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WORLD MARITIME UNIVERSITY
Malmö, Sweden

**An Evaluation of Integrated Coastal and Ocean
Management as a Means for Sustainable
Development**

**A Case Study: The Environmental and Socio-
Economic Impact of Shrimp Farming in
Bangladesh**

By

Ali Yusuf Muhammad Sultan Noor
The People's Republic of Bangladesh

A dissertation submitted to the World Maritime University in partial fulfillment
of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME AFFAIRS
(MARITIME ADMINISTRATION)

2001

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

.....(Signature)

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DEDICATION

I dedicated this Dissertation to my brave 9-year-old son, Wazed Ibne Noor who underwent a medical operation without his father's presence, because I was at the finishing stage of the writing and could not be present. I also dedicated it to my wife who went through the painful ordeal of dealing with the critical situation.

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I would like to thank the Ministry of Shipping of the People's Republic of Bangladesh for nominating me for a scholarship at the World Maritime University and the Ministry of Establishment for granting me study leave for 17 months to come to Malmö.

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I will remain grateful to my supervisor, Dr. Moira L. McConnell for her sagacious and valuable propositions to make me intellectually prepared for writing the dissertation. I will carry in my memory all the feeling of appreciation for her kind patience, her peerless sense of responsibility and her relentless and consummate effort to see me through the process of finishing it.

The library staff of the World Maritime University deserves appreciation for their continued support and assistance. Particularly, my thanks go to Susan Wangeci-Eklöv and Cecilia Denne.

My special thanks go to my loving wife, who went through the ordeal of temporary separation for a long 17 months and patiently took care of our beautiful children at home. I am also thankful to my parents who supported my family during my absence.

ABSTRACT

The United Nations Convention on the Law of the Sea, 1982 affirmed in its Preamble that, “ the problems of ocean space are closely interrelated and need to be considered as a whole.” Nearly 20 years have passed since that declaration, but the need is still felt. There is an even more urgent need for effective management of the use of coastal and ocean resources in order to prevent degradation of the ocean and to protect and conserve the ocean resources and biodiversity. Effective and strategic institutional and domestic management is required for the sustainable development of the marine resources, to ensure that the needs of future generations are met while satisfying the requirement of the present. From the 1980s, Integrated Management of the coastal zone has been considered as a key management approach to achieve sustainable development.

The shrimp farming industry in Bangladesh is an important export-oriented economic activity that has a negative ecological impact on coastal zone resources. It has both positive and negative socio-economic impacts on the coastal society. The existing sectoral management approach of marine resources and ocean activities in Bangladesh is an impediment to the sustainable development of this industry and other resources affected by it. A comprehensive national policy framework and an integrated management mechanism are needed for the protection of Bangladesh’s coastal and marine environment and the resolution of social and economic conflicts existing in the shrimp farming and coastal area.

The Dissertation focuses on shrimp farming in Bangladesh as an example of a coastal use that can have a harmful effect on the environment and on other uses. It puts forward the idea that shrimp farming in Bangladesh developed rapidly as a result of external economic forces. There is a lack of capacity in the management of shrimp farming and as a result, shrimp farming and other coastal uses are managed in a fragmented manner that does not take into consideration the negative impacts and eventually gives birth to social conflicts. This Dissertation proposes the adoption of an Integrated Coastal and Ocean Management (ICOM) approach in order to respond to specific problems and to avoid future difficulties. It recommends the creation of an Integrated Coastal and Ocean Management Commission, Environmental Impact Assessment and the strategic zoning of coastal resource use areas etc.

KEYWORDS: Integrated, Management, Coastal, Aquaculture, Sustainable, Development.

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LIST OF ABBREVIATIONS

ATDP	Agro-Technology Development Project
BOD	Biochemical Oxygen Demand
CBD	Convention on Biological Diversity
COMB	Centre of Marine Biotechnology
COP	Conference of the Parties
CSD	Commission on Sustainable Development
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organization
GATT	General Agreement on Trade and Tariffs
GOB	Government of Bangladesh
HACCP	Hazard Analysis Critical Control Point
IAM	Integrated Area Management
ICAM	Integrated Coastal Area Management
ICOM	Integrated Coastal and Ocean Management
ICZM	Integrated Coastal Zone Management
IMF	International Monetary Fund
NICOMC	National Integrated Coastal and Ocean Management Commission
NGO	Non Governmental Organization
SAP	Structural Adjustment Policy
SERC	Smithsonian Environmental Research Centre
UNCED	United Nations Conference on Environment and Development

UNCLOS	United Nations Convention on Law of the Sea (1982)
USAID	United States Agency for International Development
UNEP	United Nations Environment Programme
WCC	World Coast Conference
WCED	World Commission on Environment and Development

Chapter 1

1. Introduction

It has almost become a practice that any discussion on coastal area management or integrated management of coastal or ocean resources begins with a reference to the “ interface between land and sea” or the area or place where the land surface and the surface of the sea meet and interact (Scura et al., 1992; Laksmi & Rajagopalan, 2000). The area is important in that it is also the interface between the activities on the land and the activities in or on the oceans. The other most important fact about the area is that nature has filled it with all the resources humans need to survive. The ocean is also a source of spiritual and aesthetic values. Romantic poets have always considered the sea as a power that embodies the eternal beauty of the universe and as a spiritual power that is inspiring and a food for the nourishment of the soul. Beaches in the coastal areas provide recreational facilities for holidaymakers and at the same time, these are tools for the tourism industry and contributors to the local or national economy.

Ancient history tells us that, usually, business activities were centred on the ports or harbours because of the easy and sometimes, only means of transport opportunity by sea. With the rapid growth and expansion of modern trade and economic activities, the shipping sector has become a major factor in the perspective of sea borne trade. Today, the high-tech industries and large factories are mostly located near coastal areas, taking the opportunity of easy access to the sea. Military

activities are also a major use since naval ships ply the coastal areas and the high seas on a regular basis.

The blend of “freshwater and saltwater in coastal estuaries creates some of the most productive and richest habitats on earth” (Cicin-Sain et al. 1998, p. 15). These areas are often rich fishing grounds, which are valuable in the sense that they provide protein, nutrition and food for people, and play a vital role in the economic activities of a nation. According to the Food and Agricultural Organization (FAO), aquaculture carried out in the coastal areas has become an important food-producing sector and greatly contributes to people’s livelihoods, food security, poverty alleviation, income generation, employment and trade (NACA/FAO, 2000). In addition to resource exploitation in many coastal areas, the simple presence of mangrove forests and coral reefs act as a natural barrier to protect human communities from natural calamities like hurricanes, typhoons, and other ocean related disasters. These are the uses and activities that represent some values and are of great importance to humans (Cicin-Sain et al. 1998). All these uses and activities have been carried out largely for the well being of human society. Exploration and exploitation has occurred for generations, apparently with the idea that nature’s bounty is unlimited. However, with scientific revelations the fact is now well established that even though the land and the sea offers humans an opportunity to enjoy the gifts of nature’s resources, it is an opportunity that requires proper use, care and management. Otherwise, the opportunity will be lost.

The oceans are increasingly threatened by human activity, particularly in emerging economies. There are many factors that are gradually degrading the ocean and its valuable resources. Statistics show that about 60% of the world’s total population live near the coastal areas and two-thirds of the world’s largest cities are located on coasts (Vandermeulen, 1999; Laksmi & Rajagopalan, 2000). In the developing countries these two facts have a serious adverse effect on the coastal environment, human health and the economy of those countries. The coastal areas are affected by the pollution generated by the human activities, and industrial operations like oil exploration, ocean dumping, and minerals mining, and over exploitation of fish (Clark, 1998). The presence of sewage plants near the coastal areas, the industrial

wastes, the use of pesticides and chemicals in agricultural land and plants, all these factors are causes of contamination of the waters of the estuaries, bays and coastal areas. The shipping industry has been singled out as an important source of pollution created both by fuel and engine oil and other polluting substance discharges and the fact that the ballast waters carried by ships can contain harmful pathogens and aquatic organisms. When discharged into a new ecosystem, they can have some detrimental effects on marine species, human health and the national economy (Lazaroff, 2000).

Nature and humans are part of the same ecosystem. For example, because of increasing demands for food to sustain a growing population, every year large areas of forest are cleared to provide new areas of fertile land. Trees are sources of oxygen production, carbon dioxide conversion and carbon sequestration. By eliminating these forests, emissions of greenhouse gases, which are detrimental to human health and the environment, are increased (Dale et al. 2000). This can cause climate change, which in turn can affect the sea level and marine species. A change in sea level can have a dramatic and destructive impact on many States; particularly island States that are situated close to sea level. Preservation of the ecosystem is, therefore, essential for the existence of humans and the environment.

In 1982, the United Nations Convention on the Law of the Sea drew the attention of the international community to, " the problems of ocean space are closely interrelated and need to be considered as a whole" (UNCLOS, 1982). Chapter 17 of Agenda 21, adopted at the United Nations Conference on Environment and Development (UNCED) held at Rio in 1992, invites us to think about the entire area encompassing both the land and watersides through its call for "integrated management and sustainable development of coastal and marine areas, including Exclusive Economic Zones" (Agenda 21). It emphasizes the need for proper management of marine fishery resources under national control and the importance of the connection between land and sea, particularly regarding land-based sources of marine pollution. It also highlights the need for economic development that can meet the present and future generation's needs. The management system prompted by Agenda 21 covers management in all sectors. In 1993, the World Coast Conference declared that Integrated Coastal Zone Management (ICZM) is the most

appropriate process to anticipate and respond to long-term concerns and needs while addressing present day challenges and opportunities. There is an urgent need for coastal States to strengthen their capabilities for ICZM, working towards the development of appropriate strategies and programmes. The Conference Report suggested that ICZM involves the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development (WCC, 93).

The approach to managing the ocean and the interface has been fully developed over the last 10 years in the wake of increased coastal and ocean use. The term ICZM has been replaced by various other terms such as Integrated Area Management (IAM), Integrated Coastal and Ocean Management (ICOM). Although there are some differences in concepts, generally all terms refer to the same approach of management. This Dissertation uses the term Integrated Coastal and Ocean Management (ICOM). ICOM is concerned with the effective coordination of activities and uses on the coastal land and ocean zones. Its focus is on conflict prevention, planning, communication, and environmental impact assessment to ensure future decision-making. ICOM has been defined as

" a continuous and dynamic process by which decisions are taken for the sustainable use, development, and protection of coastal and marine areas and resources. ICM acknowledges the interrelationships that exist among coastal and ocean uses and the environments they potentially affect, and is designed to overcome the fragmentation inherent in the sectoral management approach. ICM is multi-purpose oriented, it analyses and addresses implications of development, conflicting uses, and interrelationships between physical processes and human activities, and it promotes linkages and harmonization among sectoral coastal and ocean activities" (Cicin-Sain and Knecht, 1998, p.39).

This dissertation explains the utility of ICOM and presents the idea that it is a tool for the effective management of coastal and ocean uses to ensure sustainable development. It does so by focussing on the case study of shrimp farming in

Bangladesh. It suggests ICOM as a strategy for its potential economic development and minimizing its negative environmental impact.

The shrimp farming industry in Bangladesh is a glaring example of problems arising out of a lack of integrated management of a marine resource of the coastal zone. The ecosystem in the coastal area of Bangladesh is ideal for shrimp farming. It has been endowed with a rich soil, a good climatic condition, and its water and local cultural tradition are exceptionally suitable for shrimp production (Huq et al, 2000). At the same time, the coastal areas are vulnerable to the impacts of shrimp aquaculture and other land-based and ship-source pollution. In the late 1980s and early 1990s many developing countries entered into this economically profitable industry and it has played a significant role in the economy and trade of the countries. The emergence of shrimp farming in Bangladesh was triggered by a combination of World Bank project investments, IMF financial disciplines requiring countries in high debt to shift to export industries and the spread of trade liberalization under the General Agreement on Trade and Tariffs (GATT) and some corresponding domestic and economic reform policies of Bangladesh regarding promotion of non-traditional export sector (World Bank, 1996). Although the export revenue benefited the national economy to some degree and the society at large, it also affected the same society and the environment in a serious way. It gave rise to new environmental problems, social problems and financial inequity in the society. These ecological and socio-economic impacts of shrimp farming are also concerns of the fisheries experts, scientists and policy makers of the country. The sustainability of the shrimp farming and other sectors is at stake because of the result of those impacts and because of poor coastal use and management practices (UNEP, 1999). Shrimp farming plays a vital role in the national economy of Bangladesh since it is one of the major foreign currency earning export sectors. Shrimp farming in the coastal zone has been chosen as a study of the potential utility of ICOM in Bangladesh as a means to achieve sustainable development of this and other coastal industries.

We know that a problem is a situation that is unsatisfactory and causes difficulties or discomfort for people. The assumption of that problem indicates that something,

whether it is right or wrong, will happen. Here, in this discussion, the assumption is that, if the right action is not taken to create a kind of balance between the economic use of the natural resources and the management and conservation of the resources, then ultimately, the existence of the resources and human society will be endangered. To attain the sustainable development of a particular natural resource, proper management of that resource along with integrated management of other resources, is of vital importance. In the following discussion this assumption will be supported by the example of ecological and socio-economic impacts of the non-integrated management of shrimp farming.

The key objective of this dissertation was to carry out a case study for examination of the environmental, and the socio-economic impacts of coastal zone resource use that was developed under a fragmented management approach. The study was also intended to provide an insight into the present management issues confronting many developing countries.

This dissertation intends to achieve this objective by:

- (a) tracing the historical and ecological development of the concept of Integrated Ocean and Coastal Zone Management (ICOM) and its relevance to shrimp farming
- (b) analysing the emergence of shrimp farming in the international arena and then in Bangladesh as an economic activity, its impact on environment and society and the various conflicts arising out of this economic activity
- (c) examining the need for an ICOM approach for the resolution of conflicts arising out of shrimp aquaculture and for the sustainable development of Bangladesh's shrimp farming industry
- (d) providing recommendations of resolving and preventing resource management problems, such as those mentioned in this dissertation, regarding ICOM and its utility as a means to achieve sustainable development in coastal uses of Bangladesh.

There is a scarcity of basic information and scientific data in Bangladesh; accordingly this research relies primarily on secondary data and information. Various published sources (national and international) are reviewed to support the conceptual issues and the theory. International, government and Non Governmental Organization (NGO) sources are also used to gather information on trade and environment related issues relating to shrimp farming.

In addition to this introductory chapter, the research is divided into another four chapters. Chapter 2 will discuss the concept of ICOM and its relationship to sustainable use of ocean and coastal resources such as shrimp. Chapter 3 examines aquaculture and shrimp farming as coastal economic activity in Bangladesh and other countries. Chapter 4 examines the current regulatory structure of Bangladesh with respect to environmental issues, the protection of biodiversity, aquaculture and fisheries, shipping and other coastal activities. The final Chapter is the concluding chapter. It recommends the adoption of an integrated management approach to managing the coastal and ocean zones of Bangladesh and proposes the creation of a high-level leading ICOM agency and a national legislative framework for capacity building, public participation and environmental impact assessment. It also provides some sector specific recommendations to help improve management of shrimp farming in Bangladesh.

Chapter 2

2. Integrated Coastal and Ocean Management

2.1 Background

2.1.1 Introduction

The previous chapter introduced the topic of the dissertation, the argument and the research method. The present chapter will study the historical development of the concept of Integrated Coastal and Ocean Management (ICOM). Before looking at the applicability of ICOM in relation to shrimp aquaculture, it is necessary to discuss the evolution of the concept. The evolution is a result of ideas stemming from two previous sources, namely ecological management in the context of ocean uses, and the ocean governance and regulatory system. While the ecological management attempted to improve the conservation and management approaches towards the development of the coastal resources using science and other sectoral management tools, the international regulatory regime aimed at the resolution of conflicts pertaining to the coastal territories and on the high seas through apportioning rights.

Time and again, it was felt by the international community that a coherent move combining the management approach and the regulatory regime is needed for the sustainable development of the resources. This resulted in a series of conferences Declarations, and Conventions starting with the Stockholm Declaration on the Human Environment in 1992 and the United Nations Conference on Law of the Sea (UNCLOS III) in 1982; the latter developed a comprehensive regulatory framework, the United Nations Convention on the Law of the Sea (UNCLOS), for ocean uses and activities and established measures to resolve the conflicts related to international political and jurisdictional boundaries, particularly in connection with

coastal State rights, responsibilities and protection of the marine environment. Finally, a further combination of science and management and of governance of ocean and other natural resource uses occurred in 1992 at the United Nations Conference on Environment and Development (UNCED). The outcome is reflected in Agenda 21 and the Rio Declaration on Environment and Development, which pronounced the need for a holistic approach to managing human activities affecting the environment and set out principles for this approach and a plan to implement the principles. This approach is called Integrated Management for all human activities affecting the environment. This dissertation will focus, specifically, on this approach as described in chapter 17 of Agenda 21 and, in particular, on Integrated Coastal and Ocean Management. This chapter will first look at the various international documents and conferences that contributed to the development of the ICOM concept. It will then examine the application of it in shrimp farming.

2.1.2 The Ocean Governance Regulatory Regime

As a result of technological as well as world population growth, the variety and intensity of uses of the oceans have been rapidly increasing. The environmental and economic impact of these activities is part of the ocean problems that have become universal to a large extent. Ocean governance concept is based on a regulatory approach setting out international norms, rights and conditions to be followed by all the States involved in the ocean resource uses and ocean activities. The UNCLOS is the most comprehensive agreement regulating ocean uses rights and responsibilities. The following sections describe the development of the system.

2.1.3 Law of the Sea

2.1.3.1 “Freedom of the Seas” and Geneva Conferences

Cicin-Sain & Knecht (1998) argue that the concept of the “ Freedom of the Seas” which was founded by Hugo Groitius, a Dutch Jurist, in his formed treatise *Mare Liberum* in 1609, dominated in the realm of ocean governance for more than four hundred years until the end of the second world war. They further argue that the modern ocean use regulatory regime begins with the unilateral move by the United

States in 1945 when it declared its jurisdiction over the resources of the continental shelf in response to important discoveries of oil and gas in the Gulf of Mexico. Increased activity for exploration and exploitation of marine resources led to environmental degradation, boundary disputes and user conflicts which, in turn, led to convening of international discussion regarding ocean governance.

The move to more fully set out the rights and duties of nations regarding the use of the ocean began with the 1958 Geneva Conference on the Law of the Sea (UNCLOS I) convened by the United Nations. The conference successfully adopted the following four Conventions that codified customary international law and tried to develop or settle some issues: the Convention on the Territorial Sea and the Contiguous Zone, the Convention on the High Seas; the Convention on the Continental Shelf; and the Convention on Fishing and Conservation of the Living Resources of the High Seas (Joyner, 2000). A second conference was held in 1960 to discuss the unsettled issues relating to the breadth of the territorial sea, as well as the extent of offshore fishing limits. In the early 1970s, new problems emerged as the consequence of some concerns regarding exploitation of the deep-sea bed, continental shelf areas, and offshore fishery resources, as well as the right through straits used for international navigation and archipelagic transit (Churchill and Lowe, 1999; Joyner, 2000). This resulted in the third United Nations Conference on the Law of the Sea in 1982, which adopted the comprehensive Convention on the Law of the Sea (UNCLOS) that developed from customary and conventional laws of the sea as well as introducing new ideas and approaches. It marks a watershed in international regime governing the ocean and the ocean resources.

2.1.3.2 UNCLOS 1982

One of the most significant features of UNCLOS is that it combines ocean governance with international law on environment in its part XII. Joyner (2000) calls it the core instrument of contemporary law, as it answers jurisdictional questions, sets out the rights and duties of State parties and codifies the rules, norms, and principles that govern the use of the ocean space. The Preamble of UNCLOS addresses the issue of ocean governance and mentions that “...problems of ocean space are closely interrelated and need to be considered as a whole...” In 1982,

UNCLOS introduced the world community to a new concept of ocean management that aims at regulating all the aspects of ocean uses and responsibilities. The widening of the seaward jurisdiction of the coastal States provides them an extended opportunity to use the ocean resources, but at the same time, UNCLOS imposes new responsibilities on these coastal States for management of sea activities, protection of the environment and cooperation with the neighbouring States.

UNCLOS lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It embodies in one instrument traditional rules for the uses of the oceans and at the same time introduces new legal concepts and regimes and addresses new concerns. The Convention also provides the framework for the further development of specific areas of the law of the sea such as exploitation of economic resources, transfer of technology and regional implementation arrangements. It also establishes the recognition of jurisdiction of the nations in the Exclusive Economic Zone, in the Territorial Sea and the Continental Shelf, and in the Archipelagic waters for the Archipelagic States. The Convention offers an extended foundation of jurisdiction over resources and activities to coastal States up to 200 nm. It was a triumph for them in the sense that it established their sovereign right to explore and exploit the natural resources in their territory to help achieve a better economic condition. But with this achievement came the greater responsibility to manage the resources and to protect the environment. Despite the legal achievements of UNCLOS and the need for increasing economic development, its impact on humans saw the growth of population in the coastal zones and the corresponding level of environmental degradation and destruction of resources. This generated a search for solutions to manage these pressures at international, regional, national and local level. The main approach at a domestic level that emerged and developed over time was ICOM.

2.1.4 The Environmental Management Regime

2.1.4.1 Stockholm Declaration and Creation of UNEP

It is important to note that, even before 1982 and in parallel to the UNCLOS preparations, there were attempts to combine international law on environment with international ocean governance. The 1972 Stockholm Declaration developed at the United Nations Conference on Human Environment is a milestone in the process of establishing international environmental law as a branch of international law. For the first time humanity developed an international document where the right to a healthy environment was proclaimed (Andrusevych, 2000). Principle 1 of the Declaration reads as follows: “Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations.” The Stockholm Declaration is not a convention and therefore does not directly establish the right to a healthy environment, but it provides initial support of the international community from the idea of a right to a healthy environment.

The 1972 Stockholm Conference was a step forward in the direction of the growth of the ocean management in that it paved the way for the formation of the United Nations Environment Programme (UNEP) by the General Assembly Resolution 2997 (XXVII) of 15 December 1972 (UNEP, 1999). Today, the mission of UNEP is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. The Executive Director of UNEP, Klaus Töpfer describes the objective of UNEP as “ a particular effort to nurture partnerships with other UN bodies possessing complementary skills and delivery capabilities and enhancing the participation of civil society - the private sector, scientific community, non-governmental organizations, youth, women, and sports organizations in the achievement of sustainable development” (UNEP, 2000).

Shortly after it was created, UNEP set up the Regional Seas Programme in 1974. It can be viewed as one of the most significant early efforts at ICOM at a regional level.

The Regional Seas Programme is an action-oriented programme and focuses on the causes of land based source of ocean environmental degradation and addresses the issue of mitigation or elimination of the consequences. It has a comprehensive, integrated, outcome oriented approach to fighting environmental problems through the rational management of marine and coastal areas and recognises the interdependence of coastal States in a region (UNEP, 1999). The objective of establishing Regional Seas Programme reflects a "... cross-sectoral and problem-oriented management philosophy...in dealing with environment degradation as a problem of reconciliation between development and the environment in search of sustainable development" (Chircop, 1988). The Programme at present includes thirteen regions involving more than 140 coastal States and Territories (UNEP, 1999).

2.1.4.2 Bruntland Report on Sustainable Development

The momentum for sustainable development grew from the work of the World Commission on Environment and Development (WCED) that was headed by Gro Harlem Brundtland, the Prime Minister of Norway. From 1983-1987 the Commission conducted public hearings throughout the world to review the concept of sustainability (WCED, 1987). The Report on " Our Common Future" published by the WCED in 1987 gives the definition of sustainable development as the " development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Two important ideas come out of the term "Sustainable Development" that creates a list of needs. One is the "needs of the present" that is satisfied with the supply of sufficient resources available presently. The other idea is the needs of "future generations" are to be considered and met by what is left by the present generations for the succeeding generations, and also by the ability of the future generations to manage their own resources. The linkage between generations is established by the fact that involves a sustainable use of ocean resources by the previous generation and ultimately spills over to the next generation. In this way the process continues everlastingly meeting the needs of all generations. That is why the scholars have called the sustainable development an endless process. In order to make sustainable

development, integrated management of the resources is an indispensable method. The Commission concluded in their report that our common future depends on sustainable development. It emphasised the fact that there should be a balance between economic development and environmental concerns. The report pointed out that development is not just about higher profits and better standards of living for a few people. It should aim at making life improved for everyone and this should not involve destroying or irresponsibly using up our natural resources, nor should it endanger the ecosystem that supports life on earth.

2.1.4.3 UNCED 1992

With an endeavour to attain international support for this new concept Sustainable Development which came through a long process after the creation of UNEP twenty years ago, the United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro in 1992. Several important documents were signed at the summit, most notably the Rio Declaration, Convention on Biological Diversity, the Framework Convention on Climate Change and the Agenda 21, a programme of actions for sustainable development. The Conference recognised that humans depended on the Earth to sustain life. It found linkages between human activity and environmental issues, and expressed that global concerns required local actions and recommended that people had to be involved in planning developments for their own communities if such developments were to be sustainable. Two significant Conventions namely the Framework Convention on Climate Change and the Conventions on Biological Diversity reflect the ecosystem-integrated approach. Several institutions were also introduced by the Conference, such as Commission for Sustainable Development.

2.1.4.4 UNCED and Agenda 21

The Rio Declaration on Environment and Development, proclaimed at UNCED, provides the basic principles of sustainable development. It is a set of twenty-seven principles to guide national and international actions on environment, development and social issues approved by all nations participating in the Earth Summit

Conference. Some key principles are: a) Principle of interrelationship and integration, b) Intra and intergenerational principle, c) Principle of the right to develop, d) Environmental safeguard principle, e) Precautionary principle, f) "Polluter Pays" principle g) Transparency principle h) Participatory principle (Rio Declaration, 1992). These principles are important to ICOM because they require the States to manage their resources applying an integrated decision-making model and to act in a precautionary way to protect the environment even in condition of uncertainty (Rio Declaration, 1992). The principle 13 of the Rio Declaration also urges the States to adopt an integrated and coordinated approach to their development planning so as to ensure that development is compatible with the need to protect and improve the environment for the benefit of their population (Rio Declaration).

Chapter 17 of Agenda 21, adopted at the conference, urges the Coastal States to commit themselves to integrated management and sustainable development of coastal areas and the marine environment under their national jurisdiction. Agenda 21 addresses the pressing environment and development problems of today and also aims at preparing the world for the challenges of future to attain the long-term goals of sustainable development. The concept of ICOM is the central idea regarding the management of coastal zones and ocean areas under national jurisdiction in chapter 21 and it achieved global recognition at the UNCED conference (Agenda 21). The concept was viewed as an integrated management of all sector on an international, regional, national and local level and was adopted as the solution for the problem of poor management of economic development and its impact on the environment. Throughout the chapter 17 of agenda 21, the major emphasis is laid upon not only on the rule of sustainable development of the ocean and coastal resources, but also on the importance of precautionary approach in such a process. The precautionary principle when applied aims to protect the environment from long term and irreversible damage and justifies taking action through for example, legislation and regulation, even when there is not conclusive scientific proof of the impact. The principle recognises that by the time such proof exists it is often too late and the damage cannot be repaired.

Chapter 17 of Agenda 21 entitled “ Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and protection, rational use and development of their living resources” propose the following programme areas:

- (a) Integrated management and sustainable development of coastal areas, including exclusive economic zones;
- (b) Marine environmental protection;
- (c) Sustainable use and conservation of marine living resources of the high seas;
- (d) Sustainable use and conservation of marine living resources under national jurisdiction;
- (e) Addressing critical uncertainties for the management of the marine environment and climate change;
- (f) Strengthening international, including regional, cooperation and coordination;
- (g) Sustainable development of small islands (UNEP, 2000).

2.1.4.5 The Convention on Biological Diversity, 1992 and Jakarta Mandate on Marine and Coastal Biodiversity, 1997

One of the key agreements adopted at UNCED was the Convention on Biological Diversity (CBD) which also incorporates ICOM principles. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of resources. The ocean environment does not feature specifically in the convention, but it plays an important role in protecting biodiversity and ensuring that it is used for the benefit of all. CBD recognizes the “intrinsic value” of the natural environment and marine species and emphasizes the need for sustainable development for this very reason (CBD, 1992). So the notion of sustainable development in terms of human utility moves to this new idea and acquired a fresh dimension (Kiss & Shelton, 1991). The definition of sustainable development first introduced in the Brundtland Report now includes maintenance of biological diversity as an integral part of sustainable development. Once again, the need for the precautionary principle has been emphasized in the preamble of the Convention regarding the preservation of biodiversity. The CBD operates under the concepts of

UNEP. In 1997, UNEP played another important role in the development of ICOM by the adoption of the "Jakarta Mandate on Marine and Coastal Biological Diversity", a protocol to the CBD (CBD, 2001). The Jakarta Mandate is a global consensus on the importance of marine and coastal biological diversity and is a part of the Ministerial Statement on the implementation of CBD, as adopted by the Conference of the Parties (COP) at its second meeting held in Jakarta in November 1995. The Jakarta Mandate requires the Parties to address the conservation and sustainable use of marine and coastal biological diversity, and urges Parties to initiate immediate action to implement the decisions adopted on this issue.

2.1.4.6 The Commission for Sustainable Development

The Commission on Sustainable Development (CSD) was also created as a result of UNCED in December 1992 and it is a UN organization designed to ensure effective follow-up of UNCED; to monitor and report on implementation of the UNCED agreements at the local, national, regional and international levels. The CSD is a functional commission of the UN Economic and Social Council (ECOSOC) with 53 members. It was agreed that a five-year review of UNCED progress would be made in 1997 by the United Nations General Assembly meeting in Special Session Rio + 5. This Special Session adopted a comprehensive document entitled Programme for the Further Implementation of Agenda 21 prepared by the CSD. It also adopted the programme of work of the Commission for 1998-2002. The next review will take place in late 2002 and it is titled as Rio+10 (UNEP, 1999).

2.2 Integrated Coastal and Ocean Management (ICOM)

2.2.1 ICOM as a Concept

At the domestic level the United States is believed to have started the ICOM initiative in 1972 with the adoption of coastal zone management as a formal government activity when it enacted the Coastal Zone Management Act (CZMA), (Post & Lundin, 1996). It focussed on the key aspects of management which was perceived as a social and political key issue in at that time. This was followed by a number of initiatives by other nations, mostly in Europe and North America, which

featured the fragmentary coastal zone management approach (Post & Lundin, 1996). They argue that action taken since the 1970s to improve the governance of coastal areas, regional seas and marine resources, have very clearly demonstrated that good results can be achieved and deterioration of conditions can be reserved at local level. Integrated environmental management gave a new method of managing the coastal resources.

Following the UNCED's adoption of integrated management, the concept has become the central paradigm for use of many agencies and the focus of numerous international meetings and activities including (1) the continuing work of the Intergovernmental Panel on Climate Change, especially its working group on Coastal Zones and Small Islands, (2) the 1993 World Coast Conference, held in Noordwijk, The Netherlands, (3) the U.N. Global Conference on the Sustainable Development of Small Island Developing States, and (4) the 1995 Conference on "Protection of the Marine Environment from Land-Based Activities" in Washington, sponsored by the United Nations Environment Programme. All of these meetings have concluded that ICOM is the appropriate approach with which to manage the diverse problems of coastal areas, from the pressing problems of coastal pollution and habitat degradation to the long-term implications of changing sea level (ICM Basics, 2001).

As noted earlier, the concept of Integrated Coastal and Ocean Management was developed in 1970s and gradually came into being in the international regime in mid-1980s and early 1990s. The concept adopted different names at different stages. The earlier version was called Integrated Coastal Zone management (ICZM), which developed from earlier approach of sectoral planning and management programmes of coastal zones. ICZM later developed into ICOM and during the adoption of Jakarta Mandate in 1997 it was referred to as Integrated Area Management (IAM). ICOM or ICZM or IAM differs from the earlier form of Coastal Zone Management (CZM) in the sense that it attempts a more comprehensive approach taking account of all of the sectoral activities that affect the coastal zone and its resources and dealing with economic and social issues as well as environmental/ecological concerns (Post & Lundin, 1996). Cicin-Sain et al. (2000) argue about the approach

by saying that traditional organizational approaches taken by the government and scientific studies and analysis of oceans and coasts carried out by the scientists tend to focus on “single disciplines and single sectors”.

Cicin-Sain et al. (2000) put forward examples by saying that the study of geology addresses the problems of coastal erosion and long shore drift of sediments, while physical oceanography determines the magnitude and direction of the ocean currents and waves that affect the beach and its stability. They further develop the idea mentioning that different disciplines operated independently, used separate languages, and separate patterns of worldviews and incentive structures. Besides the single sector management difficulties, many conflicts in the use of various resources and management of them and improper or poor implementation of the respective government policies led the lawmakers and scientists to replace the traditional approach and to go for a better integrated management concept. What inspired them is the thought that integrated management would serve the purpose of conflict resolution and at the same time provide a platform on which the government organizations and other institutions can operate together to achieve the objective of sustainable development (Masaulu, 2000). It has also been seen as a multi-sectoral process created to improve development planning and resource conservation through integration and cooperation (Clark, 1998).

There is a wide range and variety in the definitions of ICOM provided by different scholars, but the main spirit of each definition is the integrated and sustainable management of natural resources. We may cite some examples here.

“Ideally, an ICM program should operate within a closely integrated, coherent management framework within a defined geographical limit” (Chua, 1993, p. 2). The World Coast Conference 1993 defines ICZM as “ the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development”(p. 25).

2.2.2 The Noordwijk Guidelines and Model Laws

The World Coast Conference (WCC) 1993, which was held from 1-5 November 1993 in the Netherlands, included delegates from more than 90 nations, 20 international organizations and 23 non-governmental organizations. WCC examined actions to strengthen capabilities for sustainable development and integrated coastal zone management (ICZM). WCC considered ICZM the most appropriate means of addressing both current and long-term coastal management issues and pointed out that the aim of ICZM is to balance conflicting goals for the use of coastal resources in order to ensure the sustainable development of coastal zones. The Conference urged the coastal States to take necessary actions to undertake in preparing appropriate coastal zone management strategies (WCC, 1993). The Guidelines produced for the WCC are known as the Noordwijk Guidelines for Integrated Coastal Zone Management. They emphasized on institutional, policy, legal and regulatory aspects of the integrated management. WCC viewed ICZM as: "... a governmental process, and consists of the legal and institutional framework necessary to ensure that development and management plans for coastal zones are integrated with environmental and social goals and are made with the participation of those affected. The purpose of ICZM is to maximize the benefits provided by the coastal zone and to minimize the conflicts and harmful effects of activities upon each other..." (WCC, 1993). The Guidelines provided a general framework of the various stages of ICZM process that has to be followed by the nations adopting ICZM process. The Guidelines are not legally binding to all nations, but they offered a type of model for the structuring of ICZM process. Subsequently, a number of different models were developed. More recent legislative initiatives reflect a move towards integrated management approach. For example, the Oceans Act of Canada promotes the integrated management of oceans and marine resources to foster sustainable development of the resources, to conserve the ecosystem and to maintain biodiversity. It promotes the wide application of precautionary approach and encourages participation of various stockholders (Oceans Act, 1996). The European Model Law on Sustainable Management of Coastal Zones and European Code of Conduct for Coastal Zones is a masterly work that defines the concept of integrated management and planning, based on the principle of sustainable

development, establishes the main guidelines and makes proposals with regard to the appropriate institutions, procedures and instruments for the implementation and application of integrated management and planning. It was believed by the Council of Europe that such model law could be a source of inspiration to States and be used either to amend existing legislation or to pass new laws (Council of Europe, 2000).

2.2.3 The ICOM Process

Although differences exist regarding values, principles and goals in different societies, there are some conventional stages and planning for ICOM process. Usually, a triggering event such as an opportunity for economic development or a negative environmental impact sets the ICOM process in motion. The process may be initiated nationally, regionally or at the municipal or local level depending on which level is going to be benefited or affected. Even it may be an international problem which needs to be addressed globally on a cooperative basis. There needs a strong political commitment, locally or nationally, a “leader”- and some resource to commence the course of action. The various stages for ICOM preparation have been described by Cicin-Sain and Knecht (1998) and Noordwijk Guidelines and the following summarises these typical stages for implementation here briefly.

Initially, a preliminary concept paper containing a statement of a perceived problem, or concern and developing the use of ICOM in other countries is produced for internal discussion and reports in government. It is afterwards followed by a publicly released Discussion Paper on the need for developing a process. The potential stakeholders are identified and encouraged to join the discussion for consultation. The outcome of the consultation is a preparation of recommendations, which will be followed by review of the administrative capacity and creation of a coordination mechanism. Financial considerations take place at this stage. The second stage is the stage for designing and developing ICOM and it includes collection and analysis of data on physical, social, economic, political and legislative systems. The guiding principles for decision-making, the inventory of tools such as zoning are developed at this stage and some demonstration projects are identified. Once the proposed

ICOM plan is designed, the stakeholders are consulted and the government adopts the plan in the form of budgets, personnel allocation and legislation authorizing activities. The implementation of ICOM begins at the fourth stage by establishing a coordinating agency, communicating the plan and identifying particular project to refer to lead agency to develop as specific project and starting and maintaining the project work. At this stage, an Environmental Impact Assessment or Social Impact Assessment takes place to assess projects and development (WCC, 1993; Council of Europe, 2000). This is usually followed up by of projects in the overall plan. A key ingredient is the updating of data and to review in light of any new information or other changes.

Integrated Coastal and Ocean Management is the integrated planning and management of coastal resources and environments. The objective of ICOM is to obtain co-ordinated management of the coastal zone as a whole in relation to local, regional, national and international goals. ICOM is based on the physical, environmental, socio-economic and political interconnections. It is an active process, which can unite government and community, science and management, and sector and public interests in developing and implementing an integrated approach. The various guidelines and models give a formative shape to that approach so that the objective of ICOM can be achieved in a comprehensive and successful manner. Since this dissertation is examining the role of ICOM in the sustainable development of shrimp aquaculture and in ensuring better coastal resource management in Bangladesh, it is useful to briefly outline the relationship between ICOM and shrimp farming as an economic development use. Before proceeding to the case study, the next chapter looks at aquaculture and shrimp farming in general and the ICOM related issues.

Chapter 3

3. Aquaculture and Shrimp Farming

3.1 Aquaculture

3.1.1 Definition

The UN Food and Agricultural Organization (FAO) conference on Aquaculture Development in the Third Millennium held in February 2000 in Bangkok produced The Bangkok Declaration and a Strategy for Aquaculture Development Beyond 2000. The documents recognized the fact that aquaculture is “the fastest growing food producing sector and is an increasingly important contributor to national economic development, the global food supply and food security” (NACA/FAO, 2000, p. 4). FAO is devoting a great deal of attention to this sector with a view to ensuring that there is a sustainable development of aquaculture. FAO (1997) defines aquaculture as the farming of aquatic organisms including fish, molluscas, crustaceans and aquatic plants. Matthew Landau (1992) defined aquaculture as the large-scale husbandry or rearing of aquatic organisms for commercial purposes.

There are different versions of the definition of aquaculture. Some authors have restricted the definition to fish farming or fish husbandry only and others have used the term to include all aquatic species and plant culture. The modern meaning of aquaculture tends to encompass all forms of fish farming and farming of other organisms like oyster mussels or seaweed. Depending on the species, the culture may be done in upland, lowland, inland, coastal or estuarine water containing fresh water, or brackish or salt water, which may be cold-water or warm-water (Pillary, 1990). Aquaculture can take many forms. This chapter will focus on shrimp farming as practiced in Asia. Aquaculture is now considered as a science since it involves lot

of research and study to improve the quality and quantity of production of species and does in a sustainable way.

3.1.2 Socio-Economic and Cultural Basis of Aquaculture

Aquaculture is believed to date back to 2500 BC. An Egyptian bas-relief, which was seen on the tomb of Aktihetep, illustrates the image of tilapia fish removed from the pond by a man. In China, fish farming is believed to have started when the *Classic of Fish Culture* had been written around 500 BC by a Chinese politician named Fan Lei who later turned to be a fish culturist (Pillary, 1990; Landau, 1992). History of fish farming tells us that the practice of the culture of fish existed in different part of the world in different times. In China, the culture of carp fish which later spread to Japan, and Korea were very popular during the Tang Dynasty, 1400 to 1100 years ago. The Romans are believed to have inherited the practice of carp fish culture from the Egyptians and the French used to construct salt pans during the mid-eighteenth century to culture some species such as eels and mullets. The European countries adopted and established the methods of finfish culture by the 1850s. America, Russia and Canada started their experimental fish farming in 1853 1856 and 1857 respectively (Landau, 1992).

The other countries having a history of fish farming are Czechoslovakia, Polynesia, Hawaii, the Netherlands, and Great Britain. It gradually became a practice in Central and South America, Asia and other continents. Shrimp and other shellfish and Oyster farming began as an aquaculture during the late nineteenth and early twentieth centuries. In particular, shrimps were cultured to fill the gap caused by over-exploitation of natural fish stocks. In the last four decades, the study and research regarding aquaculture have developed a lot.

Gradually, fishing has become an integral part of the day-to-day life of the humans with respect to both food and trade. The rapid growth of human population in the twentieth century, especially after the Second World War, has created an immense demand for sources of food and nutrition. This demand has generated an increase in marine capture fisheries as a source of protein and revenue generation. With the

advent of modern technology, the fishing activity increased at a speedy rate. Developed countries increased the number of their fishing vessels, introduced effective and efficient methods of fishing and vied with each other for greater engagement in the activity. At the same time, modern scientific methods were being used for the processing of fish catches, and developments in the transport sector helped increase the scope of market range. This level of fishing has ultimately resulted in the depletion of certain fish stocks. Scientists and fisheries experts became aware of the fact that unless alternative measures were taken to increase fish production and to manage this particular ocean resource in a sustainable way, humans would encounter a severe setback in connection with shortage of food. Aquaculture was seen as a means of addressing these concerns. Aquaculture is important in the sense that it not only aims at increasing the production but also manages the production in a sustainable way to maintain a balance between production and consumption.

There were several other factors that also accelerated interest in aquaculture. Due to the rapid growth of national population every country desired to be self-sufficient in food production. The trade liberalization policy of the General Agreement on Trade and Tariff (GATT), now under the World Trade Organization (WTO), and the lending disciplines of the International Monetary Fund (IMF) influenced the member countries to increase domestic production in order to engage in export oriented aquaculture production (World Bank, 1996). The increase in the national reserve of foreign exchange through export industries is an important issue for all nations and particularly, for developing economies. Priorities like rural employment, employment of women and income generation and provision for nutrition for people also influenced many governments to adopt a policy to encourage more aquaculture (FAO, 1997).

3.1.3 Aquaculture as an Economic Sector

Some environmental and socio-economic impacts have brought a significant change in the condition of fisheries resources, and as a result, there is instability in the supply and demand of fish. However, fish remains increasingly a major source of food and nutrition, job and income in many countries. According to FAO statistics published in 2000 world fish catches and aquaculture production declined from a figure of 122 million tonnes in 1997 to 117 million tonnes in 1998 (FAO, 2000). Scientists say this was the effect of an abnormal weather pattern known as El Nino. The production rate rose again in 1999 to an estimated 125 tonnes (FAO, 2000). FAO fisheries experts argue that the increase in the production in fish had been possible due to aquaculture, as fishing on the sea did not bring any change in the total amount of fish catch (FAO, 2000).

According to FAO, about 36 million people were engaged in fishing and aquaculture production sectors in 1998, about 15 million full-time, 13 million part-time and 8 million occasional workers. Fisheries experts have discovered that employment rate in inland and marine aquaculture has been increasing and it has been estimated about 25% of the total. Preliminary 1999 data shows that there is a 4% rise in the value of the international fishery trade amounting to US\$53.4 billion in comparison to the previous year's amount estimated at about to US\$51.3 billion (FAO, 2000). The FAO data indicates that the world marine capture fisheries are declining due to overfishing, depletion and marine pollution. Since marine resources are not infinite, and need to be appropriately managed for sustainable development, aquaculture is important because it is an alternative to natural production and supplements in the preservation process. The shortage in the marine capture fishery can be dealt with through increased practice of aquaculture.

3.1.4 Costs and Benefits of Aquaculture

The 2000 Bangkok Declaration on Aquaculture Development recognizes that there has been noteworthy increase in commercial aquaculture; both in developed and developing countries that has made significant contribution to provision of food, foreign exchange earning and trade (NACA/FAO, 2000). FAO report on the State of World Fisheries points out that the development of aquaculture in the Asian region has been done in the form of a rural activity integrated into existing farming systems (FAO, 2000). Rural people thus have the opportunity to get involved in the aquaculture without having access to extra land and infrastructure. Aquaculture in the rural areas, therefore, can make important contribution to the alleviation of rural poverty, increase in domestic production and income and generation small-scale employment. This is really good news for the rural people in the developing countries who are suffering from abject poverty, malnutrition and unemployment. For example, in Bangladesh, where most farmers are relatively poor, there is vast potential for the poorest members of society to become new participants among aquaculture farmers (FAO, 2000). Women play a significant role in this regard. Since shrimp farming is not a tough labour-intensive activity, women are engaged in the hatchery and rearing ponds along with their male counterparts. It improves the economic status of women.

As noted at the end of chapter 2, unregulated and unplanned aquaculture sometimes lead to environmental degradation, decrease in production, a poor return on investment and humans and other health hazards (FAO, 1997). There are other problems such as access to modern technology and availability of financial resources for the rural poor people. These shortcomings can be overcome in the developing countries by adopting sustainable policies for effective aquaculture that take into account the local situation. The FAO Report on the State of World Fisheries appropriately mentions that the future development of aquaculture will depend on improvements in new and adaptive research and management (FAO, 2000). The Bangkok Declaration and the Strategy for Aquaculture Development Beyond 2000 provides a framework for such cooperation, which is particularly important to developing countries in their need to share expertise and technology

(NACA/FAO, 2000). Some international development agencies were very supportive of this industry in the 1990s because shrimp farming was generally regarded as less environmentally harmful in comparison to other varieties of agriculture, urban development and industrialization. However, FAO and other international agencies are concerned about impact on food security in developing countries. At the same time the countries need development with a high and rapid economic return. Although facts of detrimental effects exist in some area due to poor planning and management and absence of adequate regulations, it is believed these can be effectively eliminated through integrated management (Paez-Osuna, 2000).

3.2 Shrimp Farming

3.2.1 Introduction

Shrimp farming traces its origins to Southeast Asia where for centuries farmers raised incidental crops of wild shrimp in tidal fishponds (Shrimp News, 2001). Modern shrimp aquaculture began in the 1930s when Motosaku Fujinaga, a graduate of Tokyo University, succeeded in spawning the kuruma shrimp (*Penaeus japonicus*). He cultured larvae through to market size in the laboratory and succeeded in producing them on a commercial scale. For more than 40 years, he generously shared his findings and published papers on his work in 1935, 1941, 1942 and 1967. Emperor Hirohito honored him with the title "Father of Inland Japonicus Farming"(Shrimp News, 2001).

Aquaculture farming is used to produce prawns and shrimp as a cash crop. The biological names of Shrimp and Prawn are *Penaeidae* and *Palaemonidae* respectively. Prawns are usually referred to as fresh water forms of *Palaemonidae*, while shrimp particularly belongs to the marine species, Pillary (1990). Pillary (1990) has provided a long list of species, which are cultured by farmers in different parts of the world. In Asia, prominent species are the tiger shrimp *P. monodon* and the Indian or white shrimp *P. indicus*. P stands for *PENAEIDAE*. The other species cultured in this region are the banana shrimp *P. merguensis*, the bear shrimp *P. semisulcatus*, and the oriental shrimp *P. orientalis*. In Europe, the countries are interested in species such as *P. japonica*, and *P. kerathurus*. In Africa, farmers are

involved in the culture of *P. indicus* and *P. notialis*. The main species in Central and South America are the white-leg shrimp *P. vannamei*, the blue shrimp *P. stylirostris*, the brown shrimp *P. aztecus*, pink shrimp *P. duorarum*, and the white shrimp *P. setiferus*. The fresh- water prawn *Macrobrachium rosenbergii* is famous for its giant size. Different species need different kinds of environment for breeding and rearing. For example the salinity level for different species are not the same and the temperature level may vary for each species. Some species are used for culture in winter and some are in summer. But if the climate is moderate various species can be used both in summer and winter. Research is being carried out by the scientists to improve hatchery techniques, so that different species of shrimp larvae may adapt to different environmental conditions.

As already noted in the introduction, the farming of shrimp was prompted by the rising demand of food and particularly by the rising demand in the international market, i, e, Japan, Europe and the USA. The speedy and high return on investment encouraged the traditional farmers as well as new entrepreneurs to become involved in shrimp farming. The shrimp farming industry opened up a vast opportunity for the governments, entrepreneurs, and local communities in the developing countries. The Governments also took interest in the shrimp farming because it was a source of foreign exchange earnings. The coastal States in the Asia and the Pacific regions and in the tropical and subtropical regions have an international trade advantage in terms of climate conditions, soil quality, cheap labour, easy access to land and low costs for processing and transportation. That is why shrimp aquaculture developed in those regions so rapidly (Paez-Osuna, 2000). The total shrimp production in the world in 1998 was approximately 850,000 metric tons of which the Asian farmers produced about 72% (FAO, 1999a).

3.2.2 Shrimp Farming Methods in the Asian Region

Coastal aquaculture has a long history in the Asian countries. In the wetlands bordering the coastline, rice is cultivated for several months, and shrimp and some species of fish for the rest of the year (Rajagopal, 1996). The two types of cultivation complemented each other, benefiting both farming and fishing communities. This

traditional form of shrimp aquaculture is called extensive culture. Modern, commercially oriented, high-output, intensive shrimp aquaculture was introduced only in the last 15 years. It is different from the traditional sustainable method and can be more damaging to the environment and results in conflicts (Rajagopal, 1996). Although there are still practices of traditional extensive method of shrimp aquaculture in some countries like India, Indonesia, Vietnam, Bangladesh, semi-intensive or intensive operations have taken place largely for commercial purposes. Because of the industrialization and intensification of the farming system, the level and extent of environmental damage has increased proportionately.

Shrimp are farmed in large ponds, usually dug to a depth of at least one meter. Normally the site will be on an estuary or next to a coastline to provide a source of brackish or saltwater. A shrimp farming pond can be a converted extensive coastal fishpond, a large rice paddy area or land producing other agricultural crops, salt flats, or a newly excavated site in a clear-felled mangrove forest. During the construction of shrimp ponds the initial damage is done to the environment by stripping natural or existing farmed landscapes bare. The size and depth of ponds vary depending on location, the aquaculturist's experience, and the method of extensive or intensive farming. These ponds range in size from less than 10 to over 100 acres and can be from one meter to over 4 meter deep. Dikes or dams are created around semi-intensive ponds linking the ponds from a shallow end with a water source and a deeper end with a water exit. The ponds are connected to the water source by a series of canals. By utilizing either natural tidal flows or manual pumping, the ponds are filled with salt water several weeks before stocking. The pond is then stocked with either ocean-caught or hatchery-raised post larvae that survive for several weeks on algae and small amounts of commercial feed. As the shrimp grow, the water in the pond is exchanged slowly and aerated with electric paddle wheels to maintain needed oxygen levels. Initially, shrimp farms were built in low-lying tidal areas or among the wetlands along the coastline in many tropical areas to allow for tidal water exchange. The different farming methods are shown in detail at the table 1 below:

1. Traditional (extensive): It uses large amounts of coastal land for low-density ponds. It uses wild fry collected from the coastal area as seed, and follows

polyculture. Polyculture is a kind of system where a variety of species including mollusks, fish, macroalgae and halophytes along with shrimp are harvested in the same pond. Ideally, the population of the species in a polyculture should be arranged in such a manner that many of the nutrients introduced in the system are recycled among the organisms, thus reducing nutrients waste and pollution. The destruction of mangroves is the main harm caused by traditional farming. While most intensive farms require just a few hectares, traditional ponds can use up to 100 hectares of land. Traditional farming yields less production of shrimp and is not easily viable for commercial farming. (Paez-Osuna, 2000).

TABLE 1
Characteristics of Three Major Asian Shrimp Culture Systems

Item	Extensive	Semi-Intensive	Intensive
Pond size	5 hectares or larger	1-5 hectares	1 hectare or smaller
Stocking density	3,000-20,000/hectare	25,000-80,000/hectare	over 80,000/hectare
Water management	Mostly tidal	Pumping, some aeration	Pumping, aeration and treatment
Fry sources	Wild or hatchery	Wild or hatchery	Hatchery
Feeding	Natural through Fertilization	Fertilization with supplementary feed	Formulated diet
Crops per year	1—3	2	2—2.5
Production	300—800 kg/hectares/yr	1-3 mt/hectares/yr	8-12 mt/hectares/yr
Production cost	US\$ 2.20-3.85/kg	US\$ 3.30-6.60/kg	US\$ 6.60-10.00/kg

Source: ATDP (1997).

2. Intensive: Intensive farming yields a higher production. As noted above, it requires very little land but it pollutes large areas. There are risks of disease outbreaks, ruin of surrounding ecosystem by polluting discharges, and salinization of ground water with intensive farming. High establishment costs and operating costs and increased rate of disease make intensive farming unsafe.

3. Semi-intensive: The production rate is still higher in comparison to extensive system. Semi-intensive farming attempts to balance both of the methods above. There is less land needed for medium-density ponds and a decreased risk of disease outbreaks and amount of polluting materials discharged because of less intensive use of commercial feeds. However, there are still dangers of pollution and mangrove destruction from poor management. (Hossain, 2001; IBON, 1997; Boyd & Fast, 1992). Clay (1996) is of the opinion that semi-intensive and intensive hatcheries are prone to virus attack and the traditional hatcheries using capture species are relatively safe in this respect. Protozoa, fungi and bacteria, sometimes attack farms and hatcheries but viral diseases do the greatest damage to shrimp farms (Rosenbury, 1998; Hossain et al., 2001). Disease has been identified as the most challenging impediment to the future growth of shrimp farming. Usually, it spreads like an epidemic and the impact of disease on shrimp farming is sometimes devastating. Taiwan (1987-1988), China (1993-1994), Indonesia (1994-1995), India (1994-1996), Ecuador (1993-1996), Honduras (1994-997) and Mexico (1994-997) have faced significant collapses in their shrimp production due to diseases (Paez-Osuna, 2000). The Scale of Production of Shrimp Farm globally is reflected in the figures in Table 2 below.

This chapter has discussed aquaculture generally and has given an idea about shrimp aquaculture as a subsistence activity that existed for centuries in several societies. Shrimp farming was usually considered as a source of food. Gradually, it emerged as an economic activity that interested governments, entrepreneurs and exporters. Traditional extensive shrimp farming was largely environmental friendly and sustainable. Although the change from artisanal aquaculture practices to commercial shrimp farming has opened the door for foreign exchange earning and the opportunity for economic development for most of the countries, it also invited environmental impacts on other resource uses and socio-economic problems including social conflicts. Chapter 2 summarized some of the harms caused by shrimp farming. The case in point in the following chapter is to examine the shrimp farming industry in Bangladesh as a case study of a coastal industry developed mainly to achieve economic goals for development without managing the negative

environmental impacts and social conflicts. Eventually, the sustainability of the industry and the environment is threatened.

TABLE 2
Bangladesh in Global Commercial Shrimp Production, 1995

Country	Production (mn tonnes)	Percent of Production	Area under Production	Number of Farms
Thailand	220.0	31.0	90.0	20,000
Ecuador	100.0	14.0	125.0	1,900
Indonesia	80.0	11.0	300.0	4,000
China	70.0	10.0	13.0	6,000
India	60.0	8.0	80.0	5,000
Vietnam	50.0	7.0	225.0	2,000
Bangladesh	30.0	4.0	130.0	9,000
Mexico	12.0	2.0	14.0	250
Columbia	11.0	2.0	3.0	30
Others	88.0	12.0	42.0	2,188
Total	721.0	100.0	1022.0	50,368

Source: Aftabuzzaman (1998).

Chapter 4

4. Shrimp Farming in Bangladesh: A Case Study

4.1 Introduction

The last chapter discussed aquaculture and shrimp farming methods in general. The present chapter will examine the shrimp farming industry in Bangladesh. It will focus on the administrative and regulatory framework regarding shrimp farming and other coastal use sectors that are affected by or are in conflict with it.

4.2 Bangladesh: The Country

Bangladesh has an area of approximately 144,000 km square and has a population of 127.8 million according to statistics published in 2001 (Bangladesh Bureau of Statistics, 2001). It is a low-lying, riverine country located in South Asia with a largely marshy and jungle coastline of 710 kilometres on the northern littoral of the Bay of Bengal and in the dynamic delta of the river Ganges, Brahmaputra and Meghna (Hossain, 2001, WCC, 1993). It consists of huge floodplain and about 25000 square kilometres of land area along its coast is subjected to spring tidal influence. It is a vast delta bounded by the Bay of Bengal and most of the area in the delta is only a few meters above the sea level. There are some hilly areas in the Chittagong Hill Tracts in the far southeast and the Sylhet division in the northeast of the delta (Hossain, 2001, WCC, 1993). Cyclones, floods and droughts frequently hit the delta, one of the world's densely populated areas. It is a fragile coastline that needs proper attention for management.

The main cities along the coast are Cox's Bazar, Chittagong, Barishal, Noakhali, Shatkhira, Bagerhat, and Khulna. Some cities around the delta have small scale and hi-tech industries, such as newsprint mill, fertilizer plant, steel mill and other industries, but not enough to boost the economy.



Figure 1. Bangladesh Map Showing the Coastal Zone and Activities

Key

- O- Shitakundu, the ship scrapping area
- Shrimp Cultivation Areas
- St. Martin's Island
- - Chittagong and Mongla Port Authorities

While Bangladesh's industrial base is weak, unskilled labour is inexpensive and plentiful. Although improving, infrastructure to support transportation, communications, and power supply is poorly developed in the region. There are two international ports along the coast, namely, Chittagong and Mongla Port. Bangladesh Shipping Corporation is the State-owned shipping company having 13 different kinds of vessels. But there are privately owned ships and trawlers that ply on the sea and along the coast for business, fishing and transportation purposes. Bangladesh has a seaward zone of 200 miles exclusive economic zone. It does not have any offshore oil industry but the exploration effort is underway.

Cultivation of rice and jute is still the most prominent agricultural activity in the coastal region that is struggling for its socio-economic development. The region experiences heavy monsoon rainfalls and the alluvial soil is highly fertile because of nutrient rich sediment. The coastal zones of Bangladesh abound in rich ecosystem which is endowed with marine species, fertile lands and the world's largest mangrove forests. The low lands covering the mangrove forests are the local habitat for various fishes and other species. The forests provide timber and wood for the local communities, and raw materials for various industries. The reason that the region is highly populated is justified by the fact that people derive economic benefits and sustain their lives from the rich ecosystem and fertile agricultural land. Around 24 million people out of the total population of 127 million people live along the coastal zone of Bangladesh. Consequently the level of use of natural resources is very high and the degradation of the environment is alarming (Hossain, 2001).

Shrimp farming in Bangladesh occurs along the 710-kilometre coastline of Bangladesh. Bangladesh has an ideal and perfect natural setting for shrimp production. The water bodies in the low-lying area of the Sundarban mangrove forest are natural hub for shrimp-fries or baby shrimps. The coastal areas are the fishing grounds for artisanal and traditional fishermen. On the other hand, shrimp aquaculture is also a prominent economic activity along the coast. The case study is based on this commercial shrimp farming, its impacts and the management issues in the coastal areas.

4.3 Shrimp Farming as an Industry in Bangladesh

Shrimp aquaculture did not emerge as significant commercial activity in Bangladesh until the fiscal year 1984-85. Before that period high degree of regulation and controls by the government on international trade was a huge barrier for the private sector to invest in foreign trade. Private sector export was then mostly based on jute and tea. What helped the shrimp export activity expand are some policy decisions taken by the GOB in favour of the shrimp farming. This occurred because Bangladesh followed the financial disciplines prescribed by IMF and wanted to expand international trade by developing non-traditional export sector like shrimp. The previous regulations on import and export sectors were revised by the Export Promotion Bureau and control over export-oriented business was minimized in favour of investment, which encouraged the private sector to enter more actively into commercial shrimp culture. The commercial activity was further facilitated by the advantage of abundant natural resources and cheap labour cost. These facts helped the entrepreneurs to convert the advantages into rapid export earnings. One external factor had also been instrumental to the booming of the industry. During this period, there was a fluctuation in the production of shrimp in the Southeast Asian countries which made the development in Bangladesh easier. The combination of these domestic and external factors largely contributed towards the rapid growth of the industry and it increased the export activity further, thus ensuring long-term effect in the export sector (Bhattacharya et al. 1999).

But natural resources are not unlimited and their over-exploitation by humans endangers their existence. On the other hand, dealing with that mass cheap labour is a delicate issue as the question of their economic development is concerned. While much attention was paid to the development of the shrimp export sector and to the entrepreneurs, the environmental and social issues were largely neglected. When a triggering event generates a profit earning economic activity, it needs to adopt the ICOM strategies in the early planning stage. The continuity and the development of the economic activity and the mitigation of harms associated with it depend upon integration of economy and environment. The reform policies that will be discussed in the following section virtually ignored these issues.

4.4 Trade Reform Policies

As already mentioned in the introductory chapter, the shift from the capture based shrimp export industry to an export-oriented activity was a result of gradual trade related policy reforms implemented by the government of Bangladesh. Bhattacharya et al. (1999) have divided the reform process into three phases. Firstly, between the period covering 1981 to 1986, the government lifted some investment restrictions, import control, expanded export performance benefits and revised policies to favour the local exporters in respect with duty disadvantages and difficulties. For example, the inflow of capital into the country was free of any restrictions in so far as it concerns establishment. During the second phase covering the period from 1987 to 1991, government decisions removed some quantitative restrictions on imports through introduction of zero tariffs on imported inputs. Taking into consideration the interest of entrepreneurs and consumers, government of Bangladesh took some decisions in favour of the tariff rationalization, which, in turn, reduced the anti-export prejudice of the shrimp farmers.

Bhattacharya et al. (1999) argue that the third phase began in 1992, the year in which the Structural Adjustment Policy (SAP) of Bangladesh began implementation of comprehensive policy reform and stabilization of sectoral progress. SAP is a programme initiated by the IMF in 1982, which gives debt repayment supreme importance over national expenditure and encourages the state to become more involved in export oriented activities so that more foreign currencies can be earned and channeled back to its creditors. During this time, policy reforms regarding export related activities included broad fiscal, financial and institutional incentives. There was a considerable reduction in the import-weighted tariff from 88% to 21%, an anti-export bias was substantially removed and the private sector entrepreneurs and investors were encouraged to join export-oriented activities (Bhattacharya et al.1999).

Two export sectors were apparently benefited by export-friendly policies prompted by the SAP, namely the readymade garments industry and the shrimp industry. The new financial and institutional policies encouraged the Bangladeshi investors and

entrepreneurs to make investments in shrimp culture, shrimp processing and shrimp exports. These measures included income tax rebates, speedy customs clearance, cheaper loans and the lease of both private and Khas (State-owned) land in favourable terms and zero tariff access of inputs and incentives for direct export. A duty drawback scheme was modified by the introduction of standard schedule of flat rates for a number of imported inputs, which greatly facilitated import of input by the export oriented sectors. The new policy offered concessional rates for loans taken by the export-oriented businessmen, and the rate of interest dropped from 10-14% to 8-10%. As a result of these direct and indirect subsidies to the export sector, the export-oriented sectors showed better performance with respect to labour productivity, capital productivity, capacity utilization, and returns to capital in comparison with other manufacturing sectors (World Bank, 1996). While all preparations for the emergence of shrimp aquaculture as massive commercial activity were taken by the government one important issue was ignored; environmental impact assessment (EIA). ICOM strategy includes EIA as a tool before it sets out to resource use. As there was no integrated management policy, the use of this tool was not taken into account. Consequently, the environmental issues emerged as detrimental effects and the poor management of this sector became a concern among environmentalists, NGOs and local communities.

According to Bhattacharya et al. (1999), these adjustments stimulated what they call a non-traditional export-oriented industry to emerge in the international market. At the same time, the shrimp culture industry received important assistance from the World Bank/UNDP in the investment programme in the late 80s and early 90s. During those times these two institutions extended an amount of US \$ 30 million as loans to develop the infrastructure of the shrimp farm industry in Bangladesh (World Bank, 1996). Modern technology and foreign advice to improve the industry were also provided by these organizations. The GOB further contributed to the development of this specific industry with a number of incentives covering amendments to land-lease laws, subsidized loans and a nine-year tax holiday, a system, where one does not have to pay income tax on one's active business income for a particular period of time. The success of the industry and the success of the programme in terms of creating an economic development activity are

reflected in Table 3 The table shows a real increase in dollar rising from 33.6 to 322.4; almost the role of the industry in the country's overall export earning respect remained reliably stable.

TABLE 3
Trend in Shrimp Exports from Bangladesh

	Export of shrimp <i>Value in million US\$</i>	Export of shrimp <i>Quantity</i> <i>in (thousand tonnes)</i>	Share of Shrimp in Country's Total Export (per cent)
FY 1981	33.6	7.5	4.7
FY 1986	90.8	17.2	11.1
FY 1991	127.9	24.1	7.8
FY 1994	197.6	25.2	6.3
FY 1997	279.2	25.8	5.1
FY 1998	260.4	18.9	5.8
FY 1999	242.2	20.1	6.1
FY 2000	322.4	28.5	5.4

Source: Compiled from Export Promotion Bureau of Bangladesh Data 1981-2000

Table 4 below documents the source of land for shrimp cultivation.

TABLE 4
Shrimp Area Statistics of Bangladesh
(hectares)

Districts	1983-84	1987-88	1996-97
Chittagong & Cox's Bazar	19,531	24,755	29,717
Khulna, Satkhira & Bagerhat	31,817	68,363	103,998
Jessore	422	690	626
Patuakhali	42	64	246
Noakhali		26	75
Barisal		112	3,095
Dhaka Division			239
Total	51,812	94,010	137,996

Source: Department of Fisheries (1998).

4.5 Administrative and Legal Structure for Shrimp Farming

The general public administration in Bangladesh derives its power from the constitution and operates according to two basic guiding directives. These are the Rules of Business and Allocation of Business. These two documents provide the guidelines for each ministry to formulate its own national policy in the respective sector. Traditionally, the approach in Bangladesh to managing the marine environment in general and marine resources in particular has been based in sectoral planning. This approach is jurisdictionally based and characterized by a fragmentation of legal and administrative responsibilities between spheres of government and within and between agencies of each level of government. For example, there are single-purpose national agencies operating with an intention of the single use of the ocean resources, such as fisheries operations or shipping or aquaculture. Each organization has its own jurisdiction regarding resource use and there is a lack of coordination and communication among the jurisdictions. The policy formulation is always done at the ministry level, sometimes ignoring suggestions from the local or department level. The departments or offices at the local level implement the decisions taken in the ministry level. Different organizations aim at achieving different goals, sometimes, using the same resource. This creates confusion and often duplication and overlapping of resource use. For example, leasing of land is under the jurisdiction of both the Ministry of Land and Ministry of Water Resources. Legal responsibilities usually rest upon the Judiciary and administrative responsibilities with the respective departments. All these often result in jurisdictional problems that in turn gives rise to multiple, uncoordinated and excessive use of resources.

As Figure 1 showed, many competing activities take place in the coastal zone of Bangladesh. Some of the principal uses include shipping, seaport activities and sea transport, ship scrapping; the exploitation of living marine resources (for example, fisheries), the exploitation of non-living resources (for example, hydro-carbon), waste disposal; tourism and recreational activities. At the national level, the Ministry of Shipping is in charge of shipping and the port activities, while these sectors are managed and regulated by Bangladesh Shipping Corporation and Department of

Shipping and two port authorities, namely Chittagong and Mongla Port Authorities, respectively. Ship scrapping is a private sector enterprise in Bangladesh that remains literally unregulated. The Ministry of Agriculture and its subordinate offices at the local level manage agricultural activities, while the Ministry of Industries regulates the industries located along the coastal areas.

Generally, the Ministry of Fisheries and Livestock takes care of the policy formulation issues regarding shrimp farming. It is regulated and managed by the Department of Fisheries at the local level. The Fisheries Officer at the local level provides license for shrimp farming. The GOB is currently emphasizing a shift in priorities in management from revenue generation to biological conservation and sustainability. To this end, GOB has drawn up a general Perspective Development Plan for the period 1995-2010 to give direction to, inter alia, the fisheries sector and its development (FAO, 1999b). A comprehensive National Fisheries Policy for fisheries development and management was approved by GOB in 1998 to manage aquatic resources in a sustainable way (NFP, 1998). Unfortunately, the sectoral development strategy lacks the element of coordination among different governmental agencies and the institutions lack capacity for proper management. As a result coastal aquaculture development is threatened by conflicts of interests with other resource users, and social-economic conflicts and the outbreak of shrimp diseases.

In addition to sectoral management, there are some integrated coastal management initiatives in Bangladesh. They focus largely on mangrove and wetland areas. St. Martin's Island in the coastal areas of Cox's Bazar District has been identified as a location that needs protection under the National Conservation Strategy and a zoning plan (only for the coral reef) has been proposed as a tool for the management of that resource and human activities surrounding it. The Ministry of Environment and Forest is executing the conservation programme with technical support from an NGO, the IUCN. The Sundarbans Reserved Forest, the world's largest mangrove forest, was declared a World Heritage Site in 1997. UNDP is supporting the Ministry of Environment for the development of a system to monitor the Sundarbans ecosystem and to help protect the forests through integrated

resource management. The problems regarding the above initiatives are that, these are not based on overall management of the environment linking the environmental and socio-economic impacts of shrimp farming. The individual approach towards management of each resource, such as coral reef or mangrove, focused only on the problems created by that particular resource. The approach did not consider the interrelations between the resource uses. There was also lack of coordination and communication among the various governmental agencies engaged in different development activities and coastal uses, and lack of public participation of the local communities in decision making, that resulted in social and economic conflicts. The dissertation argues that through a series of integrated measures such as strengthening of the institutional and legal framework, proper sectoral management, resolution of conflicts, effective cooperation and coordination among various ocean and coastal users, sustainable development may be achieved and shrimp aquaculture may be fitted in the overall integrated management process.

4.6 Description of Shrimp Farming in Bangladesh

4.6.1 Shrimp Farming Methods

The previous sections have outlined the economic policy leading to the creation of shrimp farming as a growing foreign currency earning aquaculture sector and also outlined the administrative structure. This section will describe the various aspects of the practice of shrimp farming in Bangladesh. The sudden growth of the activity ranging from 1983 to 1997 might not have shown any negative sign in practices because the industry was relatively new.

Four types of aquaculture shrimp farms are found in Bangladesh: (a) Shrimp culture under control of a single person doing establishing small farm on his/her own land; (b) farms on leased land and single control using hired labour; (c) control by landowners who cultivate shrimp on their own land, primarily with family labour and sometimes with hired labour; and (d) shrimp culture controlled by several people and carried out with entirely hired labour on leased land. In Bangladesh, the most prominent form of management is the last one (ATDP, 1997). The land use and tenure policy is important since it generates lot of conflicts in the shrimp farming

area. Farms based on privately owned land are not a problem. But when an outsider from another district lease a piece of state-owned land in the locality, people of that locality do not welcome him or her often cordially, as they think it their right and priority to the use of that land. This often results in social tensions in the community. On the other hand, outsiders often try to exploit the land to the fullest leading to degradation of the land and environment and loss of productivity. In the following section the impact of shrimp farming on the land and other uses of nearby land will be explored.

Usually, paddy fields are used in shrimp farming in Bangladesh. During the dry season the salinity of soil and water in the coastal area increases and in contrast, the salinity is low during the rainy season. Land is used for paddy cultivation during the rainy season. Farmers carry out shrimp cultivation in paddy fields during the dry season, when the salinity of soil and water in the coastal region makes rice culture difficult and relatively less productive and hence less lucrative. In the southwest Khulna region the farmers resume rice cultivation when it is off-season for shrimp cultivation. In the Chittagong area, land is used for another purpose, the commercial production of salt. So, the shrimp production follows the salt production, thus making a cycle of bi-production. Given this bi-production process cycle, then shrimp farming is carried out mostly using the extensive method in Bangladesh by the artisanal fishermen. Consequently, there are many farms but the productivity is very low. The average size of a farm in Bangladesh is 14.5 hectares in comparison to 75.0 hectares in Indonesia and 112.5 hectares in Vietnam. In Thailand and China, where shrimp is cultivated through intensive and semi-intensive methods, the average farm sizes are 4.5 hectares and 2.2 hectares respectively (ATDP, 1997). The productivity level varies from 130 and 250 kg per hectare per annum, which is very low compared to other countries where shrimp is farmed through semi-intensive and intensive methods. The Agro-Technology Development Project (ATDP) in Bangladesh, which is funded by United States Agency for International Development (USAID), has found the following reasons for the choice of extensive method. These are: (a) lower variable production cost per weight of shrimp; (b) lower initial capital requirements; and (c) limited availability of fry (ATDP, 1997). In comparison to extensive method the yield of production under semi-intensive and intensive farming

is twenty to thirty times higher. The national objective of Bangladesh is to increase the production of shrimp so that export of shrimp will increase. The priority for choosing the right sort of land and farming method was ignored since the policy makers dealing with shrimp farming sector had little experience in the industry.

The entrepreneurs started the use of semi-intensive and intensive method for commercial production of shrimp in Bangladesh. The semi-intensive or intensive farming method involves establishment of specially designed shrimp farming ponds. During the establishment of shrimp ponds, usually, lowlands are converted into pools for shrimp farming. Previously these lowlands were salt flats, marshes, mangrove areas and agricultural lands. Paez-Osuna (2000) points out that between 1 and 1.5 million hectares of coastal lowlands in the world have been converted into the ground of shrimp farming. In Bangladesh about 200,000 thousand hectares of land has been converted into shrimp farming. Land use includes mangrove (14% of extensive and 33% of semi intensive), wetland areas (10.5% and 28%), salt plans (5% and 26%), and rice fields (67% and 4%) (Hossain, 2001). Deb (1998) argues that many shrimp farming ponds are unmanageably large, shallow, and 'asymmetrical in shape in Bangladesh and situated in topographically and hydrographically unsuitable areas.' Many authors have referred to the site selection for shrimp culture as being inappropriate. Improper site selection and land use are thought to be one of the causes for lower productivity of shrimp and destruction of mangroves. Zoning is important here in the sense that it may help stop the encroachment into mangrove and thus preserve the biodiversity. Zoning after geographical survey can help to find the most suitable land for shrimp farming. ICOM strategy gives zoning system a priority in the planning process. The use of this important tool in the context of Bangladesh coastal region seems to be very essential now.

4.6.2 Diseases

Over the years it has been observed that problems arise different points in the shrimp farming cycle. There are a number of issues related to shrimp seed. The artisanal fishermen or farmers usually collect wild larvae from the coastal areas. For

the commercial farmers, the rest of the seed is produced in the hatcheries or imported from the neighbouring countries like India and Myanmar. High technology is used in some of the hatcheries in Bangladesh for the production of baby shrimp. Various viruses sometimes affect these hatcheries. In fact, the damage discussed above to the shrimp farming industry in Bangladesh in 1995 was traced back as the consequence of virus attack in the semi-intensive hatcheries in the Cox's Bazar region.

In Bangladesh, the outbreak of shrimp disease has become an annual event since 1996. In 1995 the farmers, because of shortage of shrimp seed, began to import foreign baby shrimp for their farms. The seeds brought the viruses with them. Among the viruses, White Spot Syndrome virus is the most fatal one and is causing great damage to the shrimp farms in Asia (Hossain et al. 2001; Flegel, 1997). This year the attack of virus has become a growing concern since the national media is reporting attacks in different part of the coastal farming areas. On June 29, 2001 the national *Daily Ittefaq* reported that 90% of the farms located in the Shatkhira District have been attacked by the White Spot virus and the concern has been expressed that the foreign exchange earning from shrimp export may be reduced to half of the previous year's figure due to attack of virus. (Paez-Osuna 2000) points out that the common factors associated with disease include rapid expansion of the industry, lack of environmental control and increased regional incidence of disease. The problem of disease in Bangladesh can be attached to the lack of farsightedness in the decision making and planning. While it is evident that imported seed is vulnerable to virus, the decision to establish local hatcheries came very late. Even the hatcheries are not sufficient enough to meet the need for seed and the poor management and corruption in the state-owned hatcheries have resulted in low production. The export of foreign seed should have been immediately banned after it was discovered, however the government failed to adopt a precautionary approach to this issue. It was a quarantine issue to be responded by the Ministry of Health. Since there is no coordination and management planning in this regard, proper action was not taken in time.

Another worldwide concern is the use of antibiotics in intensive shrimp farming. Although the effect is satisfactorily not known and extensive research is needed to verify the effects of the use of antibiotic, the continued and self-prescribed indiscriminate use by the farmers and their persistent presence in sediments may make the pathogens antibiotic-resistant (Paez-Osuna 2000). If more intensive farming were increased in Bangladesh, then this problem would increase because more antibiotics would be used. Accordingly, the problem may be compounded by the fact that treatment of disease in the shrimp ponds of coastal areas of Bangladesh may be a time consuming factor in the long run. Research is needed to quantify the impacts on non-target organisms so that recommendations can be made regarding effluent limits for these chemicals (Paez-Osuna 2000).

4.6.3 Biodiversity Issues

Maintaining biodiversity is an important issue also, since resource use affects biodiversity and can hamper sustainable development. Traditionally, the seed collectors caught wild fry from the coastal areas in Bangladesh. This activity has an impact on the other marine species that rely on these as part of a food chain. In Bangladesh, particularly the shellfish and fin fishes are affected during the collection of tiger shrimp fry. Deb, (1998) has argued that for each catch of a tiger shrimp fry, 26 other types of shrimps, 29 fin fishes and 70 other zooplanktons are simultaneously destroyed. Deb (1998) further points out that along the entire coastline of Bangladesh about 75000 coastal people are engaged in collecting shrimp fry, catching annually about 20350 million tiger shrimp fry with an associated destruction to approximately 1,760,000 million of other commercially important species (Deb, 1998. p. 72). This kind of practice is quite contrary to the spirit of the protection of biodiversity. Loss of marine species may lead to different problems, such as, shortage of food, imbalance in the chain of food system among the marine species. Although regulations exist in this respect, lack of adequate personnel for enforcement and public awareness regarding biodiversity issues are the barriers to resolving these problems. An ICOM strategy aims at strengthening institutions and capacity building for management and protection of biodiversity and can be an effective tool to help identify and develop ways to solve these problems.

4.6.4 Shrimp Processing and Marketing

The marketing procedure is an important activity in the shrimp industry. As noted above earlier, the consumers of delicious shrimp and prawn are mostly citizens of the developed countries. Special care is needed to maintain hygienic atmosphere during the processing and marketing period. ATDP has carried out a study about the processing and the findings are interesting. It gives us vivid picture of the various stages of the marketing channel. Sorting and cleaning of the shrimp are done at the farm in the harvested area. Small-scale farmers have two options left for them regarding their production. Either they choose to carry their production to the processing plant by hiring trucks from the transport agencies or sell their productions to the local traders who buy them and carry or send them to markets. The owners of the larger production farms in Bangladesh usually have their own transport carriers to carry their production to the factories. The processing and packing of the shrimp is done in the same factory. The owners of the factories buy the shrimp from the local traders and shrimp farm owners. All the activities regarding processing i, e, cleaning, washing, freezing and packaging are carried out at the factories. The factories are usually located in the regions where farming of shrimp normally takes place. In Bangladesh, there exists about 70 processing firms and most of them are located in Khulna, Chittagong and Cox's Bazar areas. The mode of transport for the export of shrimp is shipping and two international seaports located at Chittagong and Mongla in Khulna region are used as the port for loading the cargo of shrimp.

In recent years the quality of processed shrimp exported from Bangladesh has come under scrutiny because of poor hygienic quality and non-compliance with Hazard Analysis Critical Control Point (HACCP) regulations of US Food and Drug Administration Center for Food Safety & Applied Nutrition. The HACCP system has been a widely recognized as the preferable system for assuring food safety in that it

- focuses on identifying and preventing hazards from contaminating food
- is based on sound science
- permits more efficient and effective government oversight, primarily because the record keeping allows investigators to see how well a

firm is complying with food safety laws over a period rather than how well it is doing on any given day

- places responsibility for ensuring food safety appropriately on the food manufacturer or distributor
- helps food companies compete more effectively in the world market
- reduces barriers to international trade (Pierson, 1995).

In 1997, the EU banned imports of shrimp from Bangladesh because of non-compliance with EU industrial and quality standards, which was created a sanitary health problem. The EU identified four factors to support its decision: (a) unskilled and unhygienic labourers; (b) unhygienic methods of shrimp transportation and preservation; (c) irregular and unhealthy methods for acquiring shrimp and (d) corrupt practices used to make excess profit at the expense of hygiene control (Toufique and Hasan, 1998). In a way, it also relates to the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Code) of 1995 under the World Trade Organization. SPS Code sets out the basic rules for food safety and animal and plant health standards for nations. It allows countries to set their own standards. Subsequently, a number of firms, in phases, were allowed to resume exports to the EU following receipt of the requisite certificates, although the issue of technological upgrading to improve phytosanitary standards remains on the agenda. Recently, the government has opened special credit lines to facilitate the process of quality control and technology upgrading by the shrimp processing units. This programme needs to be integrated with an overall management programme.

4.7 Some Social Aspects of Shrimp Farming

There is no conclusive evidence to be found in different literature on shrimp culture on the industry's contribution to the overall employment of people of Bangladesh. Researchers are divided in their opinion on this issue of employment generation. Some suggest that employment has indeed been created (including female income generating opportunities) in shrimp farming and in upstream and downstream activities, e.g. services, transport, catching of shrimp fries, shrimp processing etc. (Toufique & Hasan 1998; Manju 1996). On the other hand, some suggest that labour

has only shifted, as labourers have lost their jobs due to the conversion of agricultural lands into shrimp ponds and there is no net gain. More research regarding the impact of shrimp culture in terms of job creation needs to be carried out in Bangladesh. The owner-cultivator relationship is a dilemma in Bangladesh. In most cases the owner is not the cultivator and the relationship is not a congenial one. In Bangladesh, national entrepreneurs lease state-owned land in a locality coming from a different district, appointment managers and hire labourers to cultivate shrimp. Various researchers have looked upon these factors—low productivity and the ambiguous property rights—as impediments to further development of the industry. What is more worrying about these two factors that environmental concerns are linked to them and some are of the opinion that the ownership problem is a barrier to the ‘distributive justice’ in the industry (Bhattacharya et al. 1999).

Some question the activity of shrimp culture by arguing that the people involved in the business are insensitive to the local environment, indifferent to the participation and development of local people and to local knowledge, practices, and preferences. It is true that the control of land and even the market has shifted from the local communities to external entities. Some are opposed to the involvement of private sector involvement with their argument that that private property regimes are not the most favourable one for the sustainable management of natural resources including shrimp aquaculture (Bhattacharya et al, 1999).

4.8 Costs and Benefits of Shrimp Farming

As this overview of the shrimp farming in Bangladesh suggests, shrimp farming is an important economic sector because of foreign exchange earnings. It is clear there will be more activity to develop this sector in the future. The dissertation has also outlined some given problems faced by the industry in terms of its sustainability, disease, mismanagement, environmental impacts and social conflicts. Those in favour of the industry argue that while the country has a very grim prospect of making the other domestic productions as lucrative and profitable export items as the shrimp culture, the government of Bangladesh should provide more incentives to

the entrepreneurs for the economic sustainability of the industry. They say that the shipping sector of Bangladesh is partially benefited by the shrimp culture, since the transportation of shrimp to foreign countries is done by the national flag carrier of Bangladesh and the two international sea ports are used for the loading of shrimp cargo. They also argue that the economic activity is important since it is the second largest non-traditional export earning activity of the country and say that the benefits, in terms of foreign exchange earnings, incremental employment and income generation prevail over short, medium or long-term impacts (CPD, 1998).

In contrast, there are the views of the researchers who argue that the only profitability and foreign exchange earnings should not be the conclusive criteria regarding its sustainability. There are other factors to be considered. As for the protection of the environment, they point out that with additional capital provided by the government as loan or incentive the business community may pay more attention to environmental concerns and ensure safe entrance in the competitive international market. Those incentives include duty exemptions on imports of machinery, cash incentives under a cash compensation scheme, withdrawal of higher electricity consumption rate for fish processing industry, income tax exempt on export earnings and the abolition of import fee and tax at source (BFFEA, 1997).

Researchers have found no environmental benefit to be derived from the shrimp farming. What achieved are the social (indirect) and economic benefits. Even the impact has some negative social implications, such as increased violence, absence of children from schools and harassment of small farmers and women. It is to be noted that child labour is a natural phenomenon in the social perspective of Bangladesh. The poor parents rather let their children work to earn some ready cash than to send them to school.

So far in this chapter, discussion was based on the emergence of shrimp culture as an economic activity, the method applied for the culture, its direct and indirect benefits and some debates regarding the sustainability of the shrimp culture. The present dissertation aims at establishing the fact that even though an economic activity raises environmental concerns and apparently overshadows the benefits of

the activity, with the help of integrated management it is possible to achieve sustainable development of that economic activity and other resource use. In other words, the growing awareness of these problems and potential loss resulting from poor coastal activity management are undisputed. It suggests that there is the urgent need for an integrated management approach.

4.9 Environmental and Other Impacts of Shrimp Farming

4.9.1 Marine Pollution

One of the most significant functions of ICOM is to protect the environment by minimizing pollution, specially the marine environment, while still supporting economic development. Environmental issues cannot be viewed in isolation. They need to be addressed together with the process of development, taking into consideration the vital importance of maintaining the proper balance between economic development, population growth, the rational use of natural resources and environmental protection and conservation. Marine pollution is universal, but mainly affects the sea near coasts due to land based sources and ship based sources. It impacts both the marine environment itself and such external factors as human health, freshwater and food security and aquaculture. The marine pollution generated by shrimp farming is mainly through inputs of nutrients, salination of groundwater, pollution of coastal water due to shrimp pond effluents.

The other impacts caused by shrimp farming are, as noted above, the biodiversity issues arising from collection of wild seed, the removal of mangroves for construction of shrimp ponds, and social conflicts between shrimp farmers and other coastal resource users. The sustainability of the sector has also been questioned by some in view of self-pollution in shrimp growing areas, combined with the introduction of pathogens carried by ballast water, which led to major shrimp, disease outbreaks, and significant economic losses. A recent study by G. M. Ruiz and others at the Smithsonian Environmental Research Center (SERC), the Center of Marine Biotechnology (COMB) of the University of Maryland Biotechnology Institute and Old Dominion University reveals that *Vibrio cholerae*, a bacterium that causes human epidemic cholera, was detected in all ships tested, and included the

recently emerged stereotype 0139, which was previously found only in Bangladesh (Ruiz et al, 2000). This information reveals that Bangladesh coastal water is already infected by the presence of that harmful pathogen which threatens the food chain. There is no sign of ecological initiative in the port activities in Bangladesh and there is no mechanism for the effective management of ballast water. These are the defects of a sectoral management approach. ICOM as a management tool adopts an overall approach towards marine environment and resources. ICOM is a key instrument which addresses the issue of protecting the marine environment by preventing or reducing the impacts of the pollution and impacts arising out of poor planning. These objectives are generally endorsed in the earlier stages of ICOM planning.

4.9.2 Impact on Mangrove Forests

Mangrove is a kind of plant that grows in the tropical and subtropical coastal plains. The plants utilize a natural preservation system common to all marine life. Mangrove ecosystems receive different nutrients from runoff, river discharges, and coastal seawater. The ecosystems are habitats for estuarine/brackish water type species with a predominance of fish, crustaceans, and mollusks, many of which have a very high economic value (Sato, 1999). These unique coastal tropical forests are among the most threatened habitats in the world. There is about 170,000 km square of mangrove forests in the world. Mangrove associated coastal lagoons and estuaries occupy an area of about 83,000 km square. The Bangladesh coast supports about 587,380 ha of natural mangroves and a further 100,000 ha of planted mangroves (Hossain, 2001).

In Bangladesh, mangrove forests play a vital role in the economy of the country and also in the life of people who live very close to the forests. Mangrove wood is a source of timber and fuel, provides material for construction of boat and bridge and is used as raw material for newsprint, match factory and hardboard mills. The honey collectors collect 200 mt of honey and 55 mt of wax from the mangrove forests each year (Deb, 1998). Mangrove forests also supports offshore fisheries. The other

Navigation and Communication (M/O Shipping)	Shipping																				
	Ports	♠																			
Mineral Resources (M/O Energy)	Plants	♣	♦																		
	Oil Terminals		♣																		
	Offshore drilling																				
Biological resource (M/O Fisheries)	Fishing		∅	⊕	⊕	⊕				⊕	⊕										
	Shrimp farming		∅	⊕						⊕	⊕										
Waste disposal/pollution (M/O Environment)	Industrial outfalls																				
	Urban sewage																				
	Oil pollution																				
	Rivers discharge		♣	♣																	
Protection (M/O Environment)	Reserves																				
	Mangrove forest												♦								
		Shipping	Ports	Plants	Oil terminals	Offshore	Fishing	Shrimp	Industrial	Urban	Oil pollution	Rivers discharge	Reserves	Mangrove							
J	I	Navigation and Communication	Industry	Biological resource	Waste disposal & pollution	Protection															

- ♠ Reciprocally beneficial
- ⊕ Hazardous to use J
- ♣ Hazardous to use I
- ♦ Beneficial to use J
- ∅ Beneficial to use I
- ∅ Potentially conflicting

Fig 2. Interaction of Uses of the Coastal Zone of Bangladesh
Source: Based on Vallega, 1990.

services it provides are protection of adjacent areas from cyclone, shoreline stabilization, erosion control, flood control, sedimentation, toxicant retention, nutrient retention etc Bhattacharya et al (1999). It is now universally acknowledged that mangrove forests are largely negatively affected by the shrimp farming. Firstly, construction of pond and human intervention displaces natural mangrove plants in Bangladesh. Secondly, most of the studies on mangrove forests have found that the oldest mangrove forest of the Indo-Pak sub-continent, Chakaria Sundarbans, has been almost totally destroyed as a result of salt production, shrimp cultivation and human intervention. An area of 18200 ha has been dramatically reduced to 5446 ha within 10 years (Deb, 1998). The owner of the mangrove forests is the Government. These are leased out in plots to the potential shrimp farmers, who are mostly non-residents. Having possessed the land, the temporary owner usually clears the trees for the construction of pond. Because of the destruction of the mangrove forests, the natural habitats for marine species are also damaged and consequently it leads to limited scope of fishing, shortage of food, loss of employment and shortage of wood and timber materials. The loss also is a great damage to the national economy. The loss of biodiversity is an issue that has been addressed by Agenda 21, and other specific conventions like Convention on Biological Diversity, 1992. The protection of marine species and plants through proper planning and management is one of the most important factors in the ICOM process. Without the preservation of biodiversity, sustainable development is believed to be impossible. Study has shown that aquaculture activity can co-exist in harmony with the mangrove ecosystem when mangrove-friendly aquaculture methods like pen culture; cage culture methods are employed (Rasowo, 1992). There is an urgent need of effective management measures that would guarantee sustained utilization of the mangroves.

4.9.3 Intrusion of saline water

Precise scientific evidence regarding the negative impact of saline water intrusion is lacking. A Bangladeshi NGO named Nijera Kori has carried out a study in this respect. In its findings it has opined that the contrast between non-shrimp polders (dykes along the coasts) and shrimp farming polders is striking and needs to be physically seen. It further says that the findings are inadequate to express the degradation that has already taken place. Commenting on the saline water intrusion

into agricultural land the study points out to (a) increasing salinity and soil degradation, (b) deforestation and destruction of homestead vegetation, (c) destruction of coastal vegetation, and (d) water logging leading to irreversible changes in micro-flora and fauna. These factors have led to the loss of income for the local communities. Such damaging impacts were not limited to the area under shrimp farming, but extended to the adjacent areas as well (Nijera Kori 1996). Deb, (1998) argues that in the southwestern part of the country, saline water intrusion has caused problems because of loss in crop production, fresh water crisis and related gastro-intestinal diseases and loss in fodder. These problems are indirect result of poor planning and management and a lack of appropriate regulations. An ICOM strategy would require scientific research and adoption of the precautionary principle. ICOM applies scientific information for a particular management activity to reach conclusive decision. Data collection and assimilation are important in this regard because the data is analyzed and used for decision-making. The problem of salinity in water needs much attention for research and study.

4.9.4 Pollution of Coastal Waters by Wastes and Effluents

According to Paez-Osuna (2000) effluents from shrimp aquaculture are typically enriched in suspended solids, nutrients, chlorophyll and Biochemical Oxygen Demand (BOD). The intermixing of effluents can spread shrimp pathogens and create water quality problems. Survey and analysis carried out by scientific community indicate that there are potentials for self pollution which will be caused by discharge of shrimp pond sediment into the coastal water, high water exchange, lack of effluent treatment and poor feeding practices. Following the intensive culture system which is practiced in some shrimp farming areas in Bangladesh, 10-20% of the pond water is exchanged almost every day in order to remove waste metabolites, chemicals, fertilizer etc. direct discharge of which pollutes the surrounding water (Deb, 1998).

In Bangladesh, thousands of shrimp farms in the coastal areas share the same source of water for the shrimp ponds. Day after day, the prospect of getting clean water becomes limited as the effluents and wastes gradually contaminate it.

Naturally, wastes from the adjacent ponds enter new ponds during the exchange of water and create a management problem. If the wastes are discharged from a disease-affected farm, then there is the danger of spreading in other farms near the contaminated farm. Here again, the question of site selection is important. As noted earlier a Zoning Strategy which can also improve this sector specific problems, may be introduced. The characteristics of the land use pattern is such that the farmers use the same direction of inflow and outflow water system, making the ponds vulnerable to further contamination. In Bangladesh 80% of human diseases are caused by water borne factors. The impact of shrimp culture on human health has been related through diseases like skin diseases, diarrhoeal diseases, clinical malaria and intense worm infestation. While using the coastal resources and areas, the prevention of contamination is a must in the ICOM plan. If one area of the coastal zone becomes contaminated there is the scope of contamination along the whole coastal area. In this regard, various studies have suggested the polyculture technology as the possible remedy (Paez-Osuna, 2000). He argues that improved pond design, construction of buffer ponds, reduction and elimination of water exchange rates are other alternatives that could reduce the impact of shrimp pond effluents.

There are various reasons why the environmental issues arise due to the activities in shrimp aquaculture. Number one is the indifference of the entrepreneurs towards the resource use. Proper attention is not given to the over-use of wild fry and there is the indiscriminate use of leased land for the maximization of profit. Secondly, policy failure is an issue that has been at the center of discussion for years. Nonexistence of political will in the formulation of policy, inappropriate policy and the inadequate implementation of policy lead to the policy failures. Lack of an appropriate institutional mechanism at the national level is the topmost reason for failure to tackle the problems environmental degradation. Existing legal and administrative structure is not sufficient to support the institutions and there are shortages of efficient and qualified personnel. As a result, both the process of policy formulation and policy implementation suffer from the weaknesses inherent in it. These deficiencies are also reasons for the ineffective enforcement of laws and regulations regarding shrimp farming and other resource use. Along with these

problems, there is the lack of proper coordination among the various institutions managing different coastal resources.

4.10 A Critique of the Management of Shrimp Farming

In the previous sections focus was mainly on the shrimp farming method and the harms related to the exploitation a particular natural resource, shrimp. The shrimp farming industry in Bangladesh enjoys a very advantageous position in respect with noteworthy natural resources and plentiful cheap labour force. But several factors minimize the opportunity of utilizing the natural and human resources in a successful manner to increase the productivity. These negative factors are: poor management, deficiency in infrastructure and lack of conflict resolution. The shrimp industry is seen as toxic as it is increasingly becoming harmful to the ecosystem in terms with the use of nutrients, chemicals and other toxic materials. Although the damage done by the industry to the environment and people has not reached an epidemic proportion, the socio-economic and environmental impact of shrimp farming in the developing countries is very much noteworthy. Biologists and scientists are expressing their concerns in their writings regularly published in journals, magazines and daily newspapers. Some oppose the commercial production of shrimp vehemently, argue that the profit of the business is earned at the cost of general public and propose that the industry should be shut down altogether. They refer to the negative impacts, such as destruction of the irreplaceable resource of the mangrove forests, increasing salinity of soil, declining productivity of land, increasing deforestation, growing landlessness and increasing shrimp related violence as the outcome of the industry and argue that these negative impacts overshadows the potential gains. According to some, shrimp culture itself runs contrary to the concept of sustainable development (Nijera Kori, 1996).

The controversies arise because of the facts of environmental impacts and socio-economic conflicts. These are outcomes of non-compliance of regulations, defective government policy and lack of coordination among the public agencies. There are some policies and regulations regarding shrimp management in Bangladesh, but these are administered by a number of agencies and are insufficient to address the environmental and social issues. The Protection and Conservation of Fish Act, 1950,

which has been amended in 1995 mainly focuses on general fisheries, probation of use of certain kind of fish nets, enforcement etc. It does not relate particularly to shrimp aquaculture and environmental issues. The Shrimp Mohal Management policy, 1992 refers to the land tenure system managed by the Ministry of Land, but it does not have any mechanism to deal with the malpractice regarding land tenure discussed earlier. The Shrimp Cultivation and Pond Regulation Policy for Bagerhat District, 1993 is a document only related to one particular district and does not cover other areas. The Shrimp Cultivation Tax Act 1992 imposes taxes on the landowner or landholder for profitable shrimp farming on that land and the controlling authority in this regard is the Water Development Board, a subordinate office of the Ministry of Water Resources Development. The Ministry of Commerce deals only with the export issues and pays little attention to the environmental issues to be addressed in collaboration with the Ministry of Environment.

Lack of efficient personnel at the regional and local levels for enforcement of fisheries regulation fail to control the dishonest practices of the shrimp farmers. For example, collectors of shrimp fry are allowed to use a certain kind of net. However usually, they use the kind of net that helps catch other species along with the baby shrimp. This is a violation of the regulation and at the same time detrimental to the conservation of biodiversity. Most of the policies and regulations are insufficient in the sense that they tend to focus on only one issue. This sectoral management approach and lack of coordination among the different agencies is, as noted earlier, prevalent in Bangladesh. The need for a more integrated approach is distinct. The existing farming policies may be supplemented by adopting an integrated management policy so that the management process becomes a harmonious process addressing all the environmental and social issues at the same time.

Chapter 5

5. The Need for ICOM, Recommendations and Conclusions

5.1 The need for ICOM

Chapter 4 outlined the sectoral issues raised by the coastal zone activity of shrimp farming and identified a number of cases threatening the sustainability of the industry and the coastal and ocean biodiversity. Chapter 4 also highlighted the problems of rapid externally driven development of one sector, perhaps before the capacity for management and planning developed. The problems of social conflict, environmental impact and sectoral management problems-all provide opportunities to change to an ICOM approach. This last chapter will outline the usefulness of an ICOM approach in Bangladesh as a means of planning and coordinating administrative agencies and resolving economic and social conflicts and will provide recommendations as to the way it can occur.

5.1.1 Planning and Coordination

In the coastal zone of Bangladesh management of coastal and ocean resources requires ICOM, which is a process for addressing these kinds of multiple problems and the source of these problems. ICOM sets out multiple objectives to generate the efficient and maximum utilization of the various coastal resources. It aims at fixing priorities for the national objectives and needs along with regional and local objectives and needs. The setting of the objectives is done in line with the broader national perspective and goals. ICOM analyzes and addresses implications of development, conflicting uses and interrelationship between physical process and

human activities. The impacts of the shrimp farming industry on the environment are the result of poor management, lack of expertise, lack of coordination and long-term social conflicts. A poor planning process leads to poor management and negative impacts. At the national level there is the lack of integrated planning and development of action programmes for all related sectors.

An ICOM approach is focused on developing an institutional or organizational mechanism to coordinate various departments and agencies involved in coastal and ocean uses. Communication and coordination is at the heart of a successful ICOM process. The mechanism should have the required legal or legislative authority to guide and regulate the coastal actions and must have influence over the activities of all agencies and level of government that has the decision-making authority relative to the coastal zone. It must be capable of making informed decisions and have access to appropriate scientific and technical expertise and data. It is obvious that for any management of the coastal resources to be effective, it is necessary for the policies to be based on informed decision-making. This in turn requires ready access to appropriate, reliable and timely data and information, in suitable form for the task at hand. Second, strengthening the infrastructure for ocean development involves not only operational and structural adjustments, but also the provision of the necessary means - capital, technology, human resources, and managerial capabilities - so the institutional structure is capable of performing effectively what is demanded of it.

Agenda 21 provides the global recommendation for Integrated Management to achieve Sustainable Development. It calls on States to consider establishing or strengthening an appropriate coordinating mechanism (such as a high level policy planning body) at both the local and national level. In Bangladesh, decision-making is usually done at the national level. What is needed is a single institution with overall responsibilities for integrated planning and development of action programmes for all related sectors. Since ICOM is an interactive process, it acts across the various sectors of coastal resources in a harmonized way. During the ICOM process a common framework is created within which the resources of the coastal zone may be conserved, protected or exploited according to the varying

needs of society. It makes economic and demographic projections as the growing population has an impact on the use of resources. It focuses on the future circumstances in order to make certain that the desired objectives are achieved smoothly. It emphasizes proper resource accounting and follows the same analytical pattern for analyzing the cost-benefit of the use of different resources. An institutional mechanism is created to harmonize the activities and programmes that affect the coastal area and its resources. ICOM paves the way for the harmonious actions of the coastal and ocean resource use institutions and promotes better coordination among the different sectoral agencies and among the agencies within a particular sector. It ensures that the actions are consistent with agreed coastal goals.

An ICOM strategy involves a long-term plan for present and future uses of coastal and marine areas, creates zoning for uses and anticipates new uses. A zoning system can create such an environment that the management of traditional resources can accommodate new resources users and uses. In the case of shrimp farming, zoning is important so that the contamination, which is an impact of resource use, does not spread to other resource use areas, such as agricultural lands. The ICOM strategy aims at protection and conservation of the ecosystem, maintaining biodiversity of the coastal and marine areas and ensuring sustainable development. Addressing issues associated with sustainable development requires appropriate capacity within legal and administrative institutions, NGOs, and local communities. Capacity building within institutions increases the efficiency in the implementation and application of enforcement mechanism.

As already discussed, lack of trained and an insufficient personnel is one of the reasons that the shrimp farming is not properly regulated. There is a need to strengthen existing institutions. ICOM is intended to strengthen institutional and legal frameworks and create public awareness. Raising awareness of environmental hazards and pollution is an important issue in ICOM and it mobilizes public opinion against social, cultural and economic factors contributing to the pollution. Transparency regarding decision making and making the public aware of the objectives and management process enhances the effectiveness of the ICOM strategy. If the local community in the shrimp farming areas is aware of the negative

consequences and of conflict resolution mechanism, they may surely contribute to the sustainable development. As governments are often outright owners of specific coastal and marine areas, ICOM strategy involves planning to manage government-owned areas and resources wisely and with good economic returns to the public.

5.1.2 ICOM as a Means of Minimizing Economic Conflicts

Although the concept of ICOM does not aim at any socialistic view that every human being should gain equally from the benefits of an economic activity, the question of equity is still there. At least, the fairly proportionate distribution of profit can be ensured. It is a common question asked during the ICOM plan—who gains, who pays and to what extent? In the perspective of Bangladesh, the question is obvious. There is no doubt that the income from shrimp farming is higher than the income generated from other traditional activities like rice production in the same land. Rahman et al (1995) have shown in their study that the gross yield per hectare from shrimp culture (Taka 32,000/hectare) is substantially higher than rice cultivation (Taka 12,000/hectare). The study further shows that most of the incremental income goes into the pocket of the non-resident entrepreneurs. The local peasants are to remain satisfied with the daily payment for their labour. They do not have any claim to share the profits. As a result, the coastal communities, who have been using the coastal resources, are being deprived of their traditional resource use rights. Battacharya et al. (1999) have termed this as 'income erosion and income inequality.' By depriving them of the profit generated by the use of coastal resource, they have been denied the justice of distribution. The participation of stakeholders in the decision-making during the ICOM plan preparation has been greatly emphasised by the ICOM advocates. ICOM ensures active participation of the people of all walks of life at different stages of management and planning and sensitize them about the environment and development. This is important in the sense that they may feel themselves part of the development process and contribute enormously in the implementation of a management plan. However, incentives for the motivation are needed. If they are denied access to the incremental income, they become economically disadvantaged and morally destitute.

5.1.3 ICOM as a Means of Minimizing Social Conflicts

Wherever and whenever conflicts of interest over the allocation and use of any coastal resource are found, decisions have to be made to resolve those conflicts. As the coastal zones are used by a growing number of multiple individual and organizational users who claim an interest in, or a share of, various coastal resources, it is clear that enormous potential for conflict exists between different sectors and, especially, between the natural functioning of the coastal system, and the needs and expectations of societies who share the same space. Figure 2 sets out some of the potential and conflicting users in Bangladesh. The conflicts prevailing in the coastal zones of Bangladesh are the result of the sectoral approach to coastal and ocean resource management and inappropriate or poor execution of government policies. In addition to this, the local coastal community is frequently ignored in the planning, decision-making and implementation process of development programmes that often affect them directly. Conflict resolution is an issue that ICOM gives much importance since it is a barrier for sustainable development. Psychologists say that the sense of deprivation sometimes leads to dangerous consequences. Not only the poor coastal communities are deprived of their rights, there are growing conflicts between the traditional rice cultivators and shrimp farm owners. In fact, the greediness of the entrepreneurs and their persistent exploitation of the coastal community have not always gone unchallenged. Consequently, there are incidents of adverse law and order situation, terrorism, bloodshed and sometimes death (Deb, 1998; Battacharya et al.1999). All these researchers are of the opinion that the local government mechanism sides with the shrimp farm owners. The conflicts mainly arise out of territorial disputes and the forceful occupation of lands. The function of a local government mechanism is very important in the implementation of the ICOM plan. It is the local government initiative that can resolve the social conflicts arising during the resource use period.

Another social conflict arises due to the indifference of the non-resident shrimp farm owners towards the needs of the local people. Usually they expect a better world than that they are living in since an export oriented shrimp culture in that area is bringing in a lot of foreign exchange to the country. ICOM repeatedly emphasizes

the consideration of the social, cultural and historical aspects of the coastal areas so that the priorities may be fixed and the national and local needs may be addressed. If that is not done, any management approach may lead to failure since the development will not fulfill the needs of the community. If that remains undone, there will be no sustainable development and the goals of ICOM will not be achieved. The goals may be community development in terms of ecological and socio-economic development, better living standards, access to healthcare, education etc., contribution to national economy, increase in foreign trade and export if the resource generates an economic activity, and if there are employment opportunities.

The lessons learnt from the study show that multi-sectoral negative impacts can result from and also affect shrimp aquaculture and conversely, endanger its sustainability. Taking into consideration the single sector problems and the absence of integration among the affected sectors, there is the need for the introduction of ICOM in the coastal areas of Bangladesh. Users need to compromise with their respective uses and better planning to accommodate one another for better management. For example, a coral reef may support artisanal reef fisheries if fishing is limited to certain species. On the other hand, eco-tourism may be continued in the coral reef by maintaining the beauty of the reef. There is no need to replace the traditional management of shrimp aquaculture since ICOM is not intended to replace the traditional single sector management but to supplement it (Cicin-Sain & Knecht, 1998). What is needed is increased cooperation among the managers of the different sectors at different levels. Within the broader perspective of ICOM, the managers of different sectors should pursue their goals with the assistance of management plans that will guide the process and also take into account the impacts on other sectors.

Chapter 4 traced the emergence of shrimp culture in Bangladesh as an economic activity, its benefits and negative environmental impacts and social conflicts. This part of chapter 5 has considered the utility of ICOM as a tool of sustainable development and how it might be applied to ensure better coastal resource management in Bangladesh. The sudden emergence of an economic activity demonstrates the challenges faced particularly by developing countries when there

is a rapid development of one sector. Consequently the management problem of this one sector created a lot of problems in the other sectors. Although the government encouraged the entrepreneurs by providing financial and institutional assistance, the management of environmental issues was totally ignored. The existing administrative structure needs to be examined and the laws reviewed. The command-and-control mechanism in respect of the regulations is there, but ineffective and inefficient use of regulations has led to environmental degradation. The following sections outline to provide specific recommendations for steps to prepare to develop ICOM in Bangladesh. It also makes some sectoral recommendations to help improve shrimp farming management.

5.2 General Recommendations

The integration of economic development with environmental concerns needs to be addressed if the goal is to achieve sustainability in shrimp aquaculture. The GOB needs to identify strategic management of resource and particularly ICOM as a priority and undertake national measures to increase capacity to manage its resources. The economic activity itself was not supported by a healthy and proper management policy. The concept of integrated management of coastal zone emphasizes the need for management of the particular sector concerned and also integration of the management required for the other affected sectors. In the following paragraphs some recommendations will be made for the introduction of integrated management for the shrimp farming and other sectors. This may include, among others, strengthened efforts in planning and management of coastal resource development, Zoning Strategy, implementation of the Environmental Impact Assessment (EIA), monitoring of pollution, and environmental legislation.

5.2.1 Strengthening of the Legal and Institutional Framework

One of the key difficulties identified in the case study is related to the administrative and legal framework. The existing regulations and control mechanisms of shrimp sector and other related sectors should be reviewed and a national policy for integrated coastal and ocean management formulated. It should include an

integrated decision making system, capacity building activities (training, education) and an effective enforcement and implementation mechanism. The Government of Bangladesh should ensure that a useful, pragmatic and comprehensive institutional framework at the local and national level, as appropriate, is established for proper coordination and harmonization of all coastal and ocean resource use and activities. This will include the set up of a long-term, effective National Integrated Coastal and Ocean Management Commission (NICOMC) at the highest bureaucratic level and a Secretariat for the Commission. An Act should be enacted to give the Commission sufficient legislative power and authority for development planning and budgetary allocation.

In light of the coordinating role of such a Commission, it is suggested that the environment should be the focal point, and the Ministry of Environment should be the lead agency with authority to coordinate the actions of various agencies and varying responsibility for the different actions carried out in the management process. The members of the Commission should include representatives from the Ministry of Fisheries and Livestock, Ministry of Land, Ministry of Agriculture, Ministry of Industries, Ministry of Commerce, Ministry of Land, Ministry of Water Resources, Ministry of Shipping, Ministry of Health, Ministry of Education, Ministry of Local Government and other related Ministries. The Commission Secretariat should remain accountable for developing and implementing the action programmes for ICOM through the departments and subordinate offices at the local level.

The planning aspect of coastal zone management should be integrated into national development planning. The Commission should be responsible for ensuring appropriate coordination among the various Ministries and their respective departments and subordinate offices having responsibilities for decision making in the coastal resource uses and activities. In Bangladesh, the organizational structure follows a “top-down” approach. However, the policy should adopt the “bottom-up” approach also. The relative roles of the authorities at different level of implementation should be clearly identified and assigned. One of the primary difficulties in Bangladesh is availability and access to data and information. This

should be a key factor and the Secretariat should perform, among other functions, the function to monitor the data collection procedure.

Capacity building is an important issue in the ICOM process. The presence of individuals capable of designing environmental policies and regulations, and of technical experts who can provide local personnel with effective methods for mitigating and preventing environmental problems and monitor environmental performance should be ensured in the policy. They should be provided with the necessary training to develop expertise in their respective field of activities. With the help of these experts, both the Commission and the offices at the local level would be capable of making informed decisions, adopt comprehensive and coherent policy, and achieve effective implementation of the policy for suitable management and development of coastal and ocean resources including shrimp. The Commission should have an organ within itself that will make comprehensive overview of the present and projected resource use and activities by collecting, consolidating and synthesizing scientific and other related information and data regarding the resources. There should be a policy to ensure transparency by increasing the availability and accessibility of information to all interested parties. The policy should be motivated politically in such a manner that it ensures the participation of affected local people in the planning and implementation stage. The effort of establishing the mechanism should be adequately financed.

5.2.2 Environmental Impact Assessment

Environmental Impact Assessment (EIA) should be widely employed as a tool in coastal and land resource uses and activities to ensure that all environmental and social impacts on population, economic conditions, employment, cultural values, quality of life, social structures and resources are addressed very early in the planning process. An institute such as the Oceanographic Institute of Bangladesh may be created with capable and skilled scientists and biologists in order to carry out a continuous monitoring and assessment programme to collect data, assess results and identify the need for change or improvement. The immediate, short term and long term effects of shrimp culture and other activities are to be assessed

comprehensively and a guideline should be prepared accordingly in the policy. The participation of local communities, through public hearing or other mechanism, during the environmental impact assessment procedure should be ensured in the policy. EIA should be adopted in legislation as a mandatory process to analyzing costs and benefits of proposed policies and activities and other environmental and social impacts on the coastal resources and other activities.

5.2.3 Coastal Area Zoning

For the adequate management of coastal and ocean resources and to avoid the cumulative impacts of the uses and activities, the institutional mechanism must adopt some land use and water use plan to guide and direct the policy making and decision making process. In the ICOM process, the coastal management area is managed as a single unit or zone. Zoning should be one of the strategies that the Government of Bangladesh should use increasingly because that will help eliminate many problems, including the impact on the environment and particularly the mangrove destruction. For example, the introduction of a zoning system on shrimp farms would facilitate the monitoring and mitigation of environmental impacts. Geographical and environmental surveys and studies should be carried out in this respect for the identification of the vulnerable marine zones and the identification of different pollutants. The data derived from the study should be used as a basis for an economically and ecologically sound land use zoning. Only areas with obvious high potential should be used for shrimp farming because of its very high economic value, but at the same time it should be ensured that the risks of failure is reduced.

5.2.4 “Polluter Pay” Principle and Protection of the Environment

There is a growing need to raise the level of the awareness among shrimp farmers and other resource users regarding the social and environmental issues. The victims and beneficiaries of resource uses should be identified and the extent of damage caused and benefit derived from should be assessed on a regular basis. Formulation of polices and programmes should be directed to compensate the victims of shrimp farming and pollution from other sources through the redistribution

of benefits under "polluter pay principle" in the long run (Rio Declaration, 1992). Environment friendly production technologies should be developed and promoted with support from the government and donor agencies in the short term in order to ensure better human health and welfare.

5.3 Sector Specific Recommendations

5.3.1 Registration of Farming, Licensing and Regulation of Shrimp Farming

Regulation for registration of all shrimp farms with specific information should be incorporated in the policy. The introduction of licensing of shrimp farms may help control the unsystematic and unrestrained growth of shrimp farms. Moreover, when licences are issued for shrimp farms, priority should be given to cooperatives and other organisations of local fishermen and farmers. Provisions should be there for presenting proof of land title (lease, concession or ownership) when applying for an aquaculture license (FAO, 1997). The policy should aim at incorporating the FAO Code of Conduct for Responsible Fisheries and the Bangkok Declaration and Strategy for Aquaculture Development Beyond 2000. There should be definite guidelines regarding site selection, use of resources, quality control of production, health hazards including use of chemicals and antibiotics. These are prerequisites for sustainable development. If these policies of integrated management are followed in the coastal areas the sustainability in shrimp culture and other resources will surely be achieved. Measures should be taken to prevent the clearing of mangrove forests by the shrimp farm owners.

5.3.2 Ban on Trawler Shrimp Catch

Fishers use trawlers to catch mature shrimp in the coastal areas and the percentage is not significant in terms of total production. These areas are also breeding places for baby shrimp which are collected for hatcheries. As a consequence of trawler fishing mother shrimp are also caught and the natural breeding process is hampered. The Government should ban trawler fishing for shrimp catch in the coastal areas. This measure will help the conservation of wild stocks of juvenile and adult shrimp

through preservation of mangrove nurseries. FAO's Technical Consultation on Policies For Sustainable Shrimp Culture has recommended some implementation and institutional arrangements (FAO, 1997). When formulating the new policy on shrimp farming, Bangladesh should strictly follow the recommendation and try to implement the policies accordingly.

5.3.3 Construction of Hatcheries

As we have already discussed in the fourth Chapter, the need for establishment of sufficient hatchery for breeding baby shrimps is a very important issue for shrimp farming in Bangladesh. The spread of shrimp diseases believed to be carried out by foreign seeds can be minimized. Valuable foreign currency can be saved and new jobs can be created if hatcheries are developed and management properly. The dependence on wild fries can also be reduced and the biodiversity may be protected. Experience has shown that the existing state-owned hatcheries have problems and are losing money because of inefficiency and lack of the use of modern technology. The Government should encourage the private sector entrepreneurs to providing infrastructure facilities and financial support.

5.4 Conclusions

Marine resources need to be managed both qualitatively and quantitatively due to their importance to economic development, physical and social environment. In Bangladesh, particularly, where resources in the sea and coastal areas like shrimp are intricately linked with the economic lives of people, their value has increased with competing demand. Therefore, economic and ecologically sustainable efficiency of coastal resource use is a major policy consideration. Key industries such as shrimp farming cannot be left to the mercy of unregulated markets. The Government of Bangladesh is facing growing problems because it cannot address environmental and socio-economic issues in a comprehensive manner. Separate Ministries and Departments are in charge of water management, land use, environment and export; each acts independently of the other. The interdependency among sub-sectors and uses should be recognized and comprehensive planning,

taking the interest of all users into account, should be used to reduce the conflicts in the system. Although advances have been made regarding the study of the negative environmental consequences, the result of the studies is not adequate enough for the management of the industry and other resources in the perspective of protecting natural ecosystems. On the one side is the potential economic value of shrimp aquaculture and other coastal activities such as shrimp farming, eco-tourism etc. in Bangladesh and on the other side is the environmental and social concerns. Satisfactory scientific research has to be carried out so that the outcome of the research may be applied in an integrated management programme. It is of the utmost importance for the Government of Bangladesh to draw lessons from the past experiences and avoid yet more of the environmental and social disasters caused by poorly managed use of coastal and other resources.

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