b).

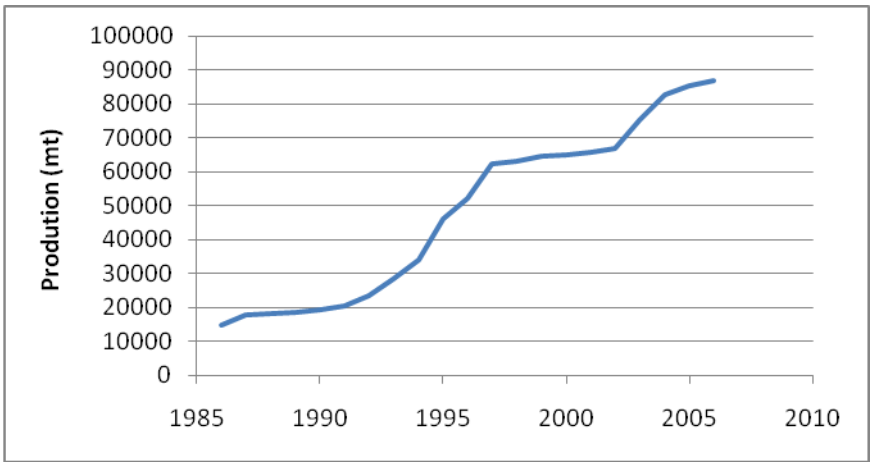

Figure 7: Shrimp production from Aquaculture 1986-2007 (DoF, 2008b).

5.3 Location of Shrimp Farms

Shrimp farms are mostly concentrated in the southwestern districts of Khulna, Satkhira and Bagerhat and the southeastern district of Cox's Bazar. The farms are mainly located within polders. In Khulna and Satkhira, farms largely alternate between shrimp and rice production, but in Cox's Bazar, they alternate between shrimp and salt production (Table 11 and Figure 8).

Table 11: Major shrimp farming districts and their share in shrimp production and farming area (DoF, 2008b).

Sl. Number	Name of District	Farm Area (ha)	% Farming Area	Production (mt)	% Production
1	Bagerhat	59424	27.27	26384	30.38
2	Khulna	51921	23.83	20249	23.32
3	Satkhira	52356	24.03	18796	21.64
4	Cox's Bazar	32018	14.70	14568	16.78
5	Jessore	6544	3.00	2421	2.79
6	Pirojpur	4484	2.06	1237	1.42
7	Chittagong	2610	1.20	1104	1.27
8	Bhola	3214	1.48	919	1.06
9	Patuakhali	3115	1.43	530	0.61
10	Narail	1214	0.56	358	0.41
11	Barguna	408	0.19	108	0.12
12	Other districts	569	0.26	166	0.19
	Total	217877	100.00	86840	100.00

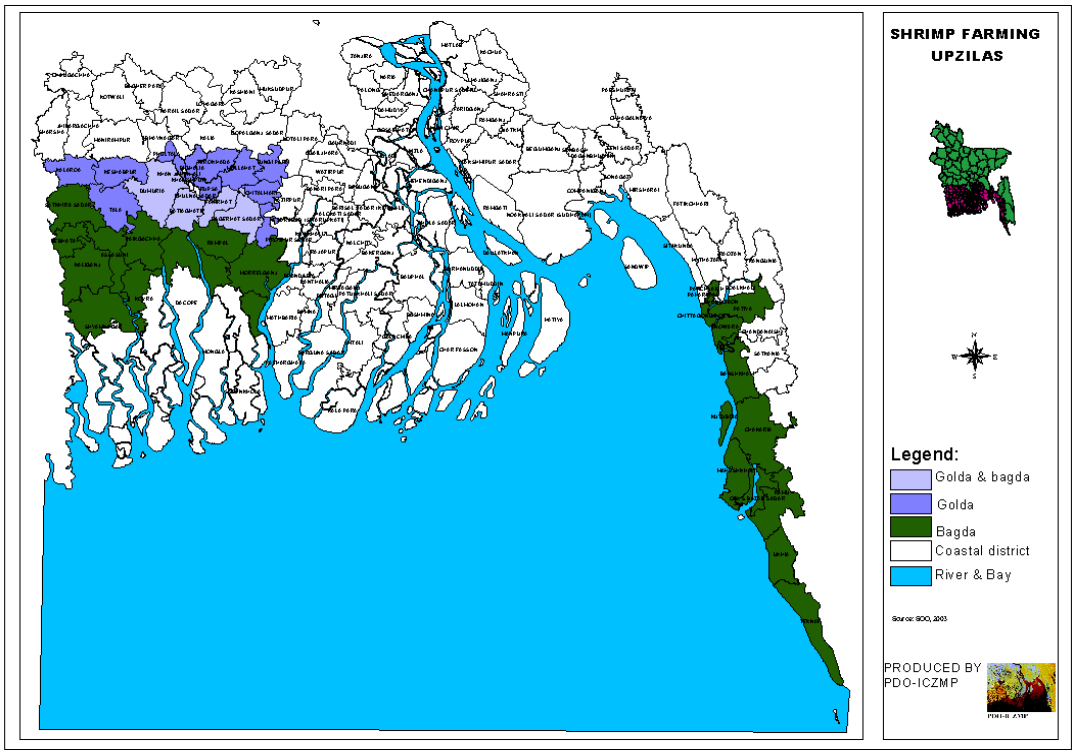

Figure 8: Shrimp farming upazilas (sub-districts) of Bangladesh (PDO-ICZMP, 2003)

5.4 Shrimp species composition

There are 36 species of marine shrimp and 24 species of freshwater prawn are found in Bangladeshi waters. Of these, only three species are cultured significantly, others are a natural product and very negligible in amount (Table 12). *Bagda* constitutes more than 90% of the export of shrimp from Bangladesh. We consider mainly *bagda* aquaculture in this study.

Table 12: Species composition of Bangladesh shrimp (in Khulna region) (DoF, 2008b).

Species	**Percentage of total production**	**Local Name**
Black Tiger Shrimp *(Penaeus monodon)*	46.39	*Bagda*
Giant Freshwater prawn (*Macrobrachium rosenbergii)*	31.51	*Golda*
Speckled Shrimp (*Metapenaeus monoceros)*	13.39	*Horina*
White prawn (*Penaeus indicus)*	0.37	*Chaka*
Others	8.34	
Total	100	

5.5 Natural Life cycle of cultured shrimp

5.5.1 Bagda (Penaeus monodon)

In natural waters, *bagda* breed and spawn in the sea and the post larvae moves to estuary and canals of low sanity. They move back to deep sea again at the juvenile stage. Bagda breeds almost throughout the year from September to July and PLs are available in nature from November to August. For bagda it takes 40 to 50 days for eggs to hatch and reach the post larval juvenile stage. As juveniles develop they settle at the bottom of shallow waters in the

mouths of the estuaries. During the monsoon period, when the salinity of estuarine and coastal waters of the major rivers decreases, these juveniles die or move back to deeper areas as they further mature to adults that spawn after 18 to 24 months.

5.5.2 Golda (Macrobrachium rosenbergii)

In natural conditions, *golda* spawns 3 to 4 times in its third year before it dies. They breed in April to August in the sea or in the estuary. Fertilized eggs take about 50 to 70 days to become juvenile, which takes place in the sea and in the estuary. *Golda* juveniles stay for another week or two in the estuary before moving inland into a fresh water habitat (river, flood lands and ponds) for grazing and growing. In 18 to 24 months they become mature for reproduction; by this time they also return to the sea.

5.6 Cropping pattern of shrimp in Bangladesh

The existing shrimp cultivation can be classified in to three farming system patterns based on alternation of crops (Nuruzzaman *et al.*, 2001) (Figure 9):

Year round shrimp cultivation: This pattern of farming system is observed in the southwest where water salinity is comparatively higher during 8–9 months of the year. Rice farming usually is not profitable in this type of saline zone.

Shrimp alternation with rice: This pattern is a common farming system found mainly in Khulna, Bagerhat and part of Satkhira. Shrimp are grown here from February to July when water salinity favours shrimp growth. After the onset of rain because of monsoon during June–July, the salinity goes down and shrimp farms can plant rice by reducing water depth. Deeper parts of shrimp farms are used to keep white fish, a valuable by-product that comes from shrimp farms.

Shrimp alternation with salt: This is the farming system prevailing in and around the Cox's Bazar district. Farmers use shrimp land for salt production from December to May. From June to September, the same land is used for shrimp production. Deeper canals inside the salt-cum-shrimp farms are stocked with shrimp PL during February–March. After closing salt production during May, farms are inundated by tidal water to grow the shrimp.

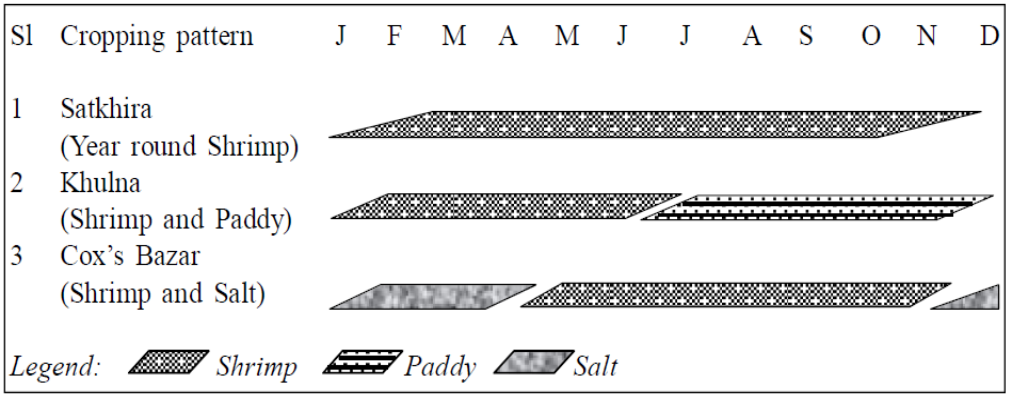

Figure 9: Cropping pattern of shrimp (Alam & Phillips, 2004)

5.7 Farming System

Bangladeshi shrimp aquaculture involves three types of farming systems: Extensive, Improved extensive and Semi-intensive. In 2007, 90% of farms were following the extensive farming system where no formulated feed, other than a homemade mixture of rice bran and wheat yeast, were used. 10% of farms followed the improved extensive system and those used formulated feed (EU, 2007). The farms under improved extensive operation are mostly *golda* farming.

5.7.1 Extensive Culture System

This is the main type of culture system prevailing in the majority of farms. This also called the traditional farming system. These farms are mostly rice fields converted to shrimp ponds with dikes up to a height of about 0.5 m to 1.0 m, width about 0.3 m to 0.6 m and to retain a water depth of at least 0.4 to 0.5 m. Ponds are heterogeneous in size and shape. Shrimp ponds of this type have an irregular bottom. Pond size varies from 0.4 to 200 ha.

Most shrimp farms of this type depend on tidal water from adjacent rivers and canals. Some farms however lack direct connection to a water source; such farms share brackish water through other farms.

Extensive culture farms change water through sluice gates constructed of either wood or concrete. Smaller farms use wooden while larger farms construct concrete sluice gates. There are two types of concrete structure, one is a box and the other is a pipe. Both the gates are regulated by a wooden shutter. Most of the farms use the same sluice for drainage and flushing. Very few farms have separate flushing and drainage gates. There is another type of closed shrimp farm fed by pump machine from adjacent canals because of higher land elevation inside the farm in relation to the elevation of the water source. They have no scope for water exchange.

Most of the farms stock PL in several instalments depending on availability of PL. Stocking density varies from about 10000 to 20000 PL per ha.

The shrimp farmers usually use very little additives in the farm. Typical additives include, lime, urea, TSP, cow dung, rice or wheat bran, fish meal and oil cake etc. They use no measure before stocking.

The production of these farms is very low, varies from 76 to 147 kg/ha.

5.7.2 Improved Extensive Culture System

Improved Extensive Culture farms are more or less similar to extensive culture farms. The main difference is that this type of farm maintains an improved water management system with separate inlets and outlets. Moreover, they follow some management practices including pond preparation, occasional use of fertilizer and food, acclimatization of PL before stocking and use of a screen in pond inlets to deter predators. It is assumed that this type of farm has a higher production than the extensive culture system (Annexure 4).

5.7.3 Semi Intensive Culture System

Semi Intensive Shrimp farming was developed during 1993–1995 in the Cox's Bazar in an attempt to increase production rate. There were only 37 Semi intensive farms covering an area of 218 ha in 1995. Those farms are no longer under semi intensive culture following the outbreak of White Spot shrimp disease in 1994. The ponds under semi intensive farms were mostly from 1–2 ha depending on the investment. Pond dikes are higher than in extensive culture to accommodate a one metre water depth. Water was pumped from adjacent brackish rivers. Stocking of hatchery PL at higher rate (10-15 PL/m^2) supported by pellet feeding and artificial aeration by paddle wheel had been the management protocol while the production obtained between two to four mt per ha with a single harvest per year.

5.8 Supply Chain of Bangladeshi Shrimp

The supply chain of shrimp is long and complicated with many players (Figure 10). Shrimp seed (post larvae) comes from hatchery or fry collectors, after rearing in farms; farmers sell them to middlemen who sell them either to local markets or depots. The depots, after primary processing of shrimp, sell to processing plants.

5.9 Shrimp Processing

There are 133 shrimp processing plants in Bangladesh. Of these, 75 are currently in operation, and only 65 have been approved by the European Union (DoF, 2008a). Most of the plants operate below their capacity because of insufficient and discontinuous shrimp supply.

The processing plants are large facilities with several processing rooms, two story shrimp warehousing, a laboratory, bathrooms, a first-aid room, and administrative offices. The entrance to the plant typically contains a trough with chlorinated water for disinfecting feet and the whole plant is kept wet with disinfectants to ensure a hygienic environment. Individuals inside the plant are required to use plastic boots to reduce contamination. The two story warehouses are kept sealed and the whole plant is built with smooth floors and walls to facilitate cleaning. Generators are used to compensate for any loss of power supply (USAID, 2006)

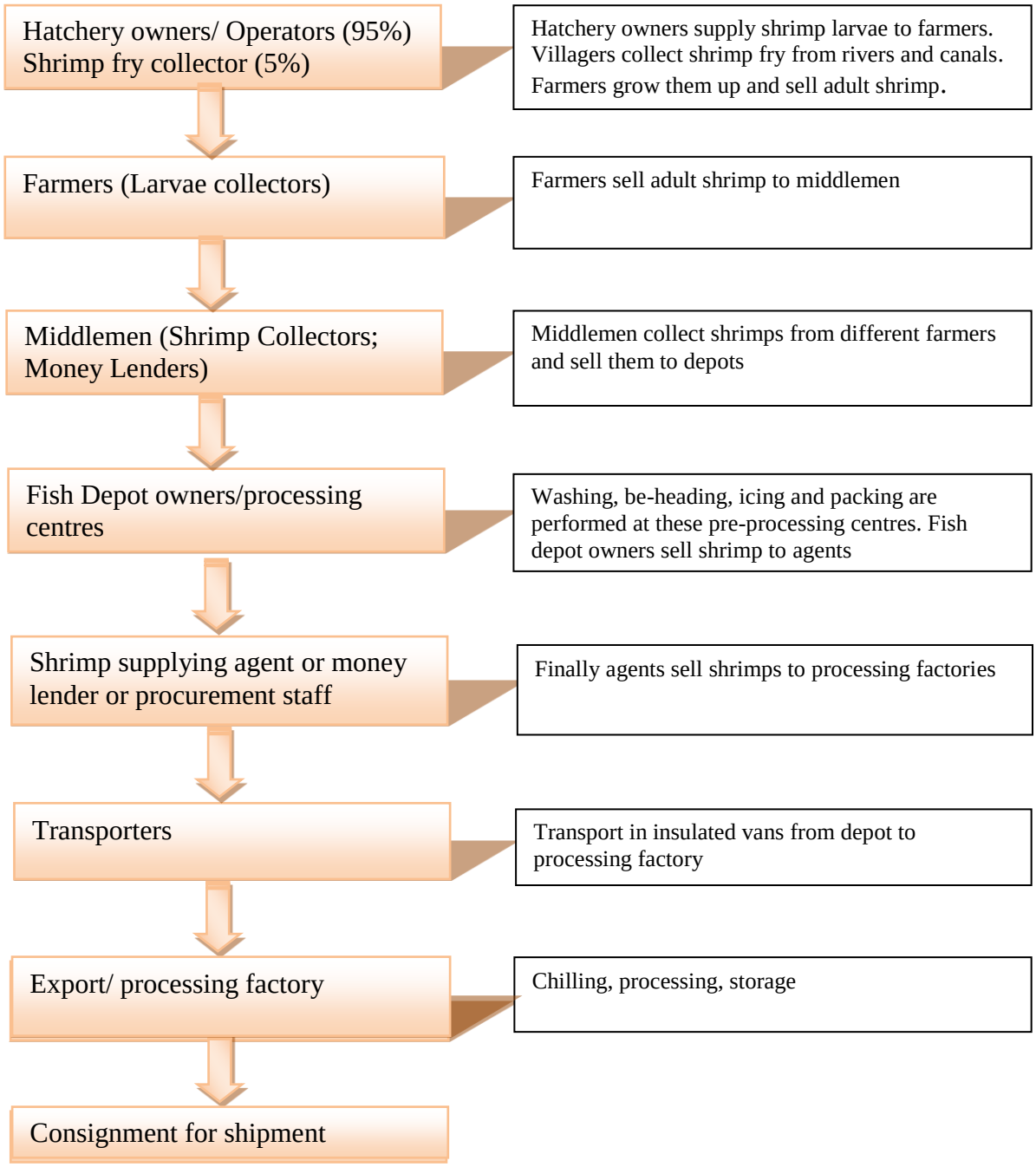

Figure 10: Supply chain of shrimp in showing fry collection from hatchery, rearing in pond, sale to depots and finally to processing plant.

Processors frequently adopt two story warehousing facilities in the factory. The first layer preserves semi or unprocessed shrimp in 5–10 kg packs, to be processed at -5° centigrade in a chilled room. The second layer in cold storage keeps fully processed shrimp that will be shipped to buyers after verification. The second layer is kept at a temperature of between –12° to –20° centigrade.

There is a range of shrimp product exported from Bangladesh, but the major product is IQF and Block Frozen (Table 13). Most of the processors sell shrimp using their own brand name

and also the brand name of importers and buyers. Many processors prefer to maintain multiple brand names as these brands enjoy different levels of popularity in different countries and/or markets.

Table 13: Different types of shrimp product exported from Bangladesh

Product	Process
Head on shell with claws	ICF, Semi-IQF and Block Frozen
Headless shell on	Head removed, neck meat trimmed, IQF raw consumer pack and raw tray packs
Headless Shell on easy peel	Head removed, neck meat trimmed, IQF raw consumer pack and raw tray packs with garlic and herb bases, butter-flied, blanched and cooked in BF or IQF process
Peeled	Peeled, headless, raw and cooked, BF or IQF
Pull de-veined (PD), P & D tail on	Peeled, headless, de-veined, raw and cooked, BF or IQF
P& D butter- flied	Peeled, headless, de-veined, butter flied, raw and cooked, BF of IQF
PD skewer, P &D butter- flied tail on skewer	Peeled, pull-de-veined, headless, IQF shutter pack raw
Cooked	Peeled, de-veined, headless and cooked

5.10 Environmental Social and Food Safety Issues Associated with Shrimp Aquaculture

5.10.1 Use of antibiotics

Antibiotics are used mainly in shrimp hatcheries for increased feeding efficiencies, improved survival rates of PL and to control pathogens. Uddin and Kader (2006) found 20 antibiotics and 15 disinfectants used in hatcheries of Bangladesh. They found 40% of hatcheries using chloramphenicol, 25% using erythromycin, 20% using prefuran and 15% using oxytetracycline.

The use of antibiotics is not much practiced in shrimp aquaculture. It mostly comes from formulated feed infused with antibiotics. However, antibiotics are not mixed in all feeds. In-pond or *gher* antibiotics are used as an ingredient in or mixed with formulated feed. *Bagda* culture is still extensive or improved extensive culture and artificial feeds are rarely used, so antibiotics are not common for them. Feed is used mainly in *golda* ponds or ghers and this is why chloramphenicol is found in freshwater shrimps (golda).

5.10.2 Use of Pesticides in Agriculture

In Bangladesh, pesticide use is modest. About 70 percent of pesticides used are for rice cultivation. Pesticide used on rice is mainly reactive; applications are only made after detecting insect infestations (Huda, 1999). However, it is believed that chemical residues such as nitrofuran, lead etc. sometimes found in shrimp, come from the pesticide used for agriculture crops. According to Matin (2003), pesticides can enter the aquatic environment through direct application, spray drift, atmospheric deposition, leaching and runoff from agricultural land, or by the indirect routes of equipment washing and disposal. In the aquatic environment, pesticides trend to adhere to suspended solids or become bound to sediment, although a small fraction remains in aquatic organisms. They are also subject to metabolic transformation in biota and to various alterations due to continuous exchange between pesticides and biota and to various chemical reactions with abiotic components.

5.10.3 Decrease of agricultural land and crop production.

Shrimp farms are mainly rice fields that have been converted to ponds or *ghers*. About 80% of the agricultural land historically used solely for rice production has been converted to rice-shrimp farming since the 1970's (Karim, 2006). The increase of shrimp farming has resulted in decreases in various crop production including rice and vegetables and many environmental problems in the form of silt accumulation at the mouths of the rivers, shortage of livestock grazing, fuel scarcity and decreases in traditional labour forces. Ali (2006) reported that shrimp culture on rice fields has significantly degraded the soil qualities, reduced rice production, and destroyed the aquatic and non-aquatic habitat in the rice ecosystem. Prolonged inundation of rice fields under saline waters increases soil acidity while decreasing soil fertility.

5.10.4 Salt-water intrusion and soil degradation

Salt-water intrusion is an important aspect of the exclusive cultivation of *bagda*. This culture needs saline water for almost 8–9 months in the case of two crops or year round for continuous cropping. The intrusion of salt water and water logging are thought to be responsible for significant and unmitigated environmental costs including increased salinity and soil degradation, deforestation and the destruction of homestead vegetation, and loss of coastal vegetation. Water logging is reported to create irreversible changes in wetland ecology and the loss of micro flora and fauna. As an effect of water logging, rice production has declined in many shrimp producing areas, leaving these communities dependent upon rice imports from other parts of Bangladesh, threatening food security and undermining nutrition (USAID, 2006). In some shrimp producing areas farmers do not follow drainage management protocols and discharge pond water inappropriately which contributes to seepage and salt water intrusion and reduces crop yields by up to one third (EJF, 2003)

5.10.5 Loss of Livestock

The expansion of the shrimp sector may contribute to the loss of livestock and access to grazing lands. The construction of ponds, dikes, and the annexation of land prevent villagers from accessing communal grazing lands. Additionally, community members may be discouraged from keeping ducks since ducks eat the shrimp larvae and feed. Livestock produce milk, meat, and dung for fuel. As a result, the landless or land poor lose additional income and a critical source of domestic fuel.

5.10.6 Disease Management

Shrimp are very delicate animals and they are vulnerable to various diseases. The major diseases recorded are:

- Viral diseases: WSBV/SEMBV/WSSV, MBV, etc.
- Bacterial diseases: vibriosis; *Leucothrix, Aeromonas* and *Pseudomonas* spp. infection
- Fungal infection: *Fusarium* sp.
- Protozoan diseases: the microsporidians *Agmasoma* and *Pleistophora*; the gregarines *Nematopsis* and *Cephalolobus*
- Nutritional, toxic and environmental diseases: soft shell, black spot, black gill, pink gill, hepatopancreatic necrosis, swollen and cramped tail, muscle necrosis, broken appendages etc.

In the early 1990's shrimp farmers tried to introduce semi-intensive shrimp aquaculture with high density PL stocking, higher dependence on formulated feed, etc. Soon after, in 1994–96, the sector experienced disaster with outbreak of White Spot Syndrome Virus (WSSV) that inhibited the hoped-for higher production rate.

In the current management system, farmers harvest all the shrimp as soon as the disease occurs. Some farmers react to the occurrence of disease in a neighbouring pond by shifting the shrimp to another pond or the canal within the big pond so the infected pond can be dried out. After leaving the pond bottom exposed to the sun for a few days and treating it with agricultural lime, $Ca(OH)_2$, the pond is filled with water again and the shrimp are restocked. Usually no antibiotics or other drugs are used for treatment of the diseased shrimp (PDO-ICZMP, 2003).

5.10.7 Rice-Shrimp Conflict and Crop Rotation

For several years there has been heated conflict between rice growers and shrimp farmers in the southern districts. Among the land owners there are those benefit from shrimp culture and want to develop that industry but others think rice is better for them. The conflict is grounded in the belief that shrimp culture turns the soil acidic, and hence less productive to rice, due to inundation under saline water for long periods. To resolve this conflict and regain the fertility of land, crop rotation between rice and shrimp was introduced a few years back. This system seems environmentally friendly and people are benefiting in several ways: it helps prevent disease outbreak in the shrimp farm, it reduces rice production cost as shrimp farming residues are good fertilizer, rice production can be higher than continuous cropping, and less pesticide is needed in fields that are periodically inundated. The government of Bangladesh has recently introduced a zoning system for aquaculture and agriculture in coastal areas to resolve the conflict.

5.10.8 HACCP and Traceability

Implementation of HACCP was started in Bangladesh during 1996 with the assistance of an FAO funded project to provide support and technical assistance to the sector based on HACCP endorsed by the US Food and Drug Administration. The program provided training in HACCP procedures to both the public and private sectors. In July 1997, when adopting the upgrading process, the EU imposed a ban on imports of fishery products from Bangladesh as serious deficiencies were found in the infrastructure and hygiene in processing establishments and insufficient guarantees of quality control by Government quality inspection services (Cato and Subasinge, 2003). Between 1997 and the end of 1998, the volume of shrimp exported dropped by 20 percent. By December 1998, shrimp exports had fallen by almost a quarter (USAID, 2006). The ban inspired a series of changes throughout the sector, spurring investment in technology, hygiene practices, and new processing techniques. The ban was withdrawn after five months upon satisfactory progress in the safety and quality assurance system.

Currently most of the shrimp processing plants have undergone substantial improvements to comply with the HACCP principles. All the EU approved processing plants have an HACCP plan and others are improving their facilities, adopting the HACCP method. The shrimp processors have already started to improve and diversify their processing methods. Despite these investments, there is evidence that a number of processing plants have failed to implement adequate changes in securing their supply of shrimp and that the risk of

contamination remains significant. Initiatives have been taken to introduce traceability of different stages of the production and supply chain of shrimp. The government of Bangladesh has formulated legislation making registration of farms and hatcheries compulsory. Most of the hatcheries and big farms are registered and recorded according to the rule.

5.10.9 Antibiotics and pesticides residues

Antibiotic contamination has been the focus of recent EU inspection. According to article 11 of European Union regulation no 178/2002, the presence of residues of nitrofurans, nitroimidazoles, chloramphenicol and malachite green excludes foods from exportation to the EU. According to the legislation, appropriate withdrawal periods must be observed in cases of aquaculture where antibiotics have to be used. To comply with the directive, the government of Bangladesh has issued notice for shrimp farms and feed industries not to use the above chemicals in feed or as medicine for shrimp. In addition, appropriate government officials are to strictly monitor the matter (EU, 2007).

5.10.10 Women and child labour

Shrimp farms and hatcheries are male oriented. Women are rarely involved in farming process but they are employed in processing plants and depots engaged in cleaning and beheading the shrimp. More than 60 percent of shrimp workers in processing plants are women. They claim to receive a salary lower than that of male workers. The working conditions are not healthy and wages are not enough to live on. Health, transport and other facilities are not adequate, as is seen in many other industries of Bangladesh.

There are also reports of a substantial amount of work being performed by children at shrimp processing, freezing, and packaging factories. Sometimes they work long hours, do not attend school, and are paid significantly less for their work (Halim *et al.*, 2001)

5.10.11 Use and Destruction of Mangrove Forest

Mangroves are highly valuable ecosystems that perform multiple functions which secure direct and indirect benefits for the coastal inhabitants. Mangroves are also essential for aquaculture and open sea fisheries in providing critical breeding, spawning, and nursery grounds for shrimp and commercial fish species.

While much of the loss of mangrove forest in Bangladesh occurred over the previous 50 years, some areas have been deforested as a result of shrimp aquaculture. Among those forests that have been identified as experiencing significant deforestation as a result of shrimp aquaculture is the Chokoria mangrove forest in the Cox's Bazar region. Approximately 8,750 hectares of mangroves have been lost to salt water intrusion, dike and pond construction, and human intervention (USAID, 2006). Most of this damage occurred in late 1970's when shrimp aquaculture had just started in Bangladesh. In recent years there has been no decline of mangrove forest due to shrimp farming.

5.10.12 Ban on Wild Fry Collection

One of the most significant environmental concerns is the destructive effect of wild shrimp fry collection from coastal areas of Bangladesh because it resulted in significant losses to biodiversity. In the late 1990s it was estimated that over 90 billion seeds of other species were caught and discarded annually during the collection of shrimp fry. This negative environmental impact caught the attention of several international organizations and interest groups. Meanwhile in the early 1990's a number of hatcheries were established by governmental and private initiatives. After a few years of this intervention, when the hatcheries attained the capacity to supply the required amount of PL for shrimp aquaculture, the government of Bangladesh imposed a ban on catching wild shrimp fry in 2000. In the years following the ban, collection of wild fry declined drastically. In 2003 it was estimated that approximately 40% of the fry used by farmers was from wild sources. The amount of wild PL used in aquaculture was only 5% in 2006 (DoF, 2007).

5.10.13 Social Impacts of Shrimp Farming

The cash-flow from shrimp production and business has made a great change in the cultural and social landscape of the southern districts of Bangladesh. Remarkable changes are visible there. For instance, mud houses have been replaced by brick houses, cell phones have become common, and gas powered vehicles, especially motorbikes have replaced vehicles pulled by beasts of burden. In addition, there has been a change in food-pattern from a more traditional vegetarian diet to a more meat-based diet, there is a higher rate in education, and there is a TV in almost every house.

Pokrank (2001) reviewed the literature regarding the social impacts of shrimp farming in Bangladesh. He found several positive and negative social impacts reported. Positive social benefits include increased employment and a growth of average wage rates, growth in purchasing power, growth in numbers of earners in households, improved health and increased use of facilities such as tube wells, sanitary latrines and more substantial housing structures, decline in land sales, a rise in land prices, a growth in profits per unit of land, greater household food security, greater earning opportunities for women in shrimp fry collecting and depot work, increased investment in local areas with the growth of processing plants, supply shops, retail outlets, improved transport, and increased supply of consumer goods. Negative social consequences he found include growth in income inequality, disruption of local networks of social security, violence against women and the landless, decline in access to sharecropping opportunities, decline in common property resources, privatization of public lands, and the exacerbation of existing unequal gender and class relations. Negative social impacts of shrimp cultivation are reported in some of the earliest studies.

Begum and Islam (2002) reported several social benefits from shrimp cultivation such as increase in the average wage rate, increase in the flow of money and drop in cases of diarrhoea and other diseases etc.

5.11 SWOT Analysis of shrimp aquaculture of Bangladesh.

An important tool often used to highlight where a business stands and what its future might hold is and analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT). It looks at internal factors, the strengths and weaknesses of a business, and external factors, the opportunities and threats facing the business. The following SWOT analysis looks at shrimp aquaculture in Bangladesh at the present time (Table: 14).

Strengths:

The main strength of Bangladeshi shrimp is the nature of operation and product demand. Aquaculture in Bangladesh is extensive or improved extensive in nature and thus the product is next to natural. The high natural productivity of soil and water, availability of saline waters, low labour cost, user-friendly farming technology etc. increase Bangladesh's potential for shrimp farming.

Weaknesses

The main weakness is its unplanned development. Very low production rate and low profit margin are weaknesses for this industry. The farms are individual, no community or industrial approach or cluster or group was formed. There prevails conflict between shrimp farmers and agriculture farmers regarding the use of land.

Opportunities

The trend of consumption of shrimp in the main markets like the EU and USA are increasing. So Bangladesh has the opportunity to increase its export. Bangladeshi shrimp can be certified and ecolabelled to increase its export.

Threats

Threats are frequent natural calamities like flood, cyclone etc. New regulations for the export market, frequent outbreak of diseases, decreasing trend of price in main markets etc. are potential treats for Bangladeshi shrimp. Bangladesh should be aware of the threats and consider them in planning and developing strategies.

Table 14: Summery of SWOT analysis of Bangladesh Shrimp Aquaculture

Strength	Weakness
1. Favourable conditions of climatic, soil and water. 2. High natural productivity 3. Less or no use of feed, fertilizers or chemicals. The product is next to natural. 4. Less cost involved 5. Mainly individual small scale farming 6. User-friendly farming technology	1. Very low production rate 2. Less profit 3. Development was not well-planned, no community approach, no cluster or group organisation 4. Conflict between shrimp farmers and agriculture farmers regarding the use of land 5. Less post harvest handling care 6. Less product quality 7. Less control over hundreds of farmers
Opportunities	**Threats**
1. Increasing trend of consumption of shrimp in developed world eg. USA and EU. 2. Product has a good demand in world market 3. Production rate could be increased by several folds 4. Can be certified as 'organic' 5. Adoption of ecolabelling can enhance market demand and restore environmental sustainability.	1. New regulations for export market 2. Frequent natural calamities like flood, cyclone etc. 3. Intensification in culture method experienced disease outbreak. 4. Competitors adopted ecolabelling 5. Decreasing trend of price in main markets eg. USA.

6 THE FAO GUIDELINES AND BAGLADESH SHRIMP AQUACULTURE

6.1 The FAO guidelines for Aquaculture Certification

The issue for developing guidelines for aquaculture certification were first discussed in the third session of the FAO Committee on Fisheries, Sub-Committee on Aquaculture, held in India in 2006. Participants of that meeting recognised that adopting certification can increase consumer confidence in aquaculture practices and products. The meeting concluded that certification schemes add higher costs for producers but deliver no significant price benefits to small-scale producers. Another concern was that the increasing number of certification schemes and accreditation bodies are creating confusion amongst producers and consumers. So the meeting asserted that there is a need for globally accepted norms for aquaculture and hence guidelines for it. The guidelines should serve as a basis for harmonization and facilitate mutual recognition and equivalence of certification schemes (FAO, 2007a).

In accordance with the decision of the COFI meeting, the FAO and NACA coordinated a number of experts and stakeholders meetings and workshops throughout the world. They developed and reviewed the drafts of the guidelines and finally submitted to COFI on October 2008.

A number of normative and reference documents used for preparation of the document. A few of them are:

- FAO Code of conduct for responsible Fisheries
- International principle for responsible shrimp farming
- Guideline of ecolabelling of Fish and Fishery products from marine Capture fisheries.
- WTO agreements on TBT and SPS measures.
- Codex Alimentarius Commission standards

The guidelines provide the principles and basis for setting standards, certifying and accreditation for developing a certification scheme with its governing and implementation procedures. It describes the minimum substantive standards for aquaculture operation, process and product to be certified. The criteria are based on animal health and welfare, food safety and quality, environmental integrity and social responsibility (FAO, 2008c).

6.2 Compliance of Bangladeshi Shrimp aquaculture with FAO guidelines

6.2.1 Animal Health and Welfare

There are some minimum substantive criteria for animal health and welfare described in the guidelines. Bangladeshi shrimp aquaculture needs to comply with the criteria for certification. The health and welfare status of Bangladeshi shrimp is described in comparison with FAO guidelines below (Table: 15).

Table 15: The minimum substantive criteria for health and welfare and Bangladeshi shrimp aquaculture

Minimum Substantive Criteria	**Bangladesh Status**
There should be an animal health management programme.	Because of the outbreak of diseases the large farms that attempted to introduce semi-intensive culture in the early 1990's had to return to extensive culture later on. The small scale farmers are always worried about intensification of shrimp farming only because of disease. Presently farmers of all sectors are mostly facing problems with maintaining good health of their farmed shrimp. They are trying to find ways to combat diseases and keep shrimp healthy to grow and have a good harvest. Recently, advanced famers are using control system technology (CST) or Modified Control System Technology (MCST) mainly for disease management. In CST, the total production process is controlled and the measures are in place for management of shrimp health and to protect against disease. In this process disease-free PL are collected from a trusted hatchery that uses disease-free mother shrimp and tests them through Polymerase Chain Reaction (PCR) and maintain the culture condition free of pathogen. In MCST, disease-free (PCR screened) PL are reared in a controlled nursery for one month thus their resistance to pathogens is developed. Then they are released into a grow-out pond. These management systems showed a good harvest for recent years but because of additional cost, very few farmers are adopting these systems.[1]
Only aquatic animals that are	It is very important that the shrimp PL used in aquaculture are healthy

[1] Md. AI Masud, Fisheries Biologist and Shrimp hatchery operator, Khulna, Bangladesh, Personal contact

Minimum Substantive Criteria	Bangladesh Status
certified as healthy and/or free of serious pathogens should be used in aquaculture.	and free of disease. The system to examine the hatchery PL through PCR prior to stocking them is in place but this facility is very limited in scope and not complete. There are a few facilities offer PCR testing but at a very high cost[2]. The capacity of screening facilities is also a limiting factor as a large number of PL is produced every year. A very small proportion of PL are screened for diseases through PCR (not more than 1%) [1]. The government of Bangladesh is developing a national shrimp seed certification system. The project is assisting in establishing a PCR-based diagnostic laboratory facility for the Department of Fisheries, in collaboration with the private sector, developing a seed certification system and training of relevant personnel to conduct screening of brood stock and larval stages of shrimp on a regular basis. It is expected that the project will result in a fully-functional seed certification system and improvement of brood stock and PL quality. The process adds cost for the farmer. The farmers also accuse the hatchery owners being reluctant to subject their PL to examination[3].
A healthy culture environment at all phases of the production cycle is necessary to reduce the risk of aquatic animal disease. That includes thorough preparation of the culture facilities before stocking, maintenance of optimal environmental conditions through management of stocking densities, aeration, feeding, water exchange, phytoplankton bloom control, etc.	Under the present culture practice, whether extensive or improved extensive, farmers use preventative measures to protect the farmed shrimp. Farmers prepare their pond by sun drying the bottom once a year, using lime (Calcium Oxide or Hydroxide) to disinfect and augment the soil. Artificial feed is used only in *golda* farms. Use of feed in *bagda* farms is very uncommon. Stocking density is very low so usually external aeration is not necessary but some advanced farmers use this facility to keep pond water more oxygenated. Usually water quality does not deteriorate but farmers examine water parameters such as pH, dissolved oxygen, salinity etc. and maintain them by using lime or a water exchanging system to maintain salinity.
Routine monitoring for early detection of aquatic animal health problems.	Farmers use a sampling method to monitor growth, survival and disease contamination frequently. They cannot detect the disease outbreak early because shrimp diseases are mainly caused by viruses and the outbreak is so rapid that sometimes farmers can do nothing but watch a generation fail.
Adoption of strategies for responsible use of drugs and antibiotics	Under the current culture system no farmer adds antibiotics directly to the pond. There is a claim that formulated feed contains antibiotics but it was refuted by tests. The EU team tested several feeds from different companies, but found no anitbiotics. Some people believe that the ingredients for feed come from Australia or Peru, where antibiotics (eg. Chloramphenicol) are not banned and for this reason believe there are antibiotics in feed[3]. Sometimes chloramphenicol was found in bone meals imported from Australia. But some experts believe that the residue of chloramphenicol and nitrofurans comes from animals excreta because the antibiotics are widely used in animal and human drugs[4]. The government of Bangladesh has restricted use of chloramphenicol and nitrofurans in feed. The amendment of respective rules is ongoing. Under these rules, the use of antibiotics and pesticides is prohibited in feed or shrimp ponds. In case of emergency, eg. the treatment of disease, antibiotics can be used with prior permission from the

[2] Shamsul kabir PhD, Team Leader, PRICE project, USAID, Bangladesh, Personal Contact.
[3] Dr. Aftabujjaman, Leader of Shrimp farmers association, Bangladesh, personal contact
[4] Habibur Rahman Khondokar, Project Director, Department of Fisheries, Bangladesh, personal contact

Minimum Substantive Criteria	Bangladesh Status
	authorised officer of the government and should follow the appropriate withdrawal period in order to satisfy the acceptable maximum residual limit (MRL).
Immediate and effective treatment of infection using permitted amount of recommended drugs.	The shrimp sector currently faces problems with proper tools for treatment of diseases. Disease outbreak occurs so quickly that there is no time to use drugs for treatment. Diagnosis of the pathogen causing disease is also often incorrect so curative measures prove ineffectual. In extensive culture people are not well equipped for early detection of disease. If infection is found before widespread outbreak of disease occurs, the farmers try to catch all the shrimp and move the healthy shrimps to another pond. The infected pond is then drained and treated with calcium oxide or hydroxide or dolomite for disinfection. After 15 to 30 days, they fill the pond with new water and restock. But this practice is limited to few farms. In most cases, just after disease is discovered, they sell the shrimp in local market.
Implementation of measures to reduce unnecessary stress and suffering of animals during culture, harvesting and marketing.	The farmed shrimp do not apparently suffer stress in the current extensive or improved extensive systems. Because of low density, shrimps have enough space and water for grazing and moving around. The harvesting system should allow the farmer to catch them live without causing avoidable stress. There is no use of chemicals, explosions, or toxins in other form used to harvest shrimp. The system from harvesting to processing involves several media and steps. Generally the agents of depots procure shrimp from farm-gate and carry them to depots for icing and packing for further transport to the processing centres. The transports take usually several hours and are not well equipped with ice and other facilities. The transfer from depot to the processing plant sometimes takes place after collecting large amounts of products from the farms. Because of this long supply chain and inadequate facility with depot and transport, the post harvest care and processing does not always comply with proper preservation, hygiene and sanitation measures. As such, the quality of products deteriorates and it is impossible to get a certificate for export or get alert from buyers subsequently.
Should provide training and awareness to the workers on good aquatic animal health management practices and their role and responsibility in maintaining aquatic animal health and welfare in aquaculture	Training and motivational drives by government and NGO initiatives began several years ago. The training is mainly aimed at technology transfer for improved health and diseases management, hygiene and safety in post harvest handling. There is a considerable amount of literature and various training materials about shrimp culture, disease prevention and management that are available to the farmers and workers in shrimp industries.

6.2.2 Food safety and Quality

Safety and quality are the mandatory requirements of food to be exported to the EU and USA markets. The guidelines for aquaculture certification dictate requirements for food safety and quality by implementing appropriate standards and regulations as defined by the FAO/WHO *Codex Alimentarius* and related codes of practice. Shown is the status of Bangladeshi shrimp aquaculture in terms of its compliance with the FAO guidelines in maintaining the safety and quality of shrimp (Table: 16).

Table 16: The minimum substantive criteria for food safety and quality in Bangladeshi shrimp aquaculture

Minimum Substantive Criteria	Bangladesh Status
Should be located in areas where the risk of contamination by food safety hazards is minimized and where sources of pollution can be controlled. Management measures should be in place to control the risk of contamination from the surroundings (e.g. agricultural farms, industries, sewage). It should not be carried out in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in aquaculture products.	Shrimp farming expanded without any formal extension and motivational drive. Due to increased price and high demand in the international market, a large number of local farmers and many outsiders like businessman, politicians, retired army, and civil officials had engaged in shrimp farming during the late 1980's. The shrimp aquaculture of Bangladesh is not well-planned. The production of rice was not so cost-effective because of lower sale price and high production cost. The land owners and farmers were looking for an alternative to rice production. They found shrimp culture more profitable. That is why they converted the rice fields to shrimp ponds. There was no external support from government or from municipality regarding planning and expansion of shrimp culture area or to control its distribution. The farms are small scale and under individual ownership so they went for shrimp farming independantly, no national or group planning was in place. In same way people sometimes stop shrimp farming and revert to agricultural cropping. This has happened recent years. Because of low production rate and lower price, many shrimp farms have reverted to rice cropping. The shrimp farming areas may be considered as pollution free because influential sources of pollution, like big industries, are rare in the shrimp farming areas. But in most areas, the farms are surrounded by agricultural farms. There are risks of contamination from agricultural fields surrounding them. The use of pesticides and fertilizers in agricultural fields is said to be responsible for presence of residues in shrimp. However there is no systematic land zoning system demarking the areas for shrimp farming and agriculture. In recent years, the need for land zoning has come up as major issue in the shrimp sector and the government of Bangladesh has announced efforts to formulate policy on the matter.
Should use appropriate feeds which do not contain unsafe levels of pesticides, biological, chemical and physical contaminants and or other adulterated substances and adopt procedures for avoiding feed contamination. Preparation of feed on the farm should conform to regulations.	In present shrimp farming practice, artificial feed is very rarely used in *bagda* farms. The feed used in *golda* farming that constitutes about 20% of total farming. The feed are claimed to be one potential source of chloramphenicol residues but the manufacturers deny the claim. Some farmers use their own home-made feed and may use antibiotics, without being aware of its side effects, in order to get more harvest.
Should only use approved drugs at approved dosage prescribed by authorised personnel. Banned drugs should not be used.	The current practices in coastal shrimp aquaculture systems did not make use of many pharmaceuticals when confronted with diseases in their stock. The large majority of shrimp farmers, both individuals and groups, harvest the products as soon as the disease is found. Though the use of drugs and antibiotics for disease control is uncommon, farmers have the tendency to use Thiodan (ingredients: endosulfan 35% and emulsifiers 65%), a kind of liquid insecticide, during preparation of ponds and with the appearance of diseases (Alam *et al.*, 2005). The doses varied from farmer to farmer; as they did not know the correct dose and it is still not mandatory to have a prescription from authorised personnel. The chemical companies are trying to market and sell products such as pesticides, herbicides, insecticides, and inorganic fertilizers, to impede the outbreak of disease. There are shortcomings in

Minimum Substantive Criteria	Bangladesh Status
	the official regulationof the use of drugs in ponds and aquaculture farms. For instance, there is no recognized authority that is authorised to give such prescription still. There are claims of farmers using banned drugs also. The formation of rules incorporating the use of drugs and designating a prescribing authority is under development.
Should use water free of biological or chemical hazards. Farms should not be located where there is a risk of such contamination.	Water used in shrimp farms comes from natural sources like rivers and canals and seem to be hazard free. Still there is risk of being cross contaminated from one farm to another because several farms share a single water source.
Should use the brood stock and post larvae from a hazard free source (in regards to antibiotics, parasites, etc.)	Currently the gravid shrimps are collected from natural sources. Generally these mother shrimps are found in good health but sometimes poor handling measures in the trawler cause infection that ultimately affects to the PL. Due to the severe outbreak of diseases (mostly viral) in recent years, there is a perception in the shrimp sector that the source of gravid shrimps may not be pathogen free and subsequent occurrence of sickness is likely. For the same reason the hatchery PL are not much trusted as free of disease. There is reason to believe the marine waters are free of antibiotics.
Should ensure traceability documenting every inputs and steps in the operation cycle.	In recent years traceability has been a most important issue for export products. The international buyers are very demanding about the traceability of the product. It ascertains the information about every step of the chain of custody of a product. To ensure traceability in the production cycle of shrimp, the government of Bangladesh has mandated registration of hatcheries from where the PL comes and registration of farms where the shrimps are grown up. Almost all farms and hatcheries are registered now (EU, 2007). The inputs used in the production process and the steps through which the shrimp come to the processing plant and finally up to the consignment, are recorded as instructed by the directives of the EU and Bangladeshi government. Though policies are in place to ensure traceability, there are still a few limitations in the opinion of the European Union Mission in 2007 and there are still several shortfalls to address the issue up to date.
Should apply HACCP principles during culture to ensure good hygienic culture conditions and safety and quality of produce.	The application of HACCP principles in processing plants started several years ago, soon after the ban that the EU imposed in 1997. Most of the processing plants are complying with the regulations controlling the critical points of potential hazards. HACCP principles are not being applied enough during culture of shrimp. The culture system, whether traditional or extensive, seems to be free of potential hazards and safe for the production of shrimp for human consumption unless it is contaminated by viral or bacterial pathogens.
Identification, classification and monitoring programs should be implemented in bivalve mollusc farming districts to prevent contamination from microbiological and chemical hazards and from biotoxins.	As reported no bivalve mollusc found growing in the shrimp farming ponds in Bangladesh, though there is no such monitoring program prevailing yet.
Should provide the workers with	A good number of training programmes were implemented during the

Minimum Substantive Criteria	Bangladesh Status
training in good hygiene management practices and their role and about their responsibility for protecting aquaculture products from contamination and deterioration.	past several years aimed at increasing proficiency and raising awareness about hygiene management in farms and processing plants among the farmers, depot workers, hatchery technicians and others associated with the production or processing of shrimp. The programmes were organised by governmental departments, specifically by the Department of Fisheries, donor assisted projects and NGO's. The people in the shrimp sector are now thought to have the knowledge and skill to address the quality and safety issues of farming and processing of shrimp and are cautious enough about hygiene and risks of contamination of shrimp. The Department of Fisheries (DoF) has several establishments called Fisheries Training and Extension Centres, where the training is mainly conducted and it is a continuous process. The DoF officials in district and sub-district levels arrange training as required for the participants. Sometimes the DoF officials arrange special training sessions in their offices as needed. A number of training and extension manuals have been published and distributed among stakeholders by governments or NGO initiatives. Though these are mainly focussed on extension of updated technology to increase production of shrimp and to develop farmers' skill on disease prevention, and improvement of management.

6.2.3 Environmental Integrity

Environmental quality is an important concern for aquaculture. According to the guidelines an aquaculture operation should have addressed several environmental issues to be certified. Bangladeshi shrimp aquaculture compliance with the FAO guidelines in maintaining environmental integrity is shown (Table 17).

Table 17: The minimum substantive criteria for environmental integrity and Bangladeshi shrimp aquaculture

Minimum Substantive Criteria	Bangladesh Status
Environmental impact assessments should be employed, according to national legislation, prior to approval of aquaculture operations	According to national rules, any industryor project that may have an impact on the environment, must undergo the Environmental Impact Assessment (EIA) and acquire certification from the Department of Environment prior to commencing operations. These rules do not apply to the current shrimp culture system because the farms are small scale and thought to have minimal effect on the environment. But the processing plants have to submit an EIA report to get a licence for operation. The local shrimp culture entrepreneurs are not aware of the necessity of undertaking Environmental Impact Assessment studies. The shrimp farms are now considered to have the aforementioned negative effects on the environment. Nonetheless, to intensify production, the farmers participate in training to increase technical knowledge, disease prevention, and improvement of management. In reality, however, some apply their learning, despite the tendency to widely use insecticides.
Aquaculture should have a routine monitoring system to identify its impacts on biodiversity, habitats, ecosystem, soil, water, natural fish species etc. and have measures to mitigate them.	The waste production from this type of shrimp farming does not seriously affect the environment. Aquatic weeds, phytoplankton, and algal blooms are the major sludge produced in shrimp farms. Farmers collect their sludge and dead fish and put them in farm dikes or at the elevated corner of the farm (Alam *et al.*, 2005).

Minimum Substantive Criteria	Bangladesh Status
	No routine monitoring system is currently in place to identify such impacts on the environment. There has been little research to identify the impacts of shrimp aquaculture on the environment. This type of impact monitoring is not possible for small scale farmers individually because of their comprehensive nature.
Aquaculture should encourage the use of native species and any exotic species used should pose a low potential risk to the natural environment, biodiversity and ecosystem health.	The shrimp species used in Bangladeshi aquaculture are mostly native. No exotic shrimp species have been recorded as cultured in Bangladesh. Some farmers are interested in white leg shrimp *(Penaeus vannamei*) which is cultured widely in Thailand and Vietnam but the species is discouraged in Bangladesh.
Responsible use of hatchery produced seed for culture. Seed from the wild should only be used when collected using responsible practices.	The shrimp culture was completely dependent on the wild source for PL up to mid 90's. Since the wild fry collection method is devastating to biodiversity, the government imposed ban on wild fry collection in 2000. By that time, several hatcheries were established and currently 95% of PL comes from hatcheries.
Responsible use of feeds, feed additives, fertilizer, chemicals, veterinary drugs and antibiotics and no use of GMOs.	The use of feed is very limited in shrimp aquaculture in Bangladesh. Artificial feed is only used in freshwater shrimp farms. The fertilizers used in shrimp farms include cow dung, urea, and Triple Super Phosphate (TSP). All these are mixed together and kept in a hole on the periphery of a shrimp farm for 2–3 months. It is then used during June and July. Lime, urea, TSP, di-ammonium phosphate, and muster cake are widely used as fertilizers to improve fertility of the pond. The majority of the cow dung used as organic fertilizer is imported from outside the area. The waste production and contamination as a consequence of the use of those inputs is very low. The use of additives and veterinary drugs is not significant but when these are used it does not seem that the application causes negative environmental effects. No use of GMOs' reported in shrimp aquaculture in Bangladesh.

6.2.4 Social Responsibility

According to the guidelines an aquaculture operation should comply with the standards regarding social responsibility. Table 18 shows how Bangladesh currently complies with the social issues outlined in the FAO guidelines for aquaculture certification.

Table 18: The minimum substantive criteria for social responsibility and Bangladeshi shrimp aquaculture

Minimum Substantive Criteria	Bangladesh Status
Aquaculture should be conducted in a socially responsible manner to contribute to rural development, poverty alleviation and food security and deliver benefits to the local community and surrounding resource users	Shrimp aquaculture contributes to the development of Bangladesh in several ways including contributing to the economy, poverty alleviation, income generation, rural development and establishing food security. But it does not happen always in a responsible manner. There are prevailing allegations that local communities are not getting as much benefit as they should.
Socio-economic issues should be considered at all stages of aquaculture planning, development	There is no comprehensive planning for shrimp aquaculture in Bangladesh. It was developed by small scale farm owners and without governmental intervention.

Minimum Substantive Criteria	Bangladesh Status
and operation, in order to maximize benefits and equity and to minimize any negative economic consequences to workers and/or communities.	In recent years, the government has been enforcing and formulating new rules to address socio-economic consequences in this sector.
Gender issues, impacts on women and youth, and opportunities for women and youth should be identified, evaluated and addressed during planning, development and operation of aquaculture.	So far there are no such measures taken for shrimp aquaculture sector of Bangladesh in a coordinated manner. Various governmental projects and non-governmental organisations have identified some of the issues and taken measures to address them.
Workers should be treated responsibly in accordance with national labour rules and regulations and international labour conventions as appropriate. They should be paid wages and provided other welfare facilities according to national rules and regulations.	The workers engaged in shrimp aquaculture are differentiated. Except the hatchery technicians, the workers are manual labour. They prepare the pond, using lime, fertilizer or feed and serve as guards for the farm to protect farmed shrimp from theft. They are also engaged during harvesting and selling of shrimp. These labours are very poorly paid and not according to government's labour rules.
Child labour should never be used outside of the existing ILO conventions and standards.	The use of child labour in aquaculture is very rare in the farms but not in depots. Child and juvenile labour is reportedly used in depots for many jobs and there are claims circulating of sub-standard pay and non-compliance with ILO conventions.

7 RECOMMENDATIONS

There are several shortcomings in operation, management, social and economic issues that need to be addressed before going forward to a certification system. As the social, environmental, food safety and quality issues, market requirements, certification process and classification are discussed earlier, the following recommendations are put forward to improve Bangladeshi shrimp aquaculture in order to achieve a product that can be accepted for certification.

Overall Strategy

A strategy needs to be developed to improve the overall position of the Bangladeshi shrimp supply in the competitive global market. A major component of this strategy is to improve the shrimp aquaculture sector in Bangladesh to comply with criteria for certification.

Organisation of farms group or cluster

As the shrimp farms are small scale and mostly run by individual entrepreneurs, it is very difficult to maintain responsible practices there. The farmers may be organised under an umbrella of a group or cluster and then take several improvement steps in a coordinated manner.

Land Zoning

Currently there is no municipal zoning of shrimp aquaculture, hatcheries, processing plants, rice culture, or other industries which create problems in the aquaculture and agriculture sectors. The pesticide residues and some other contaminants are said to come from surrounding agricultural fields. The agricultural lands are also getting saline as a result of intrusion of saline water used for shrimp culture. Both the issues are generating conflict among the different beneficiary groups. The government should zone the land or area for specific use.

Declaration of Shrimp Industrial area

The government can declare some appropriate area for shrimp industries and develop different facilities there including roads, canals, saline water reservoirs, hatcheries, ice factories and transport facilities.

Enforcement of rules and acts regarding use of drugs

The existing rules for use of veterinary drugs should be enforced. New rules may be promulgated to comply with new situations. The proper authority to prescribe chemicals and drugs in aquaculture should be designated and clear directives from the government should be in place as well.

Control of Import of Feed and Ingredients

There are claims that several imported feeds are among the sources of chemicals and drug residues found in shrimp. The feeds and feed ingredients are imported from some countries where nitrofurans and chloramphenicol are not banned. So control measures should be taken to import only safe feeds and feed ingredients.

Enforcement of Fish Quarantine Act

It is believed that the devastating WSSV was introduced by imported PL because of weak quarantine regarding fish. Proper regulations should be in place to control the import of live aquatic animals. A new law has been proposed that will help maintain the quality of fish and fishery products and prevent diseases for both import and export. Proper actions should be taken to enforce the law effectively.

Registration of Shrimp Farms

All the shrimp farms should register with an appropriate authority, like Department of Fisheries. This will help ensure traceability of product and establish a well defined supply chain. It is also essential for transfer of technology, checking utilization of safe inputs and documentation of culture practices.

Hatchery registration

A programme of hatchery registration and certification should be implemented and the respective rules and regulations should be enforced properly. A mechanism for hatchery PL batch traceability should be established and promoted for use.

Responsible use of Chemicals in Hatchery

Regulations to ensure responsible use of drugs and chemicals in hatcheries need to be implemented. A code of practice for hatchery management over the use of drugs, hygiene control and quality management needs to be established.

Use of SPF shrimp for aquaculture

PL quality health standards need to be bolstered by establishment of an appropriate number of laboratories and proper utilization of PCR methods for subsequent certification by accredited laboratories. This will ensure the use of pathogen free post larvae.

Environmental Impact Assessment (EIA)

It is not viable for every farm to have an Environmental Impact Assessment. But with the formation of clusters, groups, or industrial areas, the EIA could be undertaken. Hatcheries and processing plants must have EIA. This can be ensured by associations of the respective categories.

Sustainable Use of Gravid Shrimp

The shrimp hatchery industry is dependent upon mother shrimps from the wild capture fishery. This has a number of disadvantages including the potential for introduction of disease from the mother to the PL. The hatchery industry should develop its own domesticated broodstock that are guaranteed as pathogen free through a regular screening programme. A code of conduct for wild mother shrimp collection needs to be prepared and utilised. Specific Pathogen Free (SPF) varieties are established and domesticated for use by the industry. Fisheries Management Plan for broodstock collection is developed, including appropriate seasonal and geographic restrictions, other effort and gear restrictions or criteria.

Social welfare

There is a need for policies and strategies to ensure contribution to rural development, poverty alleviation and food security and to deliver benefits to the local community and surrounding resource users.

Women welfare

There should be no gender discrimination in wages or available positions in aquaculture. To realise this, legal regulations need to be agreed upon. The owners of aquaculture facilities and associations must ensure the rights of women in the industry. The government must monitor the implementation of such regulation.

Use of labour

Workers should be treated responsibly within the national labour rules and regulations and international labour conventions. They should be paid wages and provided other welfare facilities according to national rules and regulations. Child labour should never be used outside of the existing ILO conventions and standards. The owners of the facilities and associations must ensure the rights of children in the industry. The government must monitor adherence to these laws and conventions.

Post harvest transport and handling

Good post harvest handling practices should be ensured to avoid spoilage and microbiological hazards after harvesting of shrimp. Adequate facilities during transport, in landing stations, and fish depots should be established and a supply of quality ice should be ensured to all aquaculture regions.

Training and awareness

Currently training programmes implemented by the government and NGOs are mainly focusing on technology transfer to shrimp farmers. Along with these, much training is recommended for workers engaged in shrimp farms as well as those who collect, handle, preserve and transport shrimp in landing stations and markets. The training should address good health management and handling practices of shrimp, good hygiene management practices. The workers must understand that it is their role and responsibility to ensure good health of shrimp and for protecting shrimp products from contamination and deterioration.

Capacity building of small scale farmers

There should be a programme implemented for increased credit facility and access to different government and nongovernment resources for the small scale farmers.

Monitoring and coordination

Strong monitoring is needed of the use of chemicals and veterinary drugs in hatcheries and shrimp farms and on the issues of ecological and social impacts. Better networking and coordination need to be developed with government bodies like agriculture, livestock, forest, and land, private sectors entrepreneur, international agencies, researchers, fish exporters and consumers to exchange views, identify problems and prospects, and make sound decisions and prompt actions.

Development of guiding document

A general guiding document should be developed for responsible shrimp farming that includes technical good practice guidelines as well as environmental and social welfare safeguards. This could be according to the International principle for responsible shrimp aquaculture and technical guidelines for aquaculture certification of the FAO and other similar documents.

Promoting Organic Shrimp

The product of extensive culture can be considered natural. Thus, it can be converted to organic product by small operational changes such as limiting or banning the use of chemicals. The interest in organic shrimp production should be assessed and a certification system could be established as well.

Governing of Certification System

The certification system should first take into consideration the status of the culture system. The independence and size of farms should be considered. As experienced in India, group or clusters of farmers can be formed. Because of instability in private organisations or mistrust of them, the government may initiate the certification system and after getting the system working it can be handed over to an independent body. The Department of Fisheries would oversee the development of codes of conduct in the aquaculture sector and run the certification scheme.

8 CONCLUSION

It is difficult to conduct this type of study from a distant place. Most of the literature found on the issue was from the late 1990's and the first few years of the current decade. More recent information in published documents was hard to find. Information regarding the recent status of Bangladeshi shrimp aquaculture was collected through personal communication. The study would have been better with more input from the stakeholders. Data collection would benefit from direct interviews and study area visits also could have helped in getting a more precise outcome. However, the study was actually the start of discussion on environmental certification of Bangladeshi shrimp and tried to address the main issues regarding the minimum substantive criteria set by the FAO. More intensive studies are needed to find out the specific places to improve the situation and the ways to develop a certification and labelling system. There also need to be more studies to analyse the financial cost and benefit for adopting a certification system and development of guiding documents like code of conducts specific for Bangladeshi shrimp aquaculture.

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Annexure 1:

Questionnaire

The FAO has developed guidelines for aquaculture certification very recently. The guidelines provide the principles and basis for standard setting, certifying and accreditation for developing a certification scheme and its governing and implementation procedures. The objective of the guidelines is to harmonise among certification schemes prevailing worldwide. According to the guidelines, aquaculture should have minimum substantive criteria given in the table below. Hence please evaluate **shrimp aquaculture of Bangladesh** as accordance with the criteria and suggest your score.

Minimum Substantive Criteria	**Bangladesh Status/ Your Comment**	**Given Marks**
A. Animal Health and Welfare		
Should have an animal health management programme.		/12.5
Should use of aquatic animals that are certified as healthy and/or free of serious pathogens in aquaculture.		/12.5
Should maintain a healthy culture environment at all phases of the production cycle to reduce risks of aquatic animal disease before they occur that includes thorough preparation of the culture facilities before stocking, maintenance of optimal environmental conditions through management of stocking densities, aeration, feeding, water exchange, phytoplankton bloom control, etc.		/12.5
Routine monitoring for early detection of aquatic animal health problems.		/12.5
Should adopt strategies for responsible use of drugs and antibacterials.		/12.5
Should take immediate and effective treatment using permitted amount of recommended drugs.		/12.5
Should implement measures to reduce unnecessary stress and suffering of animals during culture, harvesting and marketing.		/12.5
Should provide training and awareness to the workers on good aquatic animal health management practices and their role and responsibility in maintaining aquatic animal health and welfare in aquaculture		/12.5
	Total score	/100
B. Food Safety		
Should be located in areas where the risk of contamination by food safety hazards is minimized and where sources of pollution can be controlled. Management measures should be in place to control risks of contamination from the surroundings (e.g. agricultural farms, industries, sewage). It should not be carried out in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in aquaculture products.		/10
Should use appropriate feeds which do not contain unsafe levels of pesticides, biological, chemical and physical contaminants and or other adulterated substances and adopt procedures for avoiding		/10

Minimum Substantive Criteria	Bangladesh Status/ Your Comment	Given Marks
feed contamination. Preparation of feed on the farm should in accordance with regulations.		
Should use approved drugs in approved dose prescribed by authorised personnel. Banned drugs should not be used.		/10
Should use water free of biological or chemical hazards. Farms should not be sited where there is a risk of such contamination.		/10
Should use the brood stock and post larvae from a hazard free source (e.g. antibiotics, parasites, etc.)		/10
Should ensure traceability documenting every inputs and steps in the operation cycle.		/10
Should apply HACCP principles during culture to ensure good hygienic culture conditions and safety and quality of produce.		/10
Should have a pest control programme, so that rodents, birds and other wild and domesticated animals are controlled, especially around feed storage areas.		/10
Identification, classification and monitoring programs should be implemented in bivalve molluscs growing areas to prevent contamination from microbiological and chemical hazards and from biotoxins.		/10
should provide training and awareness to the workers on good hygiene management practices and their role and responsibility for protecting aquaculture products from contamination and deterioration		/10
	Total score	/100
C. Environmental Integrity		
Environmental impact assessments should be employed, according to national legislation, prior to approval of aquaculture operations		/20
Aquaculture should have routine monitoring sysytem to identify its impacts on biodiversity, habitats, ecosystem, soil, water, natural fish species etc. and have measures to mitigate them.		/20
Aquaculture should encourage the use of native species and exotic species are only used that have low potential risk to the natural environment, biodiversity and ecosystem health.		/20
Responsible use of hatchery produced seed for culture. Seed from the wild should only be used when collected using responsible practices.		/20
Responsible use of feeds, feed additives, fertilizer, chemicals, veterinary drugs and antibacterials and no use of GMOs.		/20
	Total score	/100
D. Social Responsibility		
Aquaculture should be conducted in a socially responsible manner to contribute rural development, poverty alleviation and food security and deliver benefits to the local community and surrounding resource users		/20
Socio-economic issues should be considered at all stages of aquaculture planning, development and operation, in order to maximize benefits and equity and to minimize any negative economic consequences to workers and/or communities.		/20
Gender issues, impacts on women and youth, and opportunities		/20

Minimum Substantive Criteria	Bangladesh Status/ Your Comment	Given Marks
for women and youth should be identified, evaluated and addressed during planning, development and operation of aquaculture.		
Workers should be treated responsibly within the national labour rules and regulations and international labour conventions as appropriate. They should be paid wages and provided other welfare facilities according to national rules and regulations.		/20
Child labour should never be used outside of the existing ILO conventions and standards.		/20
	Total score	/100
	Grand Total	/400

Name, Position, Address, Phone & email of the respondent.

Annexure 2:

Persons Contacted

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9. Md.AI Masud, Executive partner, Rupsha Golda Hatchery and Royal Hatchery and Agro complex, jabusha, Rupsha, Khulna, Bangladesh, Email: masumnasrin1@yahoo.com
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Annexure 3:

Articles of FAO Code of Conduct for Responsible Fisheries related to sustainable aquaculture and Certification.

Article 9.1.5. States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences

Article 9.4.4. States should promote effective farm and fish health management practices favouring hygienic measures and vaccines. Safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease control chemicals should be ensured.

Article 9.4.5. States should regulate the use of chemical inputs in aquaculture which are hazardous to human health and the environment.

Article 9.4.6. States should require that the disposal of wastes such as offal, sludge, dead or diseased fish, excess veterinary drugs and other hazardous chemical inputs does not constitute a hazard to human health and the environment.

Article 9.4.7. States should ensure the food safety of aquaculture products and promote efforts which maintain product quality and improve their value through particular care before and during harvesting and on-site processing and in storage and transport of the products.

Article 11.1.11. States should ensure that international and domestic trade in fish and fishery products accords with sound conservation and management practices through improving the identification of the origin of fish and fishery products treated.

Article 11.1.12. States should ensure that environmental effects of post-harvest activities are considered in the development of related laws, regulations and policies without creating any market distortions.

Article 11.2.4. Fish trade measures adopted by States to protect human or animal life or health, the interests of consumers or the environment, should not be discriminatory and should be in accordance with internationally agreed trade rules, in particular the principles, rights and obligations established in the Agreement on the Application of Sanitary and Phytosanitary Measures and the Agreement on Technical Barriers to Trade of the WTO.

Article 11.2.13. States should cooperate to develop internationally acceptable rules or standards for trade in fish and fishery products in accordance with the principles, rights, and obligations established in the WTO Agreement.

Article 11.3.2. States, in accordance with their national laws, should facilitate appropriate consultation with and participation of industry as well as environmental and consumer groups in the development and implementation of laws and regulations related to trade in fish and fishery products.

Annexure 4:

Shrimp Farm Information (Real Example)

Example 1:

Sl.no.	Particulars	
1.	Shrimp farm's name and location	Kergatoli, Angumanpara, Palongkhali, Ukhiya
2.	Shrimp farm's registration no.	88-0341-01-05-13-0025
3.	Farm area	50 hacter
5.	Farmer's name	Shamsul Alam
6.	Culture type	Improved Extensive system
7.	Pond preparation	Drying (Oct07) 30 days, washing (Nov07) 30 days
8.	Water intake (date)	First week Dec 2007
9.	Water depth (average)	4-6 feet
10.	Liming	1000 kg (Dec 2007)
11.	Fertilization (before PL stocking)	TSP 500 kg (Dec 2007)
12.	Fertilization (after PL stocking)	Urea 500kg(Feb/08), 500kg Mar/08, 500 kg April/08
12.	First PL stocking (hatchery)	4 lac (11/12/07)
13.	2nd PL stocking (hatchery)	2 lac (15/02/08)
14.	3rd PL stocking (hatchery)	2 lac (28/02/08)
15.	4^{th} PL stocking (hatchery)	4 lac (13/03/08)
16.	Total PL stocking	12 lac
17.	Water exchange	Every high tide (10 days/month)
18.	Feed used	None
19.	Chemical used	None
20.	First harvesting (date, size, price)	23/02/08 (45-66 Pic/kg), 140 Tk/kg
21.	Last harvesting (date, size, price)	01/09/08 (16-20 Pic/Kg), 600 TK/Kg
22.	Total production (shrimp)	4800 Kg (48 Kg/Acre)
23.	Total production (other fish)	1500 Kg
24.	Total sale	12 lac Tk
25.	Total survibility (%)	16 –20 %
26.	Total cost (Lease, preparation, PL, Lime, Fertilizer, Maintenance cost, harvesting cost etc)	13,33000 Tk
27.	Net loss	1 lac 33 thousand Tk

Example 2:

Sl.no.	Particulars	
1.	Shrimp farm's name and location	Guizza Khali, Angumanpara, Palongkhali, Ukhiya
2.	Shrimp farm's registration no.	88-0341-01-05-13-0033
3.	Farm area	32 Hacter
5.	Farmer's name	Master Makbul Ahmad
6.	Culture type	Improve extensive system
7.	Pond preparation	Drying (Nov07) 30 days, washing (Dec07) 15 days
8.	Water intake (date)	3rd week Dec 2007
9.	Water depth (average)	4-6 feet
10.	Liming (CaCO3), (before PL stock)	3000 kg (Dec 2007)
11.	Fertilization (before PL stocking)	Urea 750 Kg + TSP 500 kg (Dec 2007)
12.	Fertilization (after PL stocking)	Urea 250kg + TSP 150 kg (Feb/08)
12.	First PL stocking (hatchery)	3 lac (last week Dec/07)
13.	2nd PL stocking (hatchery)	3 lac (Feb 3rd week/08)
14.	3rd PL stocking (hatchery)	4 lac (2nd week March/08)
15.	4th PL stocking (hatchery)	2 lac (Last week March/08)
16.	Total PL stocking	12 lac
17.	Water exchange	Every high tide (10 days/month)
18.	Feed used	None
19.	Chemical used	None
20.	First harvesting (date, size, price)	03/03/08 (45-66 Pic/kg), 140 Tk/kg
21.	Last harvesting (date, size, price)	30/08/08 (16-20 Pic/Kg), 600 TK/Kg
22.	Total production (shrimp)	7200 Kg (90 Kg/Acre)
23.	Total production (other fish)	1200 Kg
24.	Total sale (Shrimp + other fish)	16 lac Tk
25.	Total survibility (%)	20 –25 %
26.	Total cost (Lease, preparation, PL, Lime, Fertilizer, Maintenance cost, harvesting cost etc)	14 lac Tk
27.	Net Profit	2 lac Tk