

Environment and Security in Bangladesh:
An Impact Study of the Farakka Barrage

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By

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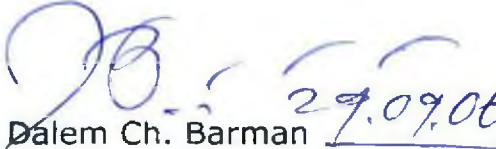
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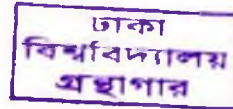
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Dedicated to

My Proud Parents

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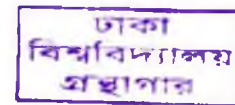
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PREFACE

The sharing of the Ganges water between India and Bangladesh is the most important international river dispute. This dispute has not only created an irritating and sensitive subject to both the India and Bangladesh but also has created an adverse and devastating environmental effect on both the countries. But in a truest sense the effect is predominating on Bangladesh's ecological balance and natural resources (mostly on non-renewable resources). The Ganges is a major international river, which has had its source from the womb of the great Himalayas and flows across the territories of India and Bangladesh and finally has been ended with the attachment of Bay of Bengal. Since the time immemorial the water of the Ganges is the lifeblood to the people of the subcontinent. The inland navigation, fishing, timber floating, social, cultural, recreational, drinking, religious and other non-economic purpose have been depended on the natural flow of the Ganges River, most particularly the socio-economic structure of Bangladesh. From the very beginning of independence the Indian government felt the necessity of economic development through the agricultural production. With this aim Indian government took the plan to construct a big barrage over the Ganges River and showed the reason that India had been lost her most fertile land to Pakistan for the partition of Indian subcontinent. Ashok Shown on the experts of water and security issue mentioned that due to the pre-independence partition, the independent India has lost a sizeable sunk of its most fertile irrigated land in the Indus and Ganges River basin to the newly created state of Pakistan, both in the western and eastern front of its boarder (Swain, 1996: 33). Due to this prescribed internal problem the very government of India took a grand initiative to utilize the water resource to aggravate agricultural production and maximum self-reliance. Finally, they constructed the Farakka Barrage and signed many treaties with the Bangladesh government to share the water of the international rivers flow over the Indian territory and finally has fallen on the Bangladeshi land. Indeed this is a long history and many treaties have been signed between the two countries. But the result is very better and the future is very bleak as India has been advanced more and planning to building up river linking project namely 'Indian River- Linking Project'. Whatever the history it has and the future plane would be undertaken by the India government, this is very devastating sign for Bangladesh. The water flow comes from the Ganges basin is very essential for the social, economic and environmental development of Bangladesh. But in a real sense,

the environmental impact is very far reaching and it affects the socio-economic structure of Bangladesh. In a word, it is related to the total existence of Bangladesh.

The study is, thus, undertaken to identify the major environmental effects happened in Bangladesh due to the adverse diversion of water by India through the Farakka Barrage and its correlation with environmental security of Bangladesh. I believe that water is most precious resource in the present world on which most of animals and plants depend to sustain. The diversion of water through Farakka Barrage and its consequent reduction of water in Bangladesh is a great threat to the people, animals, plants and the whole environment.

Finally I hope that findings of this study will help policy makers, researchers, and students to understand the needs of environmental security of Bangladesh and the necessity of continuation of natural flow in Ganges Basin to ensure the security of environment in Bangladesh and, finally, the urgency of management of the water sharing problem.

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ACRONYMS

ACUNU- American Council for the United Nations University

DANIDA-Danish Development Assistance

ESB- Environmental Security of Bangladesh

NOD- Non Offensive Defense

NTS-Non- Traditional Security

PRIO- Peace Research Institute of Oslo

NWDA- National water Development Agency

GDP- Gross Domestic Product

JCR- Joint River Commission

SAARC- South Asian Association for Regional Cooperation

JCE- Joint Committee for Expert

MOU- Memorandum of Understanding

GK- Ganges Kapotakkha

BADC-Bangladesh Agricultural Development Corporation

IUCN- International Union for the Conservation of Nature

BSS- Bangladesh Sangbad Sanastha

WDB- Water Development Board

BIWTA- Bangladesh Inland Water Transport Authority

GWTF-Ground water Task Force Report

TDS- Tidal Dissolved Solid

MPO- Master Plan Organization

WH- World Heritage

Acknowledgement

Environmental security is in high priority in the present century. In this context Bangladesh is not exceptional. Rather it has attracted the most important attention. And the environmental security is under threat by the water diversion by India through the construction of Farakka Barrage. It is, therefore, this issue has been discussed in this research work.

Doing this work I want to express my earnest gratitude to my supervisor Dr. Dalem Ch. Barman, the founder of Peace and Conflict Studies Department, University of Dhaka, Bangladesh. He extended his helping hand to me by providing his valuable comments and segmentations to guide the research work and strengthen it.

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Executive Summary

As the new millennium begins, global concerns about sustainable economic development have brought the concept of environmental security into sharp focus. Countries in all regions of the world must find the means to protect the environment in order to ensure continued access to natural resources and the health of their citizenry. But national sovereignty and regulatory policy at the level of individual nations can not guarantee success in matters related to environmental security. It is now quite apparent that threats to a nation's environmental security may not only arise outside its borders, but also from the inside of national boundary. To steer a course of sustainable development requires that nations find the means and mechanisms to take collective action to protect the land, water, air, and bio-resources through policies that are cooperatively defined and implemented. Bangladesh is not exceptional in this context. The environmental aspect of Bangladesh is no more in vast focus both in governmental mechanism and public forum. But some efforts were undertaken by some researcher to focus sharply about the environmental security. The security outlook of Bangladesh was traditional based security and it is still in the same line. The non-traditional security outlook and human orientated security system are yet to be visualized in Bangladesh due to the in capability of the state mechanism. That is why the environmental security concern is still neglected in Bangladesh.

Life and river are very much connected and seen as one. Life on earth depends on water - water maintains and links the planet's ecosystems. Water is the most precious life giving natural resource of the world. Bangladesh and her whole ecological balance are totally depended on the rivers and the water coming from out side of the boarder. Bangladesh is the lower riparian of 54 common rivers which enter Bangladesh from India. Bangladesh the lower riparian of Ganges depends on Ganges for the survival of its people, agriculture and ecosystem, particularly of North West and South Western part of Bangladesh. The Ganges provides drinking water, sustains agriculture, industrial activity, forestry, fisheries, and inland navigation, prevents salinity intrusion from the Bay of Bengal and above all, maintains the ecological balance of the country. The balance between man and nature in the Ganges basin of Bangladesh depends on the Ganges on which the livelihood of one third of the people would be threatened. The Ganges, which has inspired mysticism and shaped the Bengali mind, music and literature, is today reduced to a dying river.

These rivers are international as they flow through two or more sovereign countries. Bangladesh, known as "Land of water or better still water in land" (Novak, J), is now faced with acute water shortage during dry season. A woman in a land of water walks 2 to 3 kilometers to get drinking water from deep tube wells since the shallow pumps and surface water have all dried up. Desertification is taking place in the northwestern part of the country. Salinity is increasing in the southwest, threatening the Sundarbans, world's largest mangrove forest. Ground water is contaminated with arsenic and it is spreading fast, because not known. Rivers are dying and are filled with siltation. And it can no longer discharge flood and rainwater during monsoon resulting in unprecedented floods. The river ecosystem is dying. This has been severely disrupted by substantial diversion of the Ganges flow during dry season by India for the stated purpose of flushing the Calcutta Port through the construction of a barrage at Farakka in 1974. Ganges withdrawal during dry season is one of the most critical environmental problems Bangladesh faces. While water loss is of concern for human use, its ecological impact has never been assessed. What has been the ecological damage since the commission of Farakka in 1974 will take decades to recover even if we get water now. In this research, I have tended to focus this issue very clearly and authentically. Doing this work, the whole research has been decorated into seven chapters.

Chapter one is designed to mansion the justification, aims and objective, and different methods of the research.

Chapter two discuss about the definition of environmental security. Environmental security as a concept is new one. Homer Dixion and his colleagues in the University of Toronto was the pioneer to focus on the environmental security. This chapter just illustrates the theoretical and analytical concept of environmental security. Lastly, this chapter outlines the main areas of environmental security.

Chapter three is particularly based on the conceptual aspects of environmental security of Bangladesh. What are the areas of environment are in insecure position has been illustrated in this chapter. An attempt has also been undertaken to re-conceptualize the environmental security of Bangladesh. This is yet to be established.

Chapter four is designed to discuss about the history of construction of the Farakka Barrage. The construction and existence of Farakka Barrage is very much related to the environmental security. Through the construction of Farakka Barrage India is

diverting water from Ganges basin unilaterally. And its effect goes on the devastating impacts on the environment of different parts of Bangladesh.

Chapter five is designed to illustrate about the ratio of water diversion through the Farakka Barrage. After the operation of Farakka Barrage the ratio of water is being reduced day by day due to the unilateral diversion of water. This is very much difficult to calculate the ratio of water diversion. But for the purpose of the research I have tended to find out the actual ratio of water diversion by India from the different sources. How much water is available in Bangladesh from the Ganges basin has also been mentioned.

Chapter six is based on the discussion of the environmental impacts of water diversion by India through the Farakka Barrage over the Bangladesh. This is widely discussed issue. After the operation the government, policy makers, and researchers are discussing this issue. Still many research works are being conducted over the topic. In this work, I have focused mainly on the areas, which are very much related to the environmental insecurity of Bangladesh. The effects of Farakka Barrage are social, economical, and political contextual related. Firstly the issue was undertaken under the banner of traditional security concern. But now this has changed and attracted the attention of different quarters of people. Environmental concern, thus, has vehemently attracted the attention of all quarter of people. The correlation between the environmental insecurity and the major effects due to the operation of Farakka Barrage and unlawful water diversion by India has also been mentioned in this chapter.

Chapter Seven is designed to find out the resolution processes and mention the initiatives undertaken by both the country to solve the problem. It is mention here that many treaties and memorandums have been adopted and all remain in without bringing the fruitful result. In this connection, I have mentioned some recommendations to resolve the problem and at lest to save and maintain the environmental security of Bangladesh.

Chapter-one

INTRODUCTION

1.1 Justification of Study

Environment is the natural not man made which gives the life supporting fuel to all living being. Environmental resources (both renewable and non-renewable) provide the substance to meet the demands for all the people in the universe. But man is the enemy of environment. The environmental system emanated and continued from the time immemorial is not in same nature and character due to the increase of population rapidly and increasing demand of people. The population pressure and increasing demands of the people have destabilizing the eco-system's natural flow, which have consequently resulted different types of environmental degradation and environmental hazard. This is why in the present stage environment has become most important legitimate concerns for policy makers as well as activists all over the world. The traditional security concern (mostly reflected on the protection of minimum, core values) is not so impressing now due to the changing nature of international politics. The globalization process has made the world system most cooperative and depended on each other from bottom line top most one. This dependence indicates that the change in one region is the most obvious region in creating change and influence in another region. The natural character of the environment was made these natural dependences solid and binds them together. The natural interdependences, thus, indicate that the natural imbalance or degradation in one particular place will connect and affect the entire community of nation. It is a most important fact that many countries in the world universe are affected seriously by the environmental degradation due to not their unfriendly activities but by the activities done by the other people and other nations. Even the affected people are not the part or do not have any connection with reasons caused the third party. After the set back of the Cold War the focus of military and political conflict between two super powers has been abolished and growing concern over the connection between the environmental security and conflict has also been confronted to us. Policy makers, scholars, political leaders all over the world have proposed expanding the scope of the concept of security beyond its traditional geopolitical military focus to take into consideration the newly felt environmental security.

Bangladesh is a third world country with fragile geo- sphere. The geo sphere which include land, air and water system with non-living and non-biological resources and various other biological system viz various micro organism, wetlands and fisheries is declining day by day. On the other hand, more than 40 districts are already affected by arsenic. Agricultural productivity, salinity, decline of forests, devastating leasing of fisheries, navigation problem, high floods, and riverbank erosion are the common phenomena in the present day today. The diversion of most of the dry-season flow of Ganges by India to one of her internal river before it reaches Bangladesh is mostly responsible for this environmental problem. The diversion of water flow in the dry season and over out flow of water in rainy season by the Ganges river through the Farakka Barrage have affected agricultural and industrial production, disrupt domestic water supply, fishing and navigation, changed the hydraulic character of the river and ecology of delta in the downstream area. These trans-boarder and human inflected environmental changes have resulted in the loss of the sources of living of large population of Bangladesh. These changes, according to Homer Dixion model, are the environmental security concern for any country and thus reasonably the most environmental security concern for Bangladesh. Though some Indo-Bangladesh water sharing treaties have been signed, all have gone in attaining any fruitful result. Lastly, the most expected water sharing treaty signed in 1996 seemed to have resolved the crisis and would carry a considerable resolution both for the countries. Thus in the research, attention has been directed towards locating the environmental security concern of Bangladesh due to the diversion of water by the Farakka Barrage. Lastly, some recommendations and actions have been put forward to implement so that environmental issue that is lifeblood of Bangladesh can be saved.

1.2 Aims and Objectives

Environmental concern is most important subject in the present day context. The Farakka Barrage constructed by India over the Ganges River is the important concern for Bangladesh. Because the diversion of water during dry season and over flow of eater during the rainy season acts as a devastating consequences for the environmental and natural security of Bangladesh. That is why this research work will be accomplished putting forward the following aims and objectives:

- ◆ Conceptual framework of environmental security;
- ◆ Framework of environmental security of Bangladesh;

- ◆ To focus on the relationship between the environmental factors and security concern;
- ◆ To focus on the history of constructing of Farakka Barrage;
- ◆ To focus on the effects of Farakka Barrage on environment and security concern of Bangladesh;
- ◆ To mention the basic principles of International River and environmental law and the legitimate rights of India to divert the water in dry season and inflect more water in rainy season;
- ◆ Policy recommendations to solve this problem.

1.3 Area of Study

Environment means total biosphere and environmental security is composed of three interrelated dimensions: supply induced scarcity; demand induced scarcity and structural induced scarcity. So, for our analysis, we must cover these three dimensions and the impact of Farakka Barrage over these three dimensions. From the positional point of view, this research will focus on the area of northwestern region of Bangladesh and the areas clearly affected directly and indirectly by the water diversion of Farakka Barrage.

1.4 Research Methodology

Nature of the study

The methodological approach to this research will be designed mainly as qualitative in nature, based on qualitative and quantitative data analysis.

Study Population, study sites

To achieve the purpose of the study, data will be collected mainly from the areas affected directly by the Farakka Barrage. The northwestern region will be focused mainly in this research. Experts in this field will be counted. Data and information related to this issue will be collected from different sources.

Data Collection Techniques

Data will be collected through primary and secondary sources. Content analysis, Case study, Observation and Interview techniques will be used as tools of primary data collection. Content of different books article, journals and daily newspaper will be scrutinized first. Observation will be held in actual situation of the affected and semi affected areas of Bangladesh. Semi-structured interview session will be set up with the people who were involved with the works of Farakka and related

environmental issues. It seems that the triangulation techniques will be applied in his study. Relevant documents, books, journals and worldwide website will be used as secondary sources for collecting data.

The research will be accomplished using the following methodologies:

- ❖ **Content Analysis-** analyzing the contents of different books, journals, daily news papers, periodicals and other documents relating to the issue
- ❖ **Interview-** By interviewing of different categories of people who are the contracting parties and specialists in this field as well.
- ❖ **Participant observation-** By observing directly the situations happening in this region

CHAPTER- TWO

CONCEPTUAL FRAMEWORK OF ENVIRONMENTAL SECURITY

2.1 Introduction

During the cold war, high politics dominated national security agendas. Issues of war and peace, nuclear deterrence and crisis management, summit diplomacy, arms control, and alliance politics preoccupied those people with professional or personal interest in world politics or military strategy. By contrast the low politics most specifically the environmental security was perceived as the source of trouble but not as a threat of national security. But in the recent time the term 'Environmental Security' as a concept has had enormous attentions of policy makers and researchers both in developed and underdeveloped countries.

Environmental security as a concept is not a new concept but is being used as a new concept in the security studies due to the changing scenario of the world system and emanating threats coming from the environmental perspective. Over the past decade considerable research has been conducted on the link between the environment and security and in an effort to redefine the concept of security. The dramatic changes in the environmental context have resulted in a source of insecurity. Hence, attention has been directed in many ways to redefine the security and environment. In such a situation in my research, I have tended, first, to represent a comprehensive definition of environmental security and its major areas to be connected with Bangladesh.

To define environmental security, at first, we need to define 'Environment' and 'Security'.

2.2 Environment

Environment emphasizes the connection to physical and biological system. At the broadest level, the environment can refer to anything in which something takes place or which affects what people do; in another words, almost anything at all. At a practical level, people use the term environment to refer to physical and biological systems, as distinguished from political, economic, and other social system. This is one kind of surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation. The complex set of physical, geographic, biological, social, cultural and political conditions that surround an individual or organism and that ultimately determines its form and nature of its survival.

2.3 Security

Security is one kind of perception because it refers security for whom and what context? Until recently, the term 'security' was discussed in International Relations as the protection of territorial sovereignty and the territorial integrity of a particular country. This concept of security has emerged largely in the context of the Cold War. At its most basic level, Western security studies have focused on military strategies for nuclear weapons and conventional arms as instruments to guarantee security with armed force. Military threats have been countered with military might. The modern definition of security is closely tied to a state's defense of sovereign interests by military means. At its most fundamental level, the term security has meant the effort to protect a population and territory against organized force while advancing state interests through competitive behavior. The state has been the prevailing entity for guaranteeing security, and state-centered theories have dominated discussions of international relations, especially since World War II. Realist theory in particular, outlined here in abbreviated terms, has enjoyed wide acceptance in making and explaining security decisions. The history of state behavior has in many ways been the story of steps to advance state security. Hans Morgenthau in his book 'Politics Among Nations' describes the security as 'direct opposition' or a 'pattern of competition' within a balance of power structure to keep power, increases power, or demonstrates power (status quo, imperialism, and prestige). As the dominant actor

in an anarchical international system, the monolithic state seeks power and identifies threats to its interests through rational decisions. Under the realist paradigm, non-state actors are significant only as much as they affect the actions of states. International organizations are considered merely additional tools for states to procure and to exert power (Morgenthau, 1985: 562).

2.4 Challenges to the tradition security theory

Within this state-centered analysis, threats typically have been perceived as military challenges and have traditionally been countered with armed force. This narrow focus on military threats and responses, or 'high politics' has meant that other factors such as international economic transactions and the environment, or 'low politics' have been considered secondary issues for the security of states. During the Cold War, the assumptions of realist theory dominated the security field that narrowly focused on the East-West confrontation. Security concerns in all states were filtered through the context of the bipolar division of power. But the changing nature of international politics during the period produced some new crisis and challenges, which consequently criticized the traditional concept of security and lead the thinkers to think to redefine the security.

The oil crisis of the 1970s was most important event that dramatically illustrated the relevance of economic and resource scarcity issues for the security of states. In response to the oil crises and a larger context of interdependence, theories of Neo-liberalism brought together the elements of power and interdependence to better explain the changing nature of relations among states (Keohane and Nye, 1977). While recognizing more influential roles for non-state actors in the international system, the reactive theories of Neo-realism continued to view international politics as the struggle for power within the anarchical structure of the international system (Waltz, 1979). These theoretical tenets of neo-realism gained particular attention with the 1979 Soviet invasion of Afghanistan and the stoking of the Cold War that followed the election of Ronald Reagan. Another more recent economic dynamic challenges traditional conceptions of security. Without the unifying threat of the Soviet Union, Western powers have focused more on trade and economic competitiveness. This North-North competition has taken on a security dimension and is viewed by some to be the battlefield of the 21st century (Sandholtz *et al.*,

1992). During the same period and continuing to the present day, a number of influential international reports and conferences have highlighted global environmental threats. Coupled with numerous environmental catastrophes and discoveries, these reports have helped to create a heightened 'ecological awareness' (Brown, 1989: 521). It is in this context that environmental issues have confronted the dominance of neo-realist theory in security studies. A number of scholars have recently asserted that large-scale human-induced environmental pressures may seriously affect national and international security. Unfortunately, the environment-security theme encompasses an almost unmanageable array of sub-issues, especially if we define 'security' broadly to include human physical, social, and economic well-being (Homer Dixon, 1994: 76). The concept of environmental security presents the results of efforts to bring environmental concerns to the high table of priority issues where security has traditionally had a seat.

2.5 Environmental challenges and a quest for a redefinition of security

The preoccupation with a military conception of security has not been without costs. The narrow military conception of security has largely excluded consideration of potential non-military threats and non-military means of providing security. Economic and ecological developments in an increasingly interdependent world present potential threats for actors at all levels of analysis. The causes, effects and solutions of these economic and environmental challenges ignore national boundaries and raise many questions about the assumptions of realist theory and the associated statist definitions of security.

The notion of environmental security, conceived in a multitude of ways, represents an alternative paradigm for ordering and addressing threats in an increasingly interdependent and environmentally-degraded, post-Cold War world. As a major component of this literature, we begin by tracing the progression of academic debate concerning the links between environmental stress and violent conflict. These efforts comprise an intersecting subset of the environmental security debates. The environment as a cause of conflict literature considers whether environmental stress is a cause of violent conflict between but especially within states. Efforts employing quasi-experimental models and single-case causal analysis have sought to isolate environmental stress as a cause of acute conflict (Homer-Dixon, 1994: 75-111).

Thomas Homer Dixon and his colleagues at the University of Toronto and by the International Peace Research Institute, Oslo (PRIO) to demonstrate a link between resource scarcity and the out break of war or other forms of violence. In response to these academic and policy attempts to link environmental degradation and conflict, other observers have argued that environmental conflict is characterized by antecedent and intervening social and political conflict variables. Attempts to isolate environmental causes of conflict, therefore, can be misleading in conceptualizing the complex causal relationships behind conflict (Lipschutz and Holdren, 1991). Critics also cite a lack of examples for environmental causes of interstate conflict in particular (Deudney, 1992). In part building on findings of the conflict debates, some authors have recognized environmental concerns within both competitive and cooperative frameworks and have made the case for adding the environment to military and economic dimensions of security as a third pillar (Ullman, 1983; Buzan, 1991; Romm, 1993). A body of literature considers environmental security as an alternative paradigm for ordering and addressing threats in an interdependent world. Some conceptions redefine security beyond militaristic conceptions to reflect greater consideration of environmental and economic factors in notions of security. From this perspective, interdependent and transnational problems require cooperative models of behavior rather than conflictual methods to advance security in what should be regarded as a collective-sum game (Mathews, 1989; Thomas, 1992; Myers, 1993).

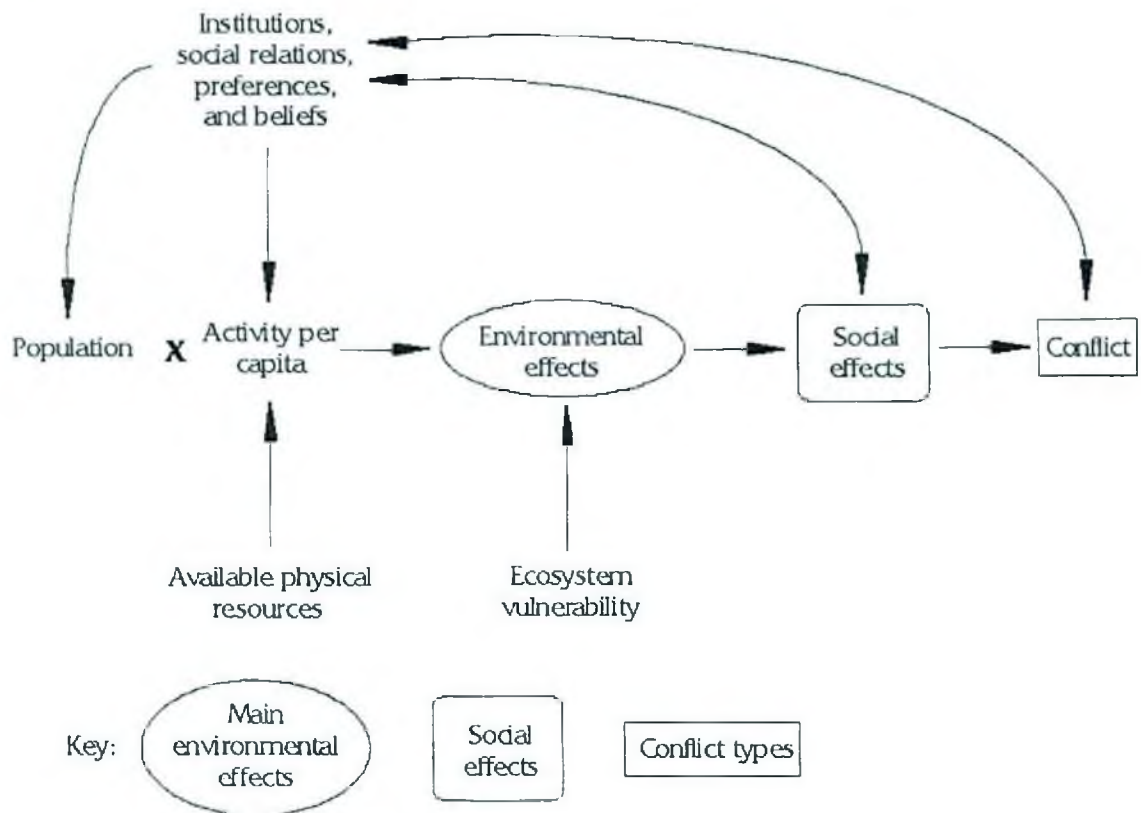
What ever the discontent and disagreement regarding the view of environmental security have this term has strong significance to bring it into light. Because environment is not merely an environment rather it is related to the economy, social and economic activities of a country. Homer Dixon has rightly explained about the emergence of environmental security. He states that a range of atmospheric, terrestrial, and aquatic environmental pressures will in time probably produce, either singly or in combination, four main, causally interrelated social effects: reduced agricultural production, economic decline, population displacement, and disruption of regular and legitimized social relations. These social effects, in turn, may cause several specific types of acute conflict, including scarcity disputes between countries, clashes between ethnic groups, and civil strife and insurgency, each with potentially serious repercussions for the security interests of the developed world (Dixon, 1991: 76-116).

2.6 Environmental stress as a cause of conflict

Much of the discussion surrounding environmental security has included attempts to establish or deny the causal links between environmental change and conflict. Various authors have asserted linkage through case study examination while often making the argument for putting environmental change at the high table of international politics. At the forefront of this effort, Thomas Homer-Dixon and his colleagues (1991; 1993; 1994) have attempted to identify links between environmental scarcity and acute conflict without formulating a precise definition of environmental security. His multi-year project focused on extensive, single case studies in developing countries suspected to be the most likely to exhibit environmental conflict. At the beginning of the project, Homer-Dixon (1991) postulated an initial conception of the links between environmental degradation and conflict as environmental change precipitating social change. This social change would then figure prominently as a cause of international conflict. Environmental change presented a possible but not necessary antecedent for acute conflict. Homer-Dixon extended his theory by specifically relating individual types of environmental change to different types of conflict. However, the link between environmental change and conflict was not considered to the exclusion of intervening variables that mediated outcomes. Homer-Dixon (1991) cited ethnicity, class, religious structures, and regime legitimacy as factors that could affect this causal relationship. Among the results of his investigations, Homer-Dixon (1993; 1994) found evidence of environmental scarcity serving as an underlying yet strong cause of intrastate conflict. This 'sub-national', 'diffuse' and 'persistent' conflict took the form of ethnic clashes due to environmentally induced population movements, and civil strife stemming from environmental scarcity that affected economic productivity and therefore livelihoods, elite interests, and state capacity to confront these challenges (Homer-Dixon, 1994: 39). These internal conflicts could lead to a fragmentation of the state or conversely, to a more authoritarian "hardening" of the state (Homer-Dixon, 1994: 36). Few cases, however, supported the interstate conflict hypothesis in terms of renewable resources as the source of conflict. Homer-Dixon also downplayed the possibility that global issues such climate change and ozone depletion will make significant contributions to conflict in coming decades. The model given by Homer Dixon can be represented by the following figure:

Figure -1: Environmental change and armed conflict

Figure 1: Environmental Change and Acute Conflict



Source: Homer Dixon, *On The Threshold: Environmental Changes as Causes of Acute Conflict*, Trudeau Centre for Peace and Conflict Studies, University of Toronto, *International Security*, Vol. 16, No. 2 (Fall 1991), pp. 76-116

From the above figure we can see that the total effect of human activity on the environment in a particular ecological region is mainly a function of two variables: first, the product of total population in the region and physical activity per capita, and second, the vulnerability of the ecosystem in that region to those particular activities. Activity per capita, in turn, is a function of available physical resources (which include nonrenewable resources such as minerals, and renewable resources such as water, forests, and agricultural land) and ideational factors, including institutions, social relations, preferences, and beliefs. The figure also shows that environmental effects may cause social effects that in turn could lead to conflict. For example, the degradation of agricultural land might produce large-scale migration, which could create ethnic conflicts as migratory groups clash with indigenous

populations. There are important feedback loops from social effects and conflict to the ideational factors and thence back to activity per capita and population. Thus, ethnic clashes arising from migration could alter the operation of a society's markets and thereby its economic activity.

2.7 Redefining security

Here attention will be directed towards redefining the security for establishing the concept of environmental security. The urgency for including environmental concerns within definitions of security has an extended history. This dialogue has become intense with the end of the cold War and the resulting search for an orienting security paradigm (Brown, 1977; Ullman, 1983; Mathews, 1989; Buzan, 1991; Pirages, 1991; Myers, 1993). The proposed conceptions of security range from viewing environmental stress as an additional threat within the conflictual statist framework to placing environmental change at the center of cooperative models of global security. The environmental stress and violent conflict debates discussed earlier do factor into many of these conceptions. Yet it is important to note that the conflict debates remain an intersecting subset, not the total universe, of the larger environmental security debates. The literature on environmental change and redefining security has become so extensive that only selected contributions can be highlighted in the review of this debate.

Richard Ullman (1983) argued for redefining security to include threats other than immediate military ones. He focuses exclusively on military threats carries the high opportunity costs of neglecting potentially more menacing dangers. Ullman acknowledged that it is intellectually challenging to incorporate non-military threats into the concept of national security. But he contended that such issues as population growth in developing nations and the accompanying competition for control of resources and transboundary migration could result in severe conflict. Ullman postulated that diminishing resources, especially fossil fuels, would be a likely source of future conflict. He redefined a threat to national security as an action or sequence of events that

- ◆ Threatens drastically and over a relatively brief span of time to degrade the quality of life for the inhabitants of a state, or

- ◆ Threatens significantly to narrow the range of policy choices available to the government of a state or to private, nongovernmental entities (persons, groups, corporations) within the state (Ulman, 1983: 133).

The addition of non-military threats to the definition of national security has roots in the economic oil crises and limits to growth arguments of the early 1970s (Meadows *et al.*, 1972). Both internal instability and international conflict were the possible results of anticipated resource scarcities. A number of studies form the basis for efforts to formulate a theory of conflict based on resource scarcity (Gurr, 1985; 51-75). Food, water and oil issues present examples of scarcity playing an important precipitating role in conflict. Traditional mechanisms of the market have proven inadequate for effectively alleviating stresses caused by such shortages. This resource scarcity literature does not necessarily employ the term environmental security, but it does provide evidence for introducing the element of non-military threats into the modern conception of security.

2.8 Environmental Security

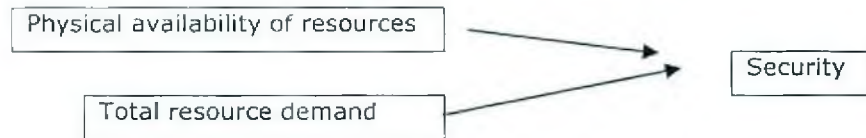
Recently Peace and Conflict Research Programs have begun to redefine the whole gamut of security concern from a multi-dimensional, multilevel perspective (Dunn, 1991: 56-72). This direction toward to redefine security has been initiated aiming at elimination of all types of violence indirect or direct. Environmental degradation and resource scarcity are the major ingredients to create both the direct and indirect violence in the society. Thus Peace and Conflict Research Program has undertaken environmental security issues very vehemently. Environmental Security according to the views of Peace and Conflict Research is used in non-military direction, which is mainly linked with the non-military threat like environment. This concept represents a demilitarization of security thinking. The concept of environmental security acknowledges the need for a political leadership to ensure the security of its citizens above and beyond their military security. A wider concept of security may also increase the range of legitimate policy choices available (Ullman, 1983:133). Environmental security means the securitizing the environmental issue and making them part of high politics. Securitization of the environmental issues describes a way of handling environmental issues where threats to the environment are seen as urgent and immediate, requiring a quick response at top political level (Buzan, 1995). Actually, it is more or less difficult to define the environmental security

because there is a propensity to include every aspect of security in to the environmental security concept. But environmental security is the freedom from social instability due to environmental degradation. It is the term to make a linkage between the environmental conditions and security interest. It is the proactive minimization of anthropogenic threats to the functional integrity of the biosphere and thus to its interdependent human component. It is defined as the state of human environment dynamism that includes restoration of the environmental degradation, and biological threats that could lead to social disorder and conflict. The American Council for the UN University has undertaken an environmental security study under its millennium project, which attempted to link environmental and security. According to this study (ACUNU, 2003) the followings are the prioritized areas of environmental security concern.

- ❖ Environmental security is the relative safety from environmental damages caused by natural or human processes due to ignorance, accident, mismanagement, or design and originating within or across national borders, and
- ❖ Environmental security is the state of human-environmental dynamics that includes restoration of resource scarcities, environmental degradation, and biological threats that could lead to social disorder and conflict.

Environmental security encompasses an all most unmanageable array of sub-issues, especially if we define security broadly to include general physical, social, and economic well being. Actually environmental threat is an action or sequences of events that threatens drastically and over a relatively brief span of time to degrade the quality of life for the inhabitants of a state. Environmental scarcities have a complex causes. The depletion and degradation of resources are function of the physical vulnerability of the resources, the size of the resource-consuming population and the technologies and practices this population uses in its consumption behavior. This can be illustrated through the following figure:

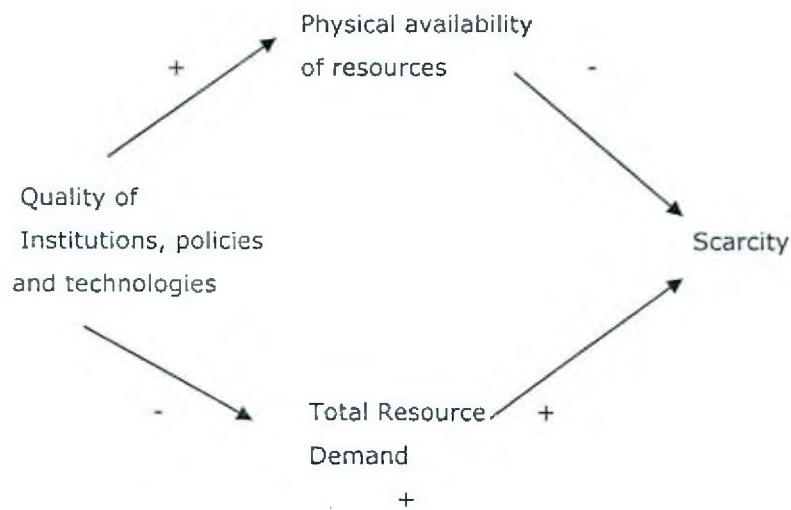
(Figure -2: Resource scarcity model)



Source: Thomas F. Homer Dixon, *Environment, Scarcity, and Violence*, Princeton University Press, 1999, p-30

According to the figure mentioned above the physical availability of the resources of a particular country is very important factor to fulfill the demand of the population. When the simple physical availability of the resources of a particular country becomes less and less, scarcity grows more and more. This complex situation creates environmental insecurity. But it is mentioned here that the physical unavailability of the resources is not major factor of creating environmental scarcity. Other factors like the policy of the government, outside factors, institutions and its quality and the technologies used by the people plays a pivotal role in creating environmental insecurity. These complex factors can be illustrated through the following figure:

(Figure-3: Matrix of scarcity)



(Source: Noratham Gunn: 2000)

Environmental change or degradation does not simply mean the interaction between human beings and their environment. It implies a destabilizing interference in the

ecosystem's equilibrium, which has negatively affected human society, expresses what is meant by environmental causes of conflict.

Environmental security is a term used by scholars and practitioners to posit linkages between environmental conditions and security interests. Although competing notions of environmental security abound, they generally fall into three sets of claims:

- ❖ States and non-state actors should guard against environmental degradation for the same reason they guard against organized violence; both kinds of threats can harm human, material, and natural resources on a large and disruptive scale.
- ❖ Local and regional environmental degradation and/or resource scarcities (exacerbated by population growth, inequitable wealth distribution, and global environmental changes) are an important contributing factor to sub-national political instability and violent conflict.
- ❖ Military and security institutions (including intelligence agencies) can and should play a greater role in environmental protection. The rise in popularity of environmental security slogans has accompanied the increasingly prominent calls for new definitions of security to replace Cold War concepts predominantly rooted in Realism.

The term environmental security refers to a range of concerns that can be organized into three general categories:

- Concerns about the adverse impact of human activities on the environment - the emphasis here is on the security of the environment as a good in itself, for the sake of future generations, as the context for human life.
- Concerns about the direct and indirect effects of various forms of environmental change (especially scarcity and degradation) which may be natural or human-generated on national and regional security. Here the focus is on environmental change triggering, intensifying or generating the forms of conflict and instability relevant to conventional security thinking. Research suggests that interstate war is less likely than diffuse civil violence. A subsidiary question is: what can conventional security resources do to address these threats? Suggestions include: using intelligence data gathering

and analysis assets, promoting technology transfer and dialogue through military to military contact programs, using the army corps of engineers to help tackle specific environmental problems, etc. A related question is, can military training, testing and war fighting activities be made less harmful to the environment.

- Concerns about the insecurity individuals and groups (from small communities to humankind) experience due to environmental change such as water scarcity, air pollution, global warming, and so on. Here the focus is on the material well being of individuals and there is no presumption that this is a traditional security issue or that traditional security assets will be useful.

Combining these we might conclude that the condition of environmental security is one in which social systems interact with ecological systems in sustainable ways, all individuals have fair and reasonable access to environmental goods, and mechanisms exist to address environmental crisis and conflicts. Environmental security addresses the consequences of environmental degradation, broadly defined to include depletion or degradation of natural resources such as air, water, land, unwise development or land use practices that may contribute to societal, political and economic factors. Environmental degradation has been perceived as an equal if not greater threat to humanity than a military threat. But security is a very debating term and expanding day by day due to the changing nature of international political, economic and social system. From the beginning of human civilization and still today the human being is searching a formidable and consistent security outlook so that people can live in a satisfactory position. The conventional security system, which had been originated in the very beginning of originating nation state, is no longer found to be a politically, economically and socially relevant setting. Because the traditional security system based upon state-centric view stressed that there is a threat to existing order arising from the external sources in the form of aggression or war. That is why, the search for emphasizing on the protection of sovereignty and building up the arm- based security outlook has been more or less irrelevant. The realist approach of security was based on the terms of power, which was closely tied with the enhancing military capability of a state making it impregnable against external threats coming from similar other states. But this shape has been replaced by a complex comprehensive security concept, which includes environmental issues. Current Norwegian documents bear witness to this profound change in the security thinking. The parliamentary Report *Main Guidelines for the Activities and*

Development of Norway's defense for the period 1994-1998 (Ministry of Defense, 1993) noted that new global factors- such as energy raw materials, environmental issues, population growth, and ethnic, religious and cultural differences- have emerged as more important potential sources of conflict, and specifically that environmental problems and lack of ecological equilibrium can contribute to insecurity and conflict (Nil Peter, 2000:474).

That is why, now, security is being defined as the security of individuals as human beings as such, and not only as citizen of a particular state. During this stage the security concern stressed on the need to pay attention to non-military threats to the life and well being of people. The challenges like global warming, acid rain, sea level rise, green house effect, diminishing capacity of the agricultural system, depletion of earth's finite resources and punching holes in the ozone layer drew the attention of states man, policy makers, and million and million of people in the world. Because the realist concept of security focused on states as unit of analysis and it never take into account the environmental issues and downplays the internal factors and the indirect transboundary effects of environmental degradation. This has led Homer Dixon to state that realism induces scholars to squeeze environmental issues into a structure of concepts including state, sovereignty, territory, national interest and balance of power. Thus in his opinion may lead theorists to ignore, distort, and misunderstand important aspects of global environmental problems (Dixon, 1991: 85). Besides the security concept of North and South is not same and never deals with the same issues of security threats. The drastic changes that have taken place in the world in terms of environmental degradation affecting human living and sustenance questions are affecting more the countries of South than the North. And so many writers like Edward Azar, Chung-in- Moon, Carolin Thomas, Ullman and many others came with their new ides of security, which are more related with the security of South. Edward Azar and Chung in Moon define security in terms of threat to established values and identities. Caroline Thomas added economic dimensions to security when she defines it not only in terms of internal security but also in terms of secure system of food, health, and trade (Gaan, 2000: 4). Thus it is obvious that the security concept formulated for the South goes beyond the state centric military dimensions of security, typical of cold war and super power logic. The miniaturization/ militarization of South by the North as a measure to protect internal security has turned out ironically to be the threat to its own system. And this

controversial formulation of security concept, thus, changed and many security concepts emerged especially during and after the 1990s. These are:

- # Common security in Palme Commission Report "Independent Commission on Disarmament and Security Issues"- This commission focused on the mutual vulnerabilities of contemporary societies in the face of extended technological warfare including nuclear, the concept of common security challenged the states to abandon their unitary military measures. Elements of comprehensive or common security found edging into policy-making bodies in the North in the 1980s. A 1980 Report on Comprehensive National Security to Prime Minister of Japan reformulated security to encompass economic vulnerabilities, natural disasters and ecological imbalances (Barnett, 1986). In the mid 1980s Mikhail Gorbachev's proposal for a comprehensive system of international security, which included disarmament, as well as economic and ecological security also, was in line with this.
- # Non- provocative Defense or Non-offensive Defence (NOD)- In search for alternatives to military confrontations in Europe some European politically active intellectuals and thinkers developed ideas of non-offensive defense in the 1980s, arguing for dismantling of ideological and military logic of blocks. Out of this movement grew the political program of de-alignment (Kaldor and Falk, 1987).
- # Feminists are of the view that contemporary discourses on security have removed women out of the political script making them insecure. Military and national security functions of the state have always been considered masculine. Feminist movements have favored defining security in multi-dimensional term (Gaan, 2000:5).
- # Barry Buzan an Asian security analyst is of the view that security should be discussed in terms of military and ecological perspective. In the similar vein, Jessica Mathew's claims that the definition of security should be expanded to encompass environmental resource and demographic issues (Jessica, 2001).

All these arguments and debates signify the truth that the state centric security and its military apparatus can no longer guarantee anyone's security. Besides the indirect political threat from environmental degradation involving environmental refugees, resource wars and so on are the substantive threat to the national security of every country and also the most important intellectual challenges to the field of security

studies. And, thus, the term 'Environmental Security' has been vehemently confronted to people all over the world as people depend on mostly the environment and environmental resources to sustain and lead their life. Thus environmental security means the security of the people and the ecology.

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CHAPTER-THREE

ENVIRONMENTAL SECURITY CONCERN OF BANLADESH

3.1 Introduction

Bangladesh, the largest deltaic region of the world, is a small state overarched by the geographical presence of India. Its idea of security is in tune with Barry Buzan's idea that domestic threats to a weak state can almost never be isolated from the influence of outside powers, thus entangling domestic security problems with its external relations. Buzan states that the tyranny of geography is the most important factor in the defense-vulnerability of the small states (Sobhan, 1990). Bangladesh possesses a host of security problems, which are no longer of conventional nature but have non-conventional nature i.e. non-traditional security issues which are in the state of constant evolution. For the sake of brevity I have decided to follow the Greg Mills model of Non-Traditional Security (NTS) wherein he lays down four elements of NTS; economic, environmental, political and territorial threats (Saniruddin Khan, 1990). Broadly speaking, on the economic front Bangladesh has to reduce the vicious circle of foreign aid dependence and debt servicing, further on it needs to exploit and explore to the fullest its oil, gas and sea resources. The People's Republic of Bangladesh is a new nation state in the northeastern part of South Asia. The great Himalayas stand as the northern ramparts, while the southern frontier is guarded by the Bay of Bengal. On the west lies the gangetic plains of India (West Bengal) and on the eastern frontier lay the almost impassable forest of Myanmar (Arakan Province) and India (Tripura and Assam hills). These picturesque geographical boundaries delineate a low-lying plain of about 1, 47,570 sq is crises-crossed by innumerable brooks, rivers, rivulets and streams. Bangladesh is a deltaic plain of three mighty rivers-the Padma (Ganges), Brahamaputra (Jamuna) and the Meghna. Much of the country's land area has been built up from alluvial deposits brought down by the major rivers. The country is mostly flat except the hilly southeastern part. Wooded marshlands and jungles mainly characterize it with forest regions in Sylhet, Rangamati, Khagrachari, Banderban, Sunderbans, Mymensingh and Tangail. Bangladesh is one of the most densely populated countries in the world. Its population exceeds 134 million with an average of more than 850 people per sq. km. About 22 million households of the country live in rural Bangladesh. The rural population is comprised of 22 percent landless, 34 percent with homesteads only,

and 12 percent marginal farmers having 0.2 to 0.4 hector of land, and 14 percent are small farmers having 0.4 to 0.8 ha of cultivated land (Banglapadeia, 2002). Bangladesh is one of the few countries that face extreme hazards due to environmental degradation and resource depletion. The degradation of the environment has been highlighted in various forms because of its universal potential for chaos and disorder. Bangladesh is faced by different types of environmental problems. These include, deforestation of the Himalayas, rise in the sea level due to global warming, sharing river waters with India (54 rivers are shared between the two neighbors) floods, tornadoes, droughts, water and soil quality and waste dumping (Courier, Dhaka, September 23, 1989). All these act as ecological threat to the environment in Bangladesh.

Before defining of environmental security of Bangladesh (ESB) we need to mention the geographical position, resources, and other issues related to the environment of Bangladesh.

3.2 Overview of the Ganges River Basin

The Ganges River Basin is the most populous river basin in the world. Within its 750,000 square kilometers (km²) 400 million people live. The Ganges River (known as the Ganges-Padma River in Bangladesh) begins in the central Himalayas and flows 2,500 kilometers to the Bay of Bengal. Over the course of millennia, this Grand River and its tributaries have formed one of the largest flood plains in the world with the sediments from the erosion of mountainous areas. The Ganges Basin is formed by a 200 to 300 kilometer-wide plain, bordered by the mountains and highlands on three sides. The Ganges River and its tributaries and distributaries flow through three countries: India, Nepal, and Bangladesh. The Ganges Basin River system remains the main source of freshwater for half the population of India and Bangladesh and nearly the entire population of Nepal. The importance of the Ganges can hardly be exaggerated, particularly in its lower stretch, where it is the only river from which freshwater supplies are obtained for the distributaries (small rivers that distribute waters through a flood plain during peak flows). Freshwater is now a highly prized commodity. As the development of South Asia picks up momentum and populations increase, the Ganges River system rapidly appreciates in importance. The Lower Ganges Basin contains both an active delta and a moribund delta, both of which are

affected by enormous flood flows in the Ganges, relentless tidal pressures from the sea, and occasional severe cyclonic storms capable of disrupting environmental systems. The balance of environmental factors is extremely delicate and complicated, so small changes in one factor affect all the others. The major environmental issues, which are associated with population factors, include:

- Increasing demands on natural resources from development activities;
- The inward penetration of higher salinity levels;
- The spread of waterborne diseases due to the extensive embankment of former bodies of water;
- Water and soil pollution;
- Decline in fisheries due to human interventions; and
- The excessive felling of the Sunderbans forest.

Bangladesh, being the downstream and deltaic portion of a huge watershed, is naturally vulnerable to the water quality and quantity that flows into it from upstream. All major rivers flowing through Bangladesh have their origins outside its borders, and, therefore, any interventions in the upper riparian regions have a significant impact on Bangladesh. Through its complex network of river systems, Bangladesh drains roughly 1.76 million km² of catchment areas of the Ganges, Brahmaputra, and Meghna rivers, of which only 7 percent lies in Bangladesh (Crow and others, 1997). This physical characteristic severely limits the degree of control and management of the inflow water in the monsoon and dry season. The extreme variation of the temporal and spatial occurrence of rainfall is a major constraint to the development of agriculture, which dominates the economy.

3.3 Country and Study Site Profile

The Lower Ganges Basin comes under the jurisdiction of the greater districts of Kushtia, Jessore, Faridpur, Khulna, Barisal, and Patuakhali. It comprises an area of approximately 40,450 km², or 27 percent of Bangladesh's total area. It is bordered by India to the west, by the Ganges (Padma) and Lower Meghna rivers to the north and east, and by the Bay of Bengal to the south. Sixty-two percent of the region is cultivated. Roughly 10 percent, or 4,000 km², is covered with a coastal mangrove forest known as the Sunderbans. Surface water areas, including rivers and natural land depressions known as beels, cover approximately 13 percent. The northern part

of the area is comparatively high to medium-high land with a rolling topography. Farther south, the topography starts off as gently sloping but soon becomes very flat. This southern part has a large number of beels and low-lying areas. In addition, the coastal areas, which include the Sunderbans, are criss-crossed by a number of tidal rivers and creeks. The area has a typical monsoon climate with a warm and dry season from March to May. A rainy season from June to October follows as does a cool period from November to February. The mean annual rainfall is 2,000 millimeters (mm), of which approximately 70 percent occurs during the monsoon season. Rainfall generally varies in a northwest to southeasterly direction, increasing from a mean annual rainfall of 1,500 mm in the northeast to 2,900 mm in the southeastern corner. Potential evaporation rates are of the order of 1,500 mm and exceed the rainfall rates from November to May. The relative humidity is high, varying from 70 percent in March to 89 percent in July. The area experiences moderate to high duration of sunshine hours, and durations in excess of 8.5 hours outside the monsoon season are not uncommon. The mean annual temperature is 26o Celsius (C) with peaks of over 30o C in May. Winter temperatures can fall to 10o C in January. The southern region of the area and in particular the southeastern coastline is vulnerable to cyclones during the monsoon season. Storm surges can cause dramatic increases in the water level of up to 4 meters above tide and seasonal levels. The southwest coastline is protected to some extent by the dampening effects of the Sunderbans, although surges do progress up the major rivers. The coastal zone consists of the extensive flat, coastal and deltaic land of the Ganges Delta, which is crossed by large tidal rivers discharging into the Bay of Bengal. The Lower Ganges Basin coastal zone is in a state of transition. It is changing from an actively developing delta of the Ganges to a semi-moribund delta partially sustained by local rivers. The coastal area is subjected to coastal processes, which include tides causing periodic variations in water levels and currents, consequential saline intrusion, wave attack on the coastal fringe, surges and extreme wave attacks due to cyclones, and possible long-term sea-level rise due to global warming. As a consequence of the flat topography, coastal processes have a major impact on the freshwater resources of the area. Tidal propagation into the delta system carries saline water inland, which mixes with the fresh water to create different levels of salinity in the river system, depending on the upland freshwater discharges.

3.4 Sundarban and the ecology of Bangladesh

The western half of the Ganges delta contains the Sunderbans, which is the largest single block of natural mangrove forest in the world. It covers 5,892 km², and contains a continuing, dynamic, and changing mosaic of plant communities. The Sunderbans house many species of flora and fauna, and part of it is being considered as a World Heritage Site. At present, the Sunderbans is under considerable threat, which may be attributed to the reduction in the freshwater flushing action caused by upstream extraction at the Farakka Barrage, increasing shrimp cultivation, over-exploitation of wood resources, increased agriculture, and increased silt deposits. The Sunderbans reserve forests encompass 580,000 hectares of land, of which 410,000 hectares is mangrove forest and 170,000 hectares is open water areas in rivers, channels, and creeks. The Sunderbans comprises approximately 45 percent of the natural productive forest and provides livelihoods for at least 500,000 people, mainly wood cutters (Bawalies); fishermen; honey collectors (Mowalies); and Nypa-leaf collectors. Besides being a forest resource, the Sunderbans is extremely important for fish production and wildlife conservation. It also serves as a protective barrier against coastal erosion, cyclonic storms, and tidal surges. The mangrove forests and mud flats of the Sunderbans serve as a vital breeding and nursery ground for fauna, consisting of fishes, crustaceans, and mollusks. Based upon salinity and species composition, three ecological zones have been recognized within the Sunderbans. These are the Freshwater, Moderately Saltwater, and Saltwater Zones. The zonation of the Sunderbans is defined by the distribution of the three mangrove species, the Sundri, Gewa and Goran. The faunal ecology of the Sunderbans mangrove habitat is an extremely complex subject of study. The complexity is due to assemblages of several species of macro-fauna and countless species of micro-fauna and their action and interactions with other biota in a complex and dynamic environment. Being a very specialized environment, the Sunderbans supports a wide assemblage of animal communities. For some species it is permanent habitat, for others it is a temporary place to feed or breed. This unique habitat depends to a great extent on freshwater flows from upstream to maintain its present character.

3.5 Lower Basin and the water condition

Bangladesh is a fertile deltaic region criss-crossed by numerous rivers and subject to periodic and occasionally catastrophic flooding. The hydrology of Bangladesh is characterized by three major international rivers: the Brahmaputra, the Ganges, and the tributaries forming the Meghna. Surface water availability varies by region according to rainfall and storage capacity in streams, ponds, and lakes. About 37 percent of the country is permanently or intermittently inundated during the monsoon season, up to a depth of 30 centimeters or more. Rainfall is abundant but seasonal. About two thirds of the annual rainfall evaporates and 15 percent percolates into the ground, raising the water table close to ground level. In the dry season, flood water recedes, and ponds and water tables fall. The general availability of water, however, remains high in most of the country. Despite this fact, irrigated agriculture during the dry season draws heavily on groundwater resources. Every year new areas are added to those affected by low water tables, which render shallow wells dry. Water is used for a variety of purposes within the Lower Ganges Basin, including irrigation, potable and industrial water supply, navigation, and agriculture. The quality of surface water outside the areas of saline intrusion is generally good, with no significant limitation upon use for irrigation. The critical issue is the extent of saline intrusion. In some instances and mainly in the irrigation and water supply sectors, water is consumed. In other sectors, such as navigation, water is not consumed but its presence is required. For aquaculture and forestry, notably within the Sunderbans, the quality of the water rather than quantity is the key issue. The ability of the rivers to transport sediment in a favorable manner is also a vital issue that has impact upon the overall allocation of water.

After assessing the environmental situation in this area, a major study concludes that the "repercussions of reduced water levels in the Ganges river, and its principal distributaries such as the Gorai, Arial Khan, etc., has disrupted fishing and navigation, brought unwanted salt deposits into rich farming soil, allowed greater saline intrusion northwards, affected agricultural and industrial productions, changed the hydraulic characteristics of the river, and caused changes in the ecology of the delta" (FPCO, 1993). The Lower Ganges Basin is experiencing an increase in human-induced interventions. This is due to the decrease of dry season flows in the Ganges, which in turn has allowed salinity levels to increase inland. The combined effect of these factors could be the following:

- The deterioration of distributary rivers from the Ganges;
- The northward movement of the saline front in the dry season as tidal movements meet lesser resistance from freshwater flows;
- The increased sedimentation of wetlands; and
- The increased monsoon flooding from inundation and poor drainage in sedimented channels.

3.6 Fish and other small animals

The availability of water of this area support multitudes of species of plants, fish, prawn and other types of organisms. Of all these living organisms, fish are the most important element in the freshwater ecosystem. They are major source of employment for the poor and the main dietary source of protein for the rural population. The relatively high level of fish production is attributed to the nutrient rich delta of the three-river system. An estimated 260 species of freshwater fish can be found in Bangladesh. However, only three species provide the major catches from the open freshwater and estuarine ecosystems: the hilsa, rohu, and catla (DANIDA, 1989). The reduced flow of river water has reduced the major carp habitats in the Ganges River Basin in Bangladesh (Ali, 1991). Most particularly fish of natural water has been reduced significantly due to the reduction of water flow in rivers and other water reservoirs. In Bangladesh the reproduction, breeding, and multiplication of open inland water fish and prawn species are very finely tuned and adjusted to the rhythm and amplitude of monsoon flooding. At this time, rivers, estuaries, beels, haors, and flood plains become inter-connected and integrated into a single biological production system. This cycle enables brood stocks and newborn young fish and prawn species to undertake upstream and downstream migrations in the rivers and laterally into and out of the flood plains. The flood plains provide landing and feeding habitats for many species. Fries of river-breeding fishes and also of estuarine or saltwater breeding prawn thrive in the flood plain (Ali, 1991).

The natural environmental concerns and its changing nature have added with some other environmental problems which have already happened and still happening in Bangladesh. The major problems are:

3.7 Global Warming and Floods:

Bangladesh is like any South Asian country cursed with monsoon floods and tornadoes. Bangladesh being close to the sea bears the brunt directly. Incalculable damage is done to agriculture caused by annual recurrence of floods. In 1988 Monsoon floods in Bangladesh killed several thousand people, leveled 2 million homes, and devastated 4 million acres of cropland and cost the impoverished nation US \$ 1.5 billion. The world's attention was drawn towards Bangladesh after these devastating floods. Floods affect 18% of the total land area. There have been at least 14 devastating floods in the last 40 years. Droughts too have taken their toll. The longest was in 1989, which caused a reported loss of 2.5 million people in terms of loss of lives and spiraling prices. The following figure will represent the areas of Bangladesh affected by the severe floods of 1987 and 1988

(Figure-4: Scenario of Flood in 1988)



3.8 Depletion of resources and sharing of river waters

Sharing of river waters of the Ganges has always been a thorn in relations between India and Bangladesh since the beginning of the construction of the Farakka Barrage in 1951. Bangladesh felt that India was willfully diverting waters, less river water availability means low fish catches for the Bangladeshis, in fact 70-80% of the protein intake of the people of Bangladesh comes from fish, and fish catches are responsible for at least 9% of the GDP. The financial losses were around half a billion dollars in agriculture, fisheries, navigation and industries. After the operation of Farakka Barrage the quality and quantity of water in many rivers in Bangladesh is

being decreased remarkably. And the resources are very much depended on the availability of water. Water is considered as the life blood of living beings. The resources both renewable and non-renewable are under serious threat due to the diversion of water by the upstream country. Bangladesh is not getting proper share of upstream water flow for India's internal diversion.

3.9 Environmental Security of Bangladesh: An Analysis

These are the major environmental concern for Bangladesh. If we closely analyze the mentioned issues we find that environmental security issues are multidimensional. And it is connected with different sources and different ways. People and the internal dynamism of Bangladesh are mostly responsible for the environmental security concern. But the most important factor for this risk and security concern is the geographical location of Bangladesh and her relation with the neighboring countries in particular with India. Geographical dictates compel Bangladesh to be dependent on India for the flow of water for its 54 international rivers. The initial discord arose over determining the share of water flow of the Ganges River. India constructed Farakka Barrage and feeder canal on the river Ganges to divert the water flow in the Bhagirati-Hoogli River along with flushing out the silts of the Kolkata port. The barrage was made operational from 1975 after which India continued unilateral withdrawal of water from the Ganges for a long period. The environmental aspects are totally depended on the natural water flow comes from the out side of the boarder of Bangladesh. The phigiology, land, water, forest and other aspects of environment are now in under threat due to the lack of natural water flow of the rivers mainly the Ganges for the diversion of water by India. In the mean time India has taken a massive initiative to make sure the presence of water availability in all the area of India through the river linking project. The Indian Ministry of Water Resources later established the National Water Development Agency (NWDA) that undertook studies on the optimum utilization of peninsular and Himalayan rivers. The government, however, has provided several rationales in favor of carrying out the project. Important among these are the situation of drought in the southeast and southwest regions and floods in the east and northeast regions.

The above discussions do not provide the adequate figure of the environmental security of Bangladesh rather reflects the environmental concern that is fundamentally related to the water diversion of India through Farakka Barrage. But

the comprehensive model of environmental security will cover many things regarding the policies, options, activities and awareness building of the people. For our research purpose I will construct a model depending on the theories provided by many theorists, which will represent the environmental security concern of Bangladesh.

3.10 Theoretical model of environmental security of Bangladesh

Environmental security of Bangladesh as a slogan will cover not the traditional aspects of security but completely the non-military aspects of security concern. Because the non-military issues of security concern are causally related to the violence, conflict and war. This is not only related to the violence and different types of conflict rather these issues are connected with the human existence and human survival in this universe. World Commission on Environment and Development (Brundtland Report) entitles "Our Common Future" thus stressed the influence of environmental degradation on the relation between states. It attempted to establish the conflictual relationship between states as: environmental stress is both a cause and effect of political tension and military conflict. It states that nations have often fought to assert or resist control over raw materials, energy supplies, land, river basin, sea passages and other key environmental resources (Nil Peterson, 2001). Theoretically, the environmental security of Bangladesh will cover the protection and preservation of renewable and non-renewable resources of Bangladesh. The protection and preservation of renewable resources will encompass cropland, forests, river water, and fish stocks, air, atmosphere, climate, oceans and biodiversity. The environmental concern for the renewable resources comes forward due to different reasons such as depletion and degradation of the resource, from increased demand for it, and from unequal distribution of the resources. These are renewable resources because they are 'ecologically integrated in a feedback circle system which guarantees their replacement or preservation of their quality. On the other hand, minerals and fossil fuels are non-renewable resources as they are exhausted in nature and are not integrated in the ecosystem. But in this research work environmental security as a concept will cover the renewable resources. In this research the areas of environmental security concerns for Bangladesh will be:

Areas of security concern for Bangladesh:

- Human-induced climate change and ozone depletion to the neglect of severe terrestrial and aquatic environmental problems such as deforestation, soil degradation, and fisheries depletion.
- Available physical resources (which include nonrenewable resources such as minerals, and renewable resources such as water, forests, and agricultural land) and ideational factors, including institutions, social relations, preferences, and beliefs. For example, the degradation of agricultural land might produce large-scale migration, which could create ethnic conflicts as migratory groups clash with indigenous populations.
- Six types of environmental change were identified as plausible causes of violent inter group conflict:
 1. Greenhouse-induced climate change;
 2. Stratospheric ozone depletion;
 3. Degradation and loss of good agricultural land;
 4. Degradation and removal of forests;
 5. Depletion and pollution of fresh water supplies; and
 6. Depletion of fisheries (Homer Dixon, 1994: 5-40).

Analyzing the above discussion on the theoretical ideas of environmental security, we may conclude by referring environmental security as the protection and reservation of and the natural continuation of two groups of resources: non-renewable, like oil and iron ore, and renewable, like fresh water, forests, fertile soils, and the earth's ozone layer. The latter category includes renewable "goods" such as fisheries and timber, and renewable "services" such as regional hydrological cycles and a benign climate. The correlation with the environmental security issues and the water diversion through the Farakka Barrage is very much vivid and well circulated. The mentioned security concerns are available and are being increased rapidly by many factors but considerably by the water diversion by India through the Farakka Barrage. This research work will be directed towards finding the feasibility and validity of the correlation of environmental destruction and the water diversion from the Ganges through the construction of Farakka Barrage.

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CHAPTER-FOUR

CONSTRUCTION OF FARAKKA BARRAGE AND WATER DISPUTES BETWEEN INDIA AND BANGLADESH

4.1 Introduction

The construction of Farakka Barrage by India was the main clue of arising dispute between Bangladesh and India across the Ganges at a place about 17 Kilometers upstream from the western borders of Bangladesh. The Barrage was constructed with a view to diverting a certain portion of the Ganges dry season flow into India's Bhagirathi- Hooghly River to resuscitate the Calcutta port with silt-free water (Islam, 1987:3). It was the statement and vision of India to improve the navigability of the Bhagirathi- Hooghly river during the dry season so that the tortuous shipping channel from the port could be flow of water and ships could be flow of water and ships could be run without any shortage of natural water flow. It was only faulty construction because the ecological balance of both the Calcutta and Bangladesh has been seriously affected due to the uneven and unwise water diversion from the Ganges water but the environmental imbalance of Bangladesh is predominating.

4.2 Construction of Farakka Barrage

If we want to analysis the events of construction of Farakka barrage, we have to look back to the Pakistani regime. So, for the proper discussion, we can discuss it under the two sections:

First Section - Pakistani period when India took plane and project to construct the Farakka Barrage.

Second Section - Bangladesh Period when India finally constructed and operated the Farakka Barrage.

The barrage is 7229 feet long and was constructed at a cost of approximately 240 million US dollars. Another barrage with a cross regulated has been constructed across the Bhagirathi river at Jangipur above the outfall of the feeder canal of the Farakka Barrage to prevent the flood water over the Farakka Barrage flowing into Bhagirathi. A 42.5 kilometers long feeder canal has been built at Haldia and

Farakka takinf off water upstream of the Farakka barrage on the right bank and falling into the Bhagirathi downstream of the Jangipur barrage. The maximum capacity of the head regulator for the feeder cannel is 40,000 cusses per second. There are locks and lock channel at the tail end of the feeder cannel and at the Jangipur barrage to provide for navigation through the cannel and across the Jangipur barrage. By judicious operation of these components, it is possible to prolong the upland supplies of water into the Hooghly, thus, counteracting the deleterious effects of the tidal flow. The diverted water is drained into the Bay of Bengal (Khan, 1976: 11).

Figure-5: Farakka Barrage



Now we shall discuss the history of the construction of Farakka Barrage according to different phases.

4.2.1 Pakistani Period

The construction of Farakka Barrage dates back to 1951, when Bangladesh was known as West- Pakistan. After the independence in 1947 Indian newly appointed government concentrated their attention to attain self- sufficiency in agricultural sector. Due to the partion India had lost a sizable chunk of its most fertile irrigated

land in the Indus and Ganges River basins to the newly created state of Pakistan both in the Western and Eastern front of its boarder. Due to this immediate loose Jawaharlal Nehru government took a massive plan to increase the agricultural production for facing increasing food crisis. For the increase of agricultural production and self-sufficiency in Indian economy, India took the plane to construct the Farakka Barrage in the poorest region in the World. This was for resuscitating the Calcutta port because it is the life line not only some of the Indian states but also vital to the overseas trade of land lock Nepal and Bhutan. C. N. Vakil and G. R. Rao the Indian expert opinioned that the natural flow of water in the Calcutta port should be increased due to resuscitate of Calcutta port and natural navigation system. Taking this view, the Indian government proposed to construct 38 kilometers canal to 200 kilometers from the coast in order to supplement the waters of the Bhagirathi-Hooghly at the lower point that would make the current of water strong enough to flush off the silt and ensure Calcutta port. After being informed about the proposal from the Indian press reports, the government of Pakistan sent a note to India on 19 October 1951, pointing out that India should be consulted before any schemes likely to prejudice her vital interests be undertaken. To this India replied that the Barrage project was only at the stage of preliminary study and that Pakistan's apprehensions were therefore purely hypothetical (Kulz, 1969: 721). India did not pay hid the apprehension of Pakistan rather she was determined and carried on the project to implement at the same time. Pakistan finding no other alternative way suggested India to submit the matter to United Nation's advisory and technical service. But India was determined to achieve her national interest. However, India and Pakistan moved to hold the bilateral discussion between the think tank levels. Following this four general meeting between India and Pakistan had been held within the time June 1960 to January 1962. But the meeting ended without fruitful result. On the contrary, on 31 January 1961, the leader of the Indian experts' team informed his Pakistani counter part about the start of the construction work of the Farakka Barrage (Abbas, A. T., 1982). Pakistani government did nothing against the unilateral decision of India to construct the Farakka Barrage. However, Pakistan was confronted a frontal war with India in 1965 concerning Kashmir. This unwelcome decision and the war of 1965 made Pakistan unfriendly towards India. Indeed, these situations lead Pakistan to advance to raise the Farakka issue in the International arena. Pakistan, for the first time, brought up the issue in the International for Peace Conference held in Washington in which 92 countries participated (Bindra, 1982:

75). It was the view of the Pakistani government that the construction of the Farakka Barrage is the threat for the security of the Pakistan and it will greatly hampered the irrigation system of West Bengal and consequently will jeopardize the agriculture system - the only source of living of the agro-based West Bengal population. Pakistani foreign minister Sharifuddin Pirzada in the country's National Assembly put forwarded the following possible detrimental consequences of the barrage on East Pakistan:

- The project would reduce East Pakistan's supply of water and deprive it of its share of water and future development.
- The Ganga- Kobadaka scheme, which was intended to irrigate two million acres of land in Kushitia and khulna district of East- Pakistan and work on which had already reached an advanced stage, would be jeopardized.
- The moisture content of the soil immediately after the monsoon season, which was vital for maturing summer crops, would be reduced drastically due to lowering of the existing water level. This would cause deterioration of agricultural conditions.
- Navigation on the Ganga and its spill channels especially the Gouri Madhumati beach would be seriously affected.
- The barrage would be a serious flood hazard to East Pakistan. India would be obliged to pour into East- Pakistan the flood discharge of the Ganga (about 1000,000 cusecs), which used to spill in to the Bhagirathi- Hooghly from the Ganga during the flood months.
- India proposed to take silt free water to the Hoogly. This would mean that more silt would be discharged into East Pakistan, causing a rise in the riverbed and consequently an increase in the flood height. The existing flood problem would thus be increased.
- The reduction of water flow would seriously affect the coastal areas of Khulna and Barishal. In that way, the saline water limit would creep up further and affect agricultural and the quality of the water supply in urban and industrial towns such as Khulna (Pakistan National Assembly Debate, 1967).

These were the apprehensive factors put forwarded by the authority of Pakistan. In response to the criticism, the Indian Irrigation Minister made a statement in the parliament on 24 June 1967 in which he mentioned that the government of India had

no intention of giving up the project or modifying it in any way in response to Pakistan's objection (Kulz, 1969: 724). India was adamant to construct the barrage to fulfill their objectives. In spite of some bilateral talks between the countries held with no positive result. On the other hand, India was of opinion that Pakistan dragged its heels in the negotiation in order to create misgiving between India and East Pakistan hoping to push East- Bengalis closer to Pakistan. In response, Pakistan stated that Indian strategy was to escalate hostilities by unilaterally proceeding with the building of the barrage of Farakka (Shown, 1996: 39). Indeed, India and Pakistan were in diplomatic conflict. India's motivation was to construct the Farakka Barrage to serve the national interest. On the other hand, Pakistan was conscious to preserve the interests of East Pakistan, as East- Pakistan was the integral part of Pakistan. However, Abbas A. T. who was a leading negotiator from Pakistani side and later on became the minister of Power, Flood Control and Water Resources of Bangladesh, gives a different account. He is of the opinion that 'to the government of Pakistan, the Kashmir question was more important than the Farakka problem--- the Indian side was a step by step approach in dealing with the various problems but Pakistan insisted on discussing the Kashmir question first. So the Farakka or any other problem could not be considered at all (Abbas A. T., 1982: 27). Indeed due to different sorts of bilateral and multilateral politics, India was determined to construct the Farakka Barrage; on the other hand, Pakistan was in close dealing with India to settle down the Kashmir problem instead of keeping India stop to construct the Farakka Barrage which is being regarded as the main culprit of creating environmental degradation of Bangladesh.

4.2.2 Independence of Bangladesh and the Farakka Issue

Anthony Maskarenhus opinioned India fought against not for the independence of Bangladesh but for the division of Pakistan (Anthony Maskarenhas, 1986). In a sense it is one kind of comment that does not carry any significance. But in otherwise, this comment bears important significance. The construction of Farakka barrage and its post advancement reflect the significance of the above comment. After the independence, Bangladesh expected to resolve the water-sharing problem with India for mutual advantage of both the neighbors in view of the support given by the India during the liberation war. Initially, A India-Bangladesh Joint Rivers Commission (JCR) was set up to develop the water of the rivers between two countries on a cooperative basis. In the meantime, India completed the construction of Farakka Barrage and

became ready to use in the beginning of 1975. The main features of the Farakka Barrage complex constituted:

- A barrage at Farakka on the Ganges with road-cum-rail bridge
- A head regulator on the right bank for the feeder canal
- Feeder canal taking off from the head regulator
- A barrage at Gangipur across the Bhagirathi - Hoogly River
- Four navigation locks; and
- Road-cum-rail and road barrages across the feeder canal (Abbas, A. T., 1982: 14-15).

On 21 April 1975, the Farakka Barrage was commissioned on a trial basis following a short-term agreement signed by India and Bangladesh. After a long negotiation, both the countries agreed on 18 April 1975 to share the water at Farakka for the last 40 days of the 1975 day-season period. The description of short-term agreement was

Table-1: The 1975 Short-term Agreement
(Amount to be shared in cusecs)

10 days period	Dependable supplies at Farakka	Amount agreed upon for Hoogly	Remaining flow for Bangladesh
27 April to 30 April 1975	55,000	11,000	44,000
1 May to 10 May 1975	56,500	12,000	44,500
11 May to 20 May 1975	59,250	15,000	44,250
21 May to 31 May 1975	65,500	16,000	49,000

(Source: Crisis on Ganges, Government of People's Republic of Bangladesh, 1976, Page-1)

From the above statistic, it is obvious that India did not get optimum amount of water what she planned to withdrawal in the active dry season period. But it was a major diplomatic breakdown because Bangladesh changed her position and permit India to operate the Farakka Barrage. Indian Government, thus, hailed the agreement as a 'break through' and as an outstanding example of neutral understanding and accomplishment (Lok Sabha Debates, 1975: 235). But this short-term agreement was not free from criticism. Both the parties criticized the

agreement. From the Indian point of view it was of opinion the Indian opposition parties that the release of 11,000-16,000 cusecs of water in the dry season was negligible to the needs of 40,000 cusecs to flush the heavily silted Hoogly (Swain, 1996: 41). Though Sheikh Mujibur Rahman, the president of Bangladesh, signed this agreement, the opposition parties also of opinion that it was a pro- Indian act and Mujib government has over looked the salient interests of Bangladesh itself. But the father of the Nation S. K. Mujib had been assassinated and it was opinion that some attribute the short-term agreement 'as one of the reasons of his fall out with the army (Mascarenhas, 1986). The situation changed when S. K. Mujib had been assassinated. The Indian government hardened her attitudes towards Bangladesh. Indeed, the unilaterally diversion of water by India was started from 1976 after the assassination of S.K. Mujib. India unilaterally started to divert the Ganges dry-season flow 40,000 cusecs at Farakka without any consultation with or concurrences by Bangladesh. This was the beginning of formal conflict regarding water sharing. Bangladesh's military government without finding any alternative way, first, brought up the issue at the Islamic Foreign Minister's Conference at Istanbul in May 1976; the Colombo Summit of non-aligned countries in August 1976 and 31st session of the United Nations in September 1976. The United Nations did not play guiding role rather referred the matter back to the two countries at the initiative of the other non-aligned countries. But the position of India was clout and stance. India was determined in her position. The military government finding no other alternative way came back from the position and concentrate to keep negotiations going at the bilateral level.

In the internal context, Bangladeshi people were deadly against of diversion of Ganges water unilaterally. Different types of uprising and movement were formed. Maulana Bhasani, a popular leader of Bangladesh, tried to form public opinion against reduced flow of the Ganges by using threats to lead a march to the Farakka. On 16 may 1976, he launched the 'Farakka Peace March' but it failed due to the intervention of the military authorities. The Government of Bangladesh issued a white paper on the Ganges water dispute in the second weak of September 1976, which stated that a grave crisis has risen for Bangladesh on account of India's unilateral action. In the beginning of 1977, Bangladesh Government brought out an explanatory in which it was warned ' failure to resolve the Farakka' issue expeditiously and satisfactorily carries with it potential threat of conflict affecting peace and security in the area and the region as a whole. The regime change in

India, especially when Indian Janata Party won in the election defeating Indian Congress created an opportunity to strengthen the relation with neighboring countries. President Ziaur Rahman also took the initiative to provide stability and development to Bangladesh by advocating in favor of forming an association for South Asian Regional Cooperation (SARC). In such a situation both the countries agreed to come in to the decision to resolve the problem and took an initiative to come to an agreement extending over a period of five years to share the Ganges water during dry season. Consequently, an agreement was signed on 5 November 1977, during the leanest ten days, 21 to 30 April. According to this agreement India was allowed to withdraw at Farakka 20,500 cusecs and Bangladesh 34,500 cusecs. As a result, India increased her share from 37.5 per cent to 40 per cent of the total flow. The agreement is given below:

Table-2: The 1977 Agreement
(Amount to be shared in cusecs)

Period	Flow at Farakka	Flow at Farakka	Withdrawal by India	Release to Bangladesh
January				
01-10		98,500	40,000	58,500
11-20		89,750	38,500	51,250
21-31		82,500	35,000	47,500
February				
01-10		79,250	33,000	46,250
11-20		74,000	31,500	42,500
21-28/29		70,000	35,000	9,250
March				
01-10		65,250	26,750	38,500
11-20		63,500	25,500	38,000
21-31		61,000	25,000	36,000
April				
01-10		59,000	24,000	35,000
11-20		55,500	20,750	34,750
21-30		55,000	20,500	34,500
May				
01-10		56,500	21,500	35,000
11-20		59,250	24,000	35,250
21-31		65,500	26,750	38,750

Source: Government of India, Ministry of Energy; The Agreement Between India and Bangladesh on sharing of The Ganges Water at Farakka and on Augmentation of its Flows, November 5, 1977).

In the above figure, it is obvious that India increased her share of water considerably in comparison to the 1975 agreement. This agreement satisfied both the parties. Indian government won in the negotiation process and ensured increased amount of water. On the other hand, Bangladeshi negotiators were happy to get a deal for five years of sharing. The Indian central government termed this agreement as 'An Agreement of Compromise' and both the countries expected to resolve the most unsettled issues between two countries. But the government of West Bengal criticized this agreement and argued that West Bengal is the most concerned with Farakka Barrage and has not got the optimum amount of water share. This agreement in Bangladesh perspective was not welcomed by any corner where the standard and common reaction was "wait and see"(Rashiduzzaman, 1978: 132).

On 25 March 1978, both the countries exchanged alternative proposals for augmenting the flow of water in the dry season as spelled out in the 1977 agreement. The Bangladeshi plan proposed the building of river strong dams in Nepal, and India proposed a scheme to divert water from the Brahmaputra River to the Ganges through a link canal across Bangladeshi territory. Bangladesh in response said no, because the proposal was legally unjustifiable, technically impracticable and economically and ecologically disastrous"(Swain, 1996: 44). In 1980s the situation worsen because the communist party of India demanded the revocation of the 1977 agreement, which according to them was against of their salient national interest. In 1982 an all-party delegation from west Bengal called on Prime Minister Indira Gandhi on the eve of the visit by the new President of Bangladesh, H. M. Ershad to New Delhi in October and demanded that their state be assured a minimum of a 40,000 cusecs flow during the lean months (Far Eastern economic Review, 1982)). In 1982 a memorandum of understanding was signed between the two parties by extending the 1977 agreement and in this memorandum few changes were incorporated. The memorandum of understanding signed in 1982 expired after 18 months. The inability of the parties to reach an agreement on any of their dry season augmentation schemes brought the dead lock to the further extension of the short- term arrangement. The refusal of the Indian government to renew the arrangement in 1984 and its unilateral siphoning off water at Farakka

were perceived in Bangladesh as a pressure tactic aimed to bring it to arrangement on the link-canal proposal (Bertocci, 1985: 233). After the assassination of Indira Gandhi, her son Rajib Gandhi became the prime minister and he then changed his foreign policy regarding the neighboring countries. In that time an attempt was initiated to resolve the water-sharing problem while the Indian Minister of Irrigation visited to Bangladesh in June 1985. But the visit did not carry any positive result. Fortunately or unfortunately this situation changed when Bangladesh had been engulfed with the severe cyclonic storm in Bangladesh. Rajib Gandhi as a reconciliatory visit came to Bangladesh to express a sense of solidarity and support and finally President Ershad and Rajib Gandhi came in to agreement for the sharing of rivers water while they were both in Nassau (Bahamas) for the summit meeting of Commonwealth Heads of Government. In pursuance of this a fresh talk was held between the delegation of two countries at New Delhi in 1985 and another new memorandum of understanding was signed for a three-year period. In this memorandum it was mentioned that river water is common to India and Bangladesh and also, both sides pledged to make a joint study to find alternatives for sharing and augmenting the dry- season flow (Crow and Lindquist, 1990). To follow up this agreement, a Joint Committee of Expert (JCE) was created where for the first time Nepal was included in the water sharing agreement. Though India was against of Nepal to be included in the discussion of water sharing, both the countries, in July 1986, jointly approached Nepal for her assistance and for the first time a trilateral discussion among foreign ministers of India, Bangladesh and Nepal were held on the 17 January 1987. In this discussion Nepal for the first time started to vacillate on the plea of studding the proposal (The Economist, 1988: 80). But in November 1987, the life of the Joint Committee of Experts expired without proceeding beyond its achievement reached in 1986. Meanwhile, Bangladesh suffered from the devastating floods of August and September 1988, which was so devastating that the three-fourths of the county went under water. From the Bangladesh side this flood was regarded as "a catastrophe of an unprecedented dimension" and at the same time "a man made curse" and appealed for international assistance. President Ershad refused to take any assistance from the India whom he did not hesitate to describe as the main culprit for the misery (Swain, 1996: 46). After the flood President Ershad, on his own initiative, flew to New Delhi on 29 September 1988 to discuss about the water sharing and India's initiative to outlet the huge water during the rainy season

but the Indian government refused to discuss and extend the 1985 water-sharing agreement.

However, an Indo--Bangladesh Task Force of Experts was set up to study the Ganges and Brahmaputra waters jointly for flood management and for water flows in both short term and long-term basis. In the Task Force Meetings, India insisted that Bangladesh should accept her 1978 proposal, while Bangladesh emphasized non-structural measures such as flood forecasting and warning etc. Actually, information about the water reserve and flood situation is difficult to know for Bangladesh because Bangladesh is in down-stream position. The Farakka water-sharing MOU of 1985 lapsed in November 1988 and India from very soon started to withdraw water at Faraka at its own will. Bangladesh's renewed attempt to internationalize the water management issue by bringing it to the UN, the Commonwealth and South Asian Association for Regional Cooperation (SAARC) ended in worsening the relationship further (Far Eastern Economic Review, 1988:24).

After three years of inactivity, the Joint River Commission met again in April 1990 after the change of the regime in India, but it carried little progress and result. But after this, the issue was in deadlock as both the countries were in the political turmoil. In the final month of 1990, a popular surge of opposition against President Earshad of Bangladesh swept him out of power. And in 1991 a new democratic government came in power under the leadership of Begom Khaleda Zia after a historic election in Bangladesh. The political turmoil at that time was in similarly severe in India. The frequent change of Governments and assassination of Rajiv Gandhi in May 1991 had put the country in a soul-searching disposition. After achieving some sorts of stability at home, Prime Minister Rao of India and Prime Minister Zia of Bangladesh met in New Delhi in the last week of may 1991. There, they agreed to make "renewed endeavors for achieving an acceptable long-term and comprehensive arrangement" and in the meantime they decided to deliver an interim arrangement for sharing the dry-season flows at Farakka (Muni, 1992: 53).

4.3 Internationalization of the problem

The failure of reaching any agreement with India over the water sharing and the simultaneous falling water level in the Bangladesh infuriated several political parties and organizations observed the "Farakka Day" on 16 March 1993 by burning an effigy of Indian Prime minister Rao and taking out processions towards the Indian Mission in Dhaka. In its response an Indian diplomat told that these sorts of things would not

give pleasure to the Indian Government. Rather these would hurt New Delhi (The pioneer, 20 May, 1993). In the meantime Bangladeshi Prime Minister Kaleda Zia met with the Indian counterpart in the Non-Aligned Movement Summit in Jakarta, Indonesia in September 1993 to come in the short-term arrangement of water sharing for assimilating huge domestic pressure. But India insisted on Bangladesh's acceptance of the link-canal proposal. Finding no hope from the Indian side even in terms of short-term agreements, Bangladesh again started to institutionalize the Ganges water disputes. The series of initiatives undertaken by Bangladesh can be describes as

- Prime Minister Khaleda Zia in her speech to the 48th session of the United Nations General Assembly, on 1 October 1993 alleged, "the unilateral withdrawal of the Ganges water by India has created unimaginable adverse effects on the economy and environment of Bangladesh (The Dailly Star, 1993). In spite of India's sharp reaction Bangladesh continued its effort to mobilize international attention to the Farakka water withdrawal.
- In the Commonwealth Heads of Government Meeting at Limassol, Cyprus in the latter part of October 1993, the then Prime Minister of Bangladesh described her country's misery due to the Farakka withdrawal (The Daily Star, 21 October 1993).
- Prime Minister Khaleda Zia also discussed the problem with Nepal during her visit to Katmandu in November 1994 where she urged for a 'tripartite framework' to solve water crisis. Though the Prime Minister of Nepal welcomed the Bangladesh proposal, at the same time wanted to discuss the matter with India before any commitment (The Telegraph (Dhaka), 27 November 1993).
- Along with the attempts of their government, the Bangladeshis living abroad have started organizing seminars, protest march to highlight the Farakka problem in various international capitals (The Telegraph (Dhaka), 27 November).
- The frustration of Bangladesh side can be described from the fact that while the Ambassador designate of Cuba was presenting his credentials, the president of Bangladesh brought up the Farakka issue to solicit Cuban support (The Daily Star, 26 November, 1993).

- During the Chinese Foreign Minister's visit to Dhaka in February 1994, Bangladesh Foreign Minister discussed the problem with him. The Prime Minister Zia also brought up this issue in her visit to Japan in April 1994.

These were the initiatives undertaken by the Bangladesh to internationalize the issue and through it to the international community to create international awareness regarding this type of vital issue. From the very beginning India was reluctant to raise the issue in international level and did not welcome any third party intervention in this issue. One of the Foreign Policy Analyst of Bangladesh described this initiative like " the main objective of this approach by Bangladesh has not been so much to bring in nay third party to mediate as to create international public awareness on the challenges faced by the country as a result of unilateral withdrawal of water from an international river by an upper riparian in absolute disregard to the adverse effects caused to the lower riparian (Iftekaharuzzaman, 1994: 227). However, the attempts undertaken by Bangladesh to internationalize the issue further worsened the relationship between Bangladesh and India. India halted the bilateral negotiation with Bangladesh. In that time due the international politics Bangladesh did not able to get much support form the international arena. Finding no other alternative way, Bangladesh started her bilateral talk with India. The process of bilateral initiative again started in May 1995 after a meeting between the Prime Ministers of two countries in New Delhi (The Telegraph, 4 May, 1995). In its follow up, their Foreign Secretaries met in Dhaka in June 1995, where they decided to convene a meeting of the Joint River Commission (JRC) after a lapse of nearly 4 years. In its meeting the Foreign Secretary of India stressed the need of permanently solving the Farakka issue while completely ruling out the involvement of Nepal. Indian position was not favorable to a short-term arrangement to share at Farakka, and at the same time India pressurizes Bangladesh to accept its plan for diverting water from Brahmaputra. But the power transition in Bangladesh changed the situation in 1996 when the Awami league came in power and tried to have a long-term solution of Farakka water sharing problem. On 12 December 1996 prime ministers of Bangladesh and India signed a treaty on sharing of Ganges water. A similar agreement was signed at first in 1977 for five years, which was replaced by a MOU in 1982. Between 1989 to 1996, no agreement or treaty was existed between two countries on the sharing of the Ganges water during which time India unilaterally diverted Ganges water in the upstream of Farakka as well as at Farakka. After wining in election Prime Minister SK. Hasina Wazed government started negotiating with

India on the Ganges water sharing. Things moved very rapidly and treaty was reached between the two countries on 12 December 1996. The basic principles of the treaty are as follows:

- The flow at Farakka was calculated on the basis of average flow (50% dependable flow) for the period of 1948 to 1988.
- Proportion of sharing between Bangladesh and India is 45:55 and in some cases the proportion will be 30:70
- During the period from 1 March to 31 May the sharing will be on the basis of so called hydraulic cycle when one side will have 35000 cusec guaranteed flow and the other side will receive rest of the flow. In such a cycle when the flow is 50,000 cusec when India will receive 35,000 cusec and Bangladesh will receive only 15000 cusec.
- When the flow falls below 50,000 cusec no sharing principle will exist, Bangladesh and India will sit immediately to decide equitable sharing
- The same principles will be applied to the sharing of flow of other common rivers.

The second major dam is a hydroelectric barrage at Farakka, located close to the point where the main flow of the river enters Bangladesh. This barrage, built by India to counter water deterioration at the port of Calcutta, diverts fresh water from the Ganga into the Bhagirathi River via a large canal. The barrage and its water flow management have been a long lingering source of dispute with Bangladesh. Bangladesh claims that the Farakka Barrage deprives the country of a valuable source of water on which it depends, because the Ganges water are vital to irrigation, navigation, and prevention of saline incursions in the Bangladesh Ganges delta region. Bangladesh holds that there should be joint control of the river as it is an international river. Interim agreements have been reached regarding this issue between India and Bangladesh, most recently the 'Treaty between the government of the Republic of India and the government of the People's Republic of Bangladesh on sharing of the Ganga/Ganges waters at Farakka' signed on December 12, 1996, but a permanent settlement has not yet been attained. This treaty allocates the river's water according to a complex formula. The following represents the breakthrough agreement regarding water allocation only:

Table-3: Sharing of water by Bangladesh and India in 1996 treaty

Availability At Farakka	Share of India	Share of Bangladesh
70,000 cusecs or less	50%	50%
70,000-75,000 cusecs	Balance of flow	35,000 cusecs
75,000 cusecs or more	40,000 cusecs	Balance of flow

(Subject to the condition that India and Bangladesh each shall receive guaranteed 35,000 cusecs of water in alternate three 10-day periods during the period March 1 to May 10.)

These were the main principles of 1996 water sharing treaty signed between the India and Bangladesh at time. More than ten years have already been passed after the signing of the treaty but the result is not satisfactory. India is still diverting water unitarily and ignoring the main points of water sharing treaty. This results in huge environmental destruction in the lower riparian countries especially in Bangladesh.

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CHAPTER-FIVE

DECREASE OF WATER IN BANGLADESH DUE TO FARAKKA BARRAGE: AN ANALYSIS

5.1 Introduction

Water is an important natural resource that plays a significant role in protecting and preserving environmental, ecological, social and economic systems as well as sustains life on earth. Indeed, water is often considered as the equivalent of oil in the present century. There is a growing literature, which describes water both as an historic and, by extrapolation, as a future cause of interstate warfare. Westing (1986) suggests that competition for limited freshwater leads to severe political tensions and even to war. Gleick (1993) describes water resources as military and political goals, using the Jordan and Nile as examples; Remans (1995) uses case studies from the Middle East, South Asia, and South America as well-known examples of water as a cause of armed conflict; Samson and Charrier (1997) write that, 'a number of conflicts linked to freshwater are already apparent,' and suggest that, "growing conflict looms ahead"; Butts (1997) suggests that, "history is replete with examples of violent conflict over water," and names four Middle Eastern water sources particularly at risk; and Homer-Dixon (1994), citing the Jordan and other water disputes, comes to the conclusion that "the renewable resource most likely to stimulate interstate resource war is river water." Ganges River is such in position where tension between the Bangladesh and India always exists. This Ganges river is shared by four sovereign states: China, Nepal, India and *Bangladesh*. Therefore, the lives and livelihood of about 400 million people of above-mentioned four countries, together with its flora and fauna, have been conditioned by the waters of this great river (Nishat, 2001: 85). A small portion of the Ganges River system (230 km of 2600 km of river length and 46,300 km² out of 1,087,300 km² of basin area) is located in Bangladesh but plays a pivotal role in shaping the overall socio-economic development and maintaining ecological system of the country. Actually, about one-third of Bangladeshi population, of which 80% is dependent on agriculture, is directly or indirectly dependent on this river. But it is a matter of fact that the lifeblood of Bangladeshi people is decreasing day by day due to the construction of Farakka

Barrage. Many observation and research have been conducted to estimate the natural flow and the reduced flow in Bangladesh due to the Farakka Barrage. For proper understanding and mentioning the actual figure I shall mention different cross analysis.

5.2 Decrease of water flow in Bangladesh

Water is decreasing in the Ganges basin for diverting by India. Geographically India is in advantageous position and situated in the upper riparian position. From the very beginning India was the enemy of Pakistan and Bangladesh being the part of Pakistan up to 1971 was too so. But the liberation war of Bangladesh changed the position of India regarding Bangladesh. After liberation Bangladesh expected to have all round cooperation from India. But after the short while of liberation India put pressure over Bangladesh to operate the Farakka Barrage. Finally Bangladesh gave her consent and India operated the farakka Barrage with taking an agreement between two Countries. But the situation was not the same what the situation exists in the present time. The internal as well as the international political conditions has led India to change her position and now India is behaving from realistic point of view. This realistic view of India in the context of water sharing is conducive for her internal development but very much devastating for Bangladesh. The following discussion will represent the actual condition.

5.2.1 The 1975 Short-term Agreement

The water sharing between India and Bangladesh under the 1975 agreement will be presented in the following table:

(Table-4: Amount to be shared in cusecs)

10 days period	Dependable supplies at Farakka	Amount agreed upon for Hoogly	Remaining flow for Bangladesh
27 April to 30 April 1975	55,000	11,000	44,000
1 May to 10 May 1975	56,500	12,000	44,500
11 may to 20 may 1975	59,250	15,000	44,250
21 May to 31 May 1975	65,500	16,000	49,000

Source: Crisis on Ganges, Government of People's Republic of Bangladesh, 1976, Page-1

During the last months of 1975, the Ganges conflict was forgotten due to the internal turmoil in Bangladesh. From the end of the 40-day interim agreement, India had been diverting almost 40,000 cusecs from the Ganges and presumably this continued through the remainder of 1975 (Crow, 1997:107).

5.2.2 The 1977 Short-term Agreement

The quantity of water has been decrease after the operation of Farakka Barrage. Special Studies made by the Bangladesh government specifically mentioned the actual estimate of water diversion by India. The following table will represent the amount of decrease of water:

Table-5: Estimate of diversions (1000 cusecs)

Period	Type	Dec	Jan	Feb	Mar	Apr
1975-76	Unimpaired discharge	120	88	75	65	58
	Impaired discharge	120	67	52	29	26
	Estimated discharge	0	21	24	36	32
1996-77	Unimpaired discharge	129	81	70	60	54
	Impaired discharge	86	50	39	32	34
	Estimated discharge	23	31	31	28	22

Through this treaty India got a lion share of water in the Ganges Basin. In the driest ten -day period Bangladesh gave away 20,000 cusecs of the historical flow (Crow, 1997: 119).

5.3 Comparative statement showing water-sharing treaty in 1977 and 1996

But if we closely and carefully analysis the main two treaties signed between India and Bangladesh we certainly find that the source and diversion of water by India is increasing day by day. For proper understanding we mention a comparative analysis between the two treaties signed in respectively 1977 and 1996.

(Table-6: Comparative statement showing water-sharing treaty in 1977 and 1996)

Period	Bangladesh			India		
	1977	1999	Increase/ Decrease	1977	1996	Increase/ Decrease
January 1-10	58500	67516	9016	40000	40000	0
January 10-20	51250	57673	6423	38500	40000	1500

January 20-31	47500	50154	2654	35000	40000	5000
February 1-10	46250	46323	73	33000	40000	7000
February 10-20	42500	42859	-359	31500	40000	8500
February 20-29	39250	39106	-144	30750	40000	9250
March 01-10	38500	35000	-3500	26750	39419	12669
March 10-20	38000	35000	-3000	25500	33931	8431
March 20-31	36000	29688	-6312	25000	35000	10000
April 1-10	35000	35000	0	24000	28180	4180
April 10-20	34750	27633	-7117	20750	35000	14250
April 20-30	34500	35000	500	20500	25992	5492
May 1-10	35000	32351	-2649	21500	35000	13500
May 10-20	35250	35000	-250	24000	38590	14590
May 20-30	38750	41854	3104	26750	40000	13250

(Source: Shawn, 1996)

From the above table and figures, it is evident that Bangladesh receives lower amount of flow as per 1996 treaty than the 1977 agreement and quantum of decrease varies from 7117 to 144 cusec during critical period from 21-28 Feb to 11-20 May. On the other hand, India receives more flow as per 1996 treaty than the 1977 agreement, which varies from 14590 to 4180 cusec during the same period. During this period Bangladesh has lost about 1.2 million avert of water which is sufficient to irrigate about 1.2 million acres of land the economic values of which is to the true of some million US\$ every year. Taking advantage of the recent treaty India has already entered into agreement with Bhutan to divert flows of Sankos and Manas, which are tributary to the Brahmaputra to the Ganges. According to international law inter basin transfer of water is unlawful. If India succeeded in diverting the flow from Sankos and Manas, then, Bangladesh is loosing its Brahmaputra water also. India has already constructed diversion structure over Teesta & Mahananda and also planning to construct reservoir on the Barak, which is the main source of Meghna. In one sentence it can be concluded that India is trying to strangulate Bangladesh over the sharing of water of common rivers. If the upstream flow in all the river systems of Bangladesh reduces in dry months, then Bangladesh is definitely heading towards an ecological disaster in near future.

Different study revealed that the lowest average monthly discharge of the Ganges was found to be 316 m³/s in March 1993 against the pre-diversion average monthly discharge of 2213 m³/s for the same month. During the year 1992-93, the lowest

average monthly discharge was found 544 m³/s in February 1993 against the pre-diversion monthly average of 2519 m³/s for the same month and again 430 m³/s against 2081 m³/s in April 1993. It is also observed that due to diversion minimum discharge has reduced to as low as 270 m³/s in April 1993 as against a minimum discharge of 2081 in April 1974. The water level has also been recorded as low as 4.22 meter in April 1993 as against a minimum value of 6.70 meter in March 1974. Another analysis undertaken to compare discharges in various years at Hardinge bridge utilizing 1956 to 1987 further revealed that the averages of the highest annual discharge (August-September) before and after 1975 are 46998 m³/s and 55570 m³/s respectively. On the other hand the averages of the lowest discharge (March-April) before and after 1975 were found to be 2006 m³/s and 809 m³/s respectively. This showed that average peak discharge has increased by about 12% compared to average peak flow before 1975. On the same basis the average annual low flow had decreased by 60%. Similar result has been reported by FAP-4 studies (FPCO 1993). The average post-diversion flow will decrease even more unless the sharp declining trend is reversed.

Consequently, Farakka Barrage has also seriously affected dry season flow of the Gorai, major distributaries of the Ganges, due to low flow in the Ganges since diversion. Due to reduction of flow in the Ganges during lean flow season, the Gorai is gradually silting up at the off take. An analysis conducted on the discharge entering into the Gorai from the Ganges on a monthly basis before 1975 and thereafter showed that significant reduction of discharge has taken place in the Gorai especially during January-March period. Before 1975, percent of discharge entering into the Gorai was (during January-March) some 8 -12% of the Ganges discharge. This gradually further shrank and reduced to about 0.15% during the last few years for the same period; necessitating dredging of the river with little increase in flow in the recent time. Dry season flows had been cut off completely by 1992 and has it been possible to partly restore only through substantial dredging in 1998. (The Daily Star: 2004). The Ganges by itself is noted for massive discharge and sediment load. Changes in flow and sediment load have induced sediment deposition in the reach within the territorial boundary of Bangladesh. Sedimentation as high as 3 meter at some places has been found. The sediment flow in the Ganges showed a decreasing trend. The excessive lowering of the discharge due to upstream diversion during low flow season has reduced the depth of flow hampering navigation and accelerated the silting up of the bed. The hydraulic geometry of the river has undergone significant

changes creating problems in the distribution of sediment load. As a consequence, the shifting character and meander parameters has also changed.

5.4 Decrease of water in Bangladesh: an evaluation

Observation shows that the natural flow in the Ganges has been considerably declined after flow regulation in 1975. The following figure will shows the minimum daily discharge of 1,460 m³/sec (23-24/04/67) at Hardinge Bridge for the pre-Farakka period (1965-1974) has been reduced to just 135 m³/sec (14/04/95) in post-Farakka period (1975-1998) (Tazkara, 2001: 0000). This reduction is about 1100% less than pre-Farakka flow. A comparative analysis of daily, monthly and annual discharge (Table 1) shows that the minimum flows have been reduced remarkably but the rate of change for daily minimum discharge is much higher than monthly and annual minimum flow. On the other hand, the daily and monthly maximum flows have been increased while the annual maximum and minimum flows are decreased marginally.

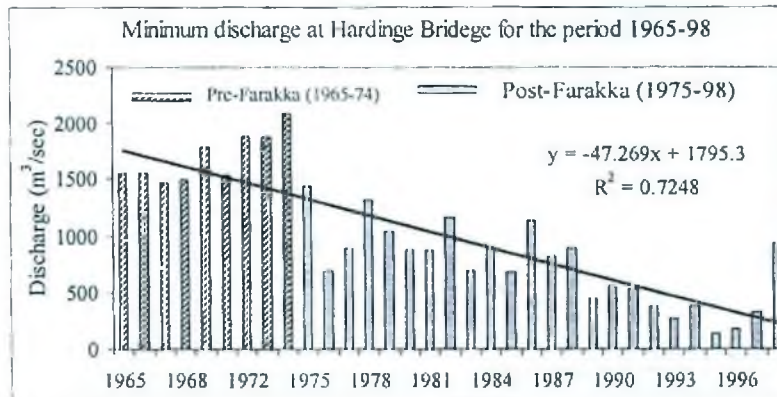
Table 7: Comparative statistical analysis of pre and post Farakka discharge (in cumecs) in the Ganges at Hardinge Bridge

Flow (cumec)	Statistical Value	Before construction of dam (1965-1974)	After construction of dam (1975-1997)	Difference between pre and post-Farakka
Daily	Minimum	1,460	135	-1325
	Maximum	56,083	80,228	24,145
	Average	10,516	10,758	242
	Sd	12,243	14,490	2246
	Cv	1.164	1.352	0.188
Monthly	Minimum	42,033	5,144	-36889
	Maximum	1,517,878	1,623,000	105,122
	Average	319,875	324777	4901
	Sd	78413	96895	18,482
	Cv	0.213	0.367	0.154
Annual	Minimum	2,822,415	2,392,449	-429,966
	Maximum	5,182,656	5,160,910	-21746
	Average	3,838,506	3,897,320	58,814
	Sd	764,296	748,486	-15810
	Cv	0.199	0.192	-0.007

(Source: Tazkara Khatun, 2000)

This ratio of reduction of water in the Harduge Bridge has been represented through the following diagram. Here the statistical method has been used to calculate the reduction rate and to state it clearly.

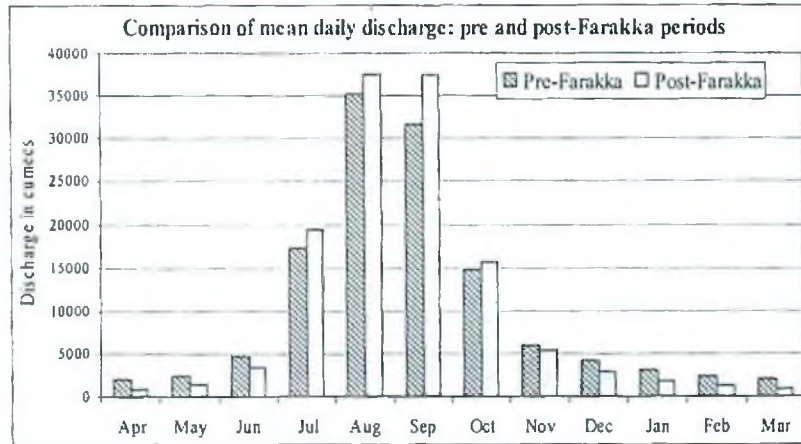
Figure 6: Reduction of minimum flow near Harding Bridge (Bangladesh) for the period 1965-1998.



(Source: Tazkara Khatun, 2001)

It is also revealed that the dry season (November to May) discharge has been remarkably decreased while the monsoon (June to October) flow substantially increased after the flow regulation at Farakka. For example, the daily minimum discharge has been reduced 1100% while the maximum flow increased by only 146% (56,083 cumecs to 80,228 cumecs). The ratio of the maximum and minimum discharge for the post Farakka period has been increased exponentially (pre-Farakka 38: 1, and post-Farakka 594:1). Therefore, the extreme seasonality becomes more acute than before. March and April months are considered as the worst months for decreasing discharge while September is considered another worst month for the highest discharge and flooding. The following hydrograph (Figure 4) shows the increase of monsoon flow and decrease of lean season flow. Furthermore, the dry spells and flood intensity have been increased remarkably (Tazkara, 2001: 00).

Figure 7: Reduction dry season flow and increase of monsoon flow.



From the figure it is shown that the water discharge in the pre-Farakka was much higher than the post-Farakka period. In pre-Farakka period India was aware of the interest of the lower riparian neighboring countries specially Bangladesh. This situation is now in lowest position. After the signing of water sharing treaty in 1996 an understanding was set up between two countries for sharing water both in dry season and rainy season. But the changing of political condition in Bangladesh has altered the position of India. But for the sake of environmental security the like minded political situation is not the last resort rather the existence of the habitat should be counted by the upper riparian country.

5.5 Reference:

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CHAPTER-SIX

MAJOR IMPACTS OF FARAKKA BARRAGE ON BANGLADESH AND ENVIRONMENTAL SECURITY CONCERN

6.1 Introduction

Being a downstream location, Bangladesh roughly drains 352×10^3 million cubic meter (mcm) of water 1.5 billion tons of sediment per year from of the Ganges Basin of which vast majority (95%) comes from outside of its border. Therefore, any interventions in the upper riparian regions would have a significant impact on Bangladesh (Rashid, 1998). Subsequently, the unilateral and disproportionate water diversion at Farakka has severely affected the natural flow in the down stream of the Ganges. As a result, the Ganges and most of its distributaries are severely suffered from surface water deficit; even some of them are almost died and dried up during the dry season (Nishat, 2001). Agriculture, navigation, irrigation, fisheries, forestry, industrial activities, salinity intrusion of the coastal rivers, ground water depletion, riverbed degradation, sedimentation, coastal erosion, navigation and other economic activities as well as environment and society have been degraded greatly. Due to the lack of sector-wise data, it is difficult to predict the actual loss. However, the estimated total loss over the period 1976-2004 is 800,000 million BDT¹ (with a maximum loss in fishery sector) (Badsha, 2004). The environmental, economic, socio-cultural and health impacts of water diversion are discussed below.

6.2 Documents contain the effects of Farakka Barrage

The impact of Farakka Barrage is very complex. While we will discuss the effect of Farakka Barrage, it is needed to review the existing research works undertaken both by Bangladesh and India in different period available on this subject. It is true that the construction of Farakka Barrage was the most important concern of Bangladesh than India. That is why most of the research works were conducted by Bangladesh during 1976-1977 when large quantities of water were diverted down the river Hooghly. Besides, the United Nations agencies also conducted some research concerning the effect of Farakaka Barrage. Three documents provide most of the

¹ BDT is Bangladeshi currency which is called 'Taka'. Current exchange rate: 1 \$US= 58.50 BDT

evidence for assessing the impact of Farakka diversions during 1976 and 1977.

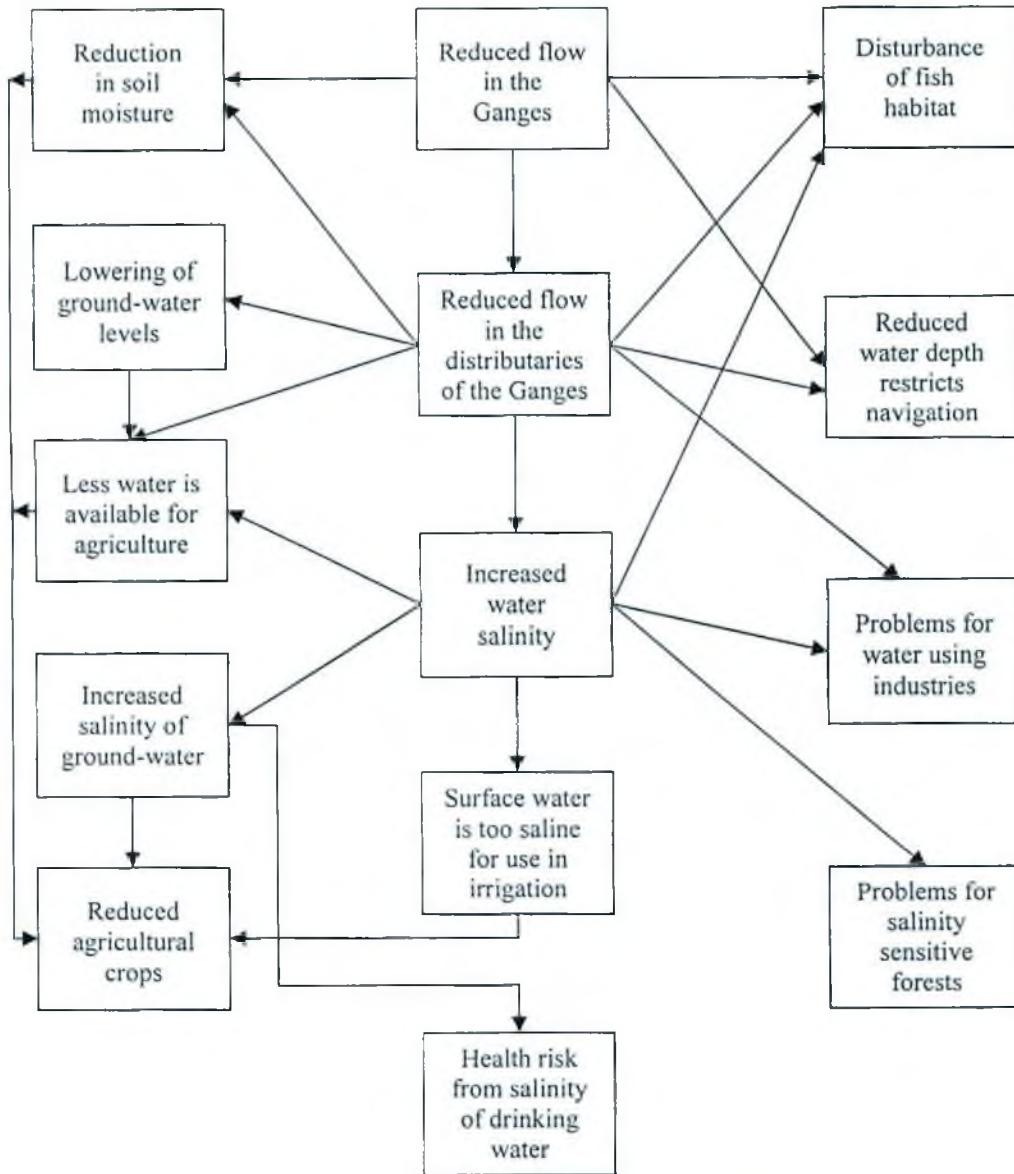
These are:

- ^ The Farakka Barrage'- prepared by the Indian government
- ^ White Paper on the Ganges water Dispute- prepared by the Bangladesh government
- ^ Special Studies- formulated by the government of Bangladesh and a San Francisco- based firm of engineering consultants and funded by the World Bank. This document is a large, four-volume work and it constitutes the most thorough investigation made into the impact of Farakka diversions on Bangladesh during the 1976 and 1977 (Crow, Lindquist and Wilson, 1997:128).

These three documents which provide descriptions of the mechanism by which a reduction in the flow of the Ganges may cause agricultural, industrial or ecological damage and quantitative assessments of the extent of damage caused by the reductions experienced by Bangladesh in 1976 and 1977. Special Studies is the most systematic of the three documents. It was formulated by a group of experts who were given the access and the resources, which enabled them to make empirical measurements of the physical processes involved. These experts, most of them from North America, worked in co-operation with the Bangladesh Government's Special Studies Directorate and under the overall guidance of three eminent American hydrologists. But the discussion and information provided by these documents not necessarily provide the complete figure of the environmental destruction caused by the withdrawal of water by the Farakka Barrage. But for our analytical clarity we will discuss the main effects of water diversion of Farakka Barrage over Bangladesh. The major effects over Bangladesh due to the water diversion produce environmental insecurity particularly in the northwestern region.

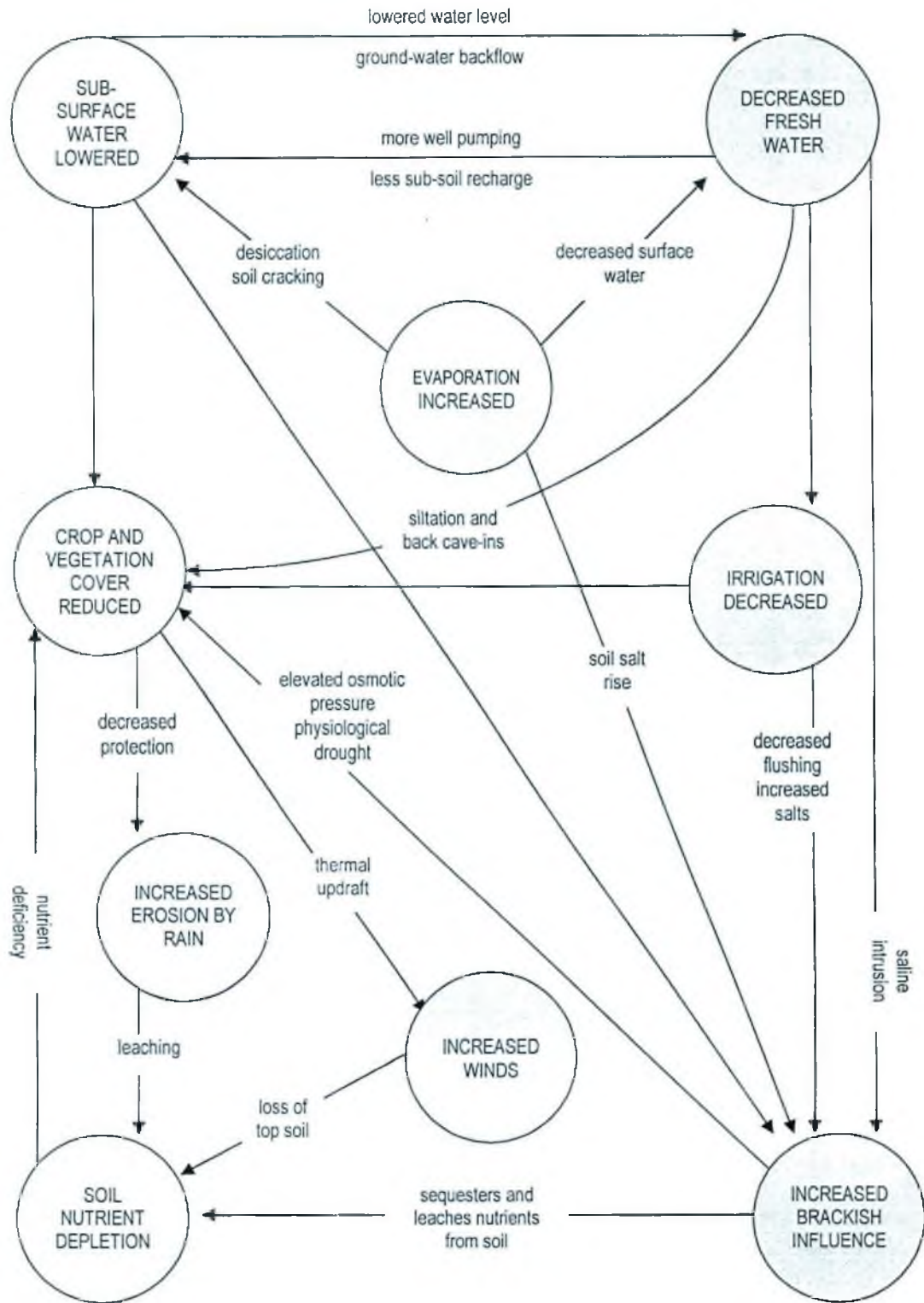
The following figure will show chain of cause and effect linking reduced river flows to potential consequences:

Figure-8: Summary of the impact of reduced Ganges flows



(Source: Crow, Lindquist and Wilson, 1997:125)

Figure 9: More far-reaching claims of the consequences of reduced Ganges flows.



Source: White Paper on the Ganges Water Dispute, From Ben Crow and others, Sharing the Ganges: The politics and technology of river development, University Press Limited, Dhaka, 1997, page-126

These are the figures, which represent the actual impact of Farakka Barrage very clearly and specifically. On the basis of the above figure, I shall tend to mention the impacts of Farakka Barrage.

6.3 Impact Areas:

The impact of the construction of Farakka Barrage over the river Ganges is much debated issue and complicated to discuss. And the impact study is very comprehensive one. But here attention will be given to the areas of impact where the issues of environment of Bangladesh are closely connected. Under this connection the possible areas are:

6.3.1 Agriculture

The most devastating impact of the reduced water availability in the dry seasons has been on the agricultural sector. We know that agricultural production in Bangladesh is very important. Before the diversion of water through the Faraka Barrage it has been estimated that 75 per cent people were engaged in agricultural sector and more than 30 percent of the GDP came from the agricultural sector. But the situation changed after the operation of Farakka Barrage. In the White paper published in 1977, Bangladesh Government asserted that India's diversion of water had resulted in lose of rice output of 236,000 tons in 1976. Bangladesh argued that there were three ways in which the Farakka diversions reduced rice and other agricultural production:

- reduced river flows caused depleted soil moisture levels, with the result that crop yields were lower.
- Increased salinity in river water may have precluded irrigation or, if the water was used for irrigation or inundation, crops may have been damaged by the salinity.
- Bangladesh farmers may have perceived increased salinity levels or decreased water availability and may, therefore, have chosen to delay planting their crops (Crow, 1995: 149).

These three situations consequently reduce the agricultural production. The situation is not satisfactory in the present position rather the condition of agricultural

production has been reduced. Previous discussion found that the salinity and arsenic level have been exceeded the permissible or tolerance level and the potential evapotranspiration has been increased due to the reduction of the Ganges flow. As a result, the soil fertility has been considerably deteriorated as well as the crop yield has been decreased. Annual loss from agricultural sector is estimated about US\$ 650 million (Mirza, 1998: 719). It is also estimated that today Bangladesh could have been a position to produce an additional 3.6 million tons of food grains annually which in financial terms amount to 23,000 million take if there had been natural flow in the Ganges and its distributaries (Nishat, 1996: 79).

In addition, the agriculture practices have also been changed over the last three decades. For instance, the people were used to grow three major crops: rice (*Oryza sativa*), jute (*Corchorus species*) and Sugarcane (*Saccharum officinarum*). The study carried by Adel (2001) shows that the production of sugarcane remain almost unchanged but the production of jute, (the earlier main cash crop) dropped significantly since 1980s and rice cultivation increased markedly. Furthermore, the shrimp cultivation is become a predominant occupation instead of traditional jute or rice especially in the coastal region. Presently the farmers are used to continuous mono cropping of rice (particularly HYV rice) or shrimp instead of varieties of pulses, oil seeds and fishes. The Noble Prize winners Pat Mooney and Cary Fowler (1985) described this as "genetic erosion" (SOS, 2004). Due to the surface water shortage, present agriculture of this basin is heavily dependant on the ground water that indirectly contributes to the depletion of ground water table. The following figure will prove the significance of this argument:

Table-8: Rate of Increase of Agricultural production

Division	1981-1982	1989-1990	Per Year Increase
Chittagong	2,501	5,105	13.01%
Dhaka	13,673	34,347	18.90%
Khulna	2,808	11,095	36.89%
Rajshahi	23,861	38,200	7.51%

Source: Bangladesh Agricultural Development Corporation, Dhaka.

From the above figure it is obvious that due to the lacking of fresh water in the agricultural sector people are depending on the alternative sources to fulfill the demand. And the ground water is the important source to mitigate the increasing demand. This increasing number of using of Shallow tube well not only affects the

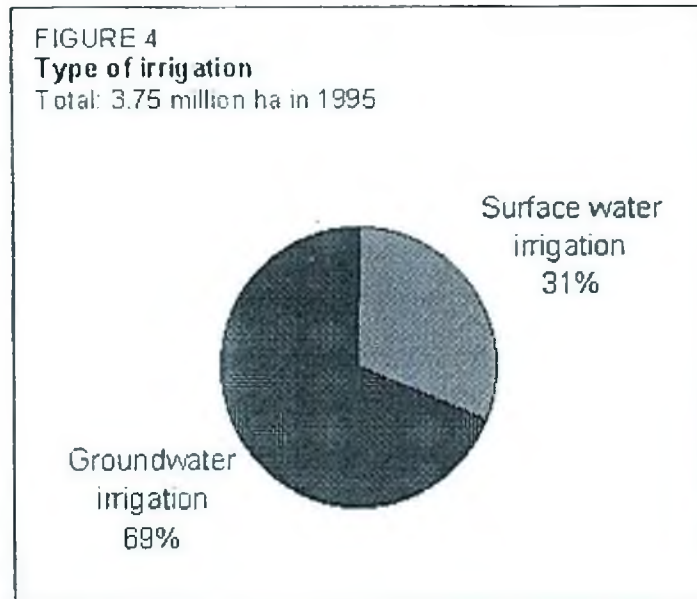
agricultural production of Bangladesh but also affects seriously the environment. The water diversion through Farakka Barrage by India is more or less solely responsible to originate the crisis in Bangladesh. In the mean time the GK project is in serious interruption due to the shortage of water from the from the Ganges basin.

6.3.3 Irrigation and the environmental concern

In Bangladesh, the expansion of minor irrigation (small-scale irrigation) is a vital component of the Government's agriculture strategy. Irrigation through major canals (large-scale irrigation) covers only 6 percent of the total irrigated area, the remainder being classed as minor irrigation consisting of low lift pumps (LLPs: power operated centrifugal pumps drawing water from rivers, creeks and ponds), shallow tube-wells (STWs: with a motorized suction mode pumping unit), deep tube-wells (DTWs: with a power operated force mode pumping unit), manually operated pumps (MOPs: extracting water from a shallow tube-well) and traditional systems. At the end of the dry season, the water level falls beyond the suction limit of the centrifugal pump. In these situations, it is possible to draw water by placing the STW in a pit. An STW in a pit is called a deep-set shallow tube-well (DSSTW) or a very deep-set shallow tube-well (VDSSTW). Where static water levels fall further (over 10.7 m), a submersible or vertical turbine (FMTW: force mode tube-well) is needed.

From 1982 to 1997 more than two million hector of land has brought under irrigation system. Due to the increasing irrigation system the demand of deep shallow tube well has also been increased considerably, which has resulted the major environmental problem in environment, ground water and the quality of land. In 1994, 665 VDSSTWs and 32 FMTWs had been constructed by farmers as a result of the promotional action of the project. However, there has been a general reduction in the area irrigated by wells as a consequence of aquifer draw down, and there has been an increase in salinity intrusion particularly along the coastal areas in the southwest of the country. The area salinized by irrigation was estimated at 100 000 ha in 1991. Currently, the irrigation potential is estimated at 7 550 000 ha, of which about 3 751 045 ha had been brought under irrigation by 1995. The following figure will clearly show the case

Figure-10: Irrigation by type of water control in 1995



It has reduced Bangladesh's capacity to irrigate its own land particularly in the southwest region (the whole pre-1993 Khulna division and the Southern part of Rajshahi division) and at the same time has worked against the planning of non-irrigated crops, which deepened upon the residual moisture of the soil. Though Bangladesh is one of the best water regions on the earth, the interference across the border has limited her capability to irrigate, to only 23 per cent of the total arable land. The uncertainty of water availability of the Ganges has been a serious concern for a large number of farmers in the southwestern region, which also includes the Ganges- Kobadak (GK) project area, as farmers cannot plan their irrigation program in the dry seasons. The GK project, which has been providing irrigation to 142,000 hectares, is under serious threat due to the lacking of the natural water and the available water comes from the rivers flown over the India and Nepal. Due to the construction of Farakka Barrage over the Ganges river the natural flow of Ganges river which consequently comes to Bangladesh is totally controlled and regulated by India. This situation has made Bangladesh depended on India's will to get the natural flow of water and as its result the GK project and other irrigation projects are more or less dead. No further steps to operate the projects are yet to be taken due to the lack of the availability of water. This situation has been created a complex nature of environmental insecurity. The growing dependence on the ground water for lacking of natural flow come from India has had tremendous environmental effects.

6.3.4 Forest especially the mangrove forest and environmental security concern:

For the environmental security forest plays a pivotal role in keeping the checks and balance situation in the environment. We generally know that 25% forest reservation is very essential to preserve the environmental balance and natural ecosystem of any particular country. Bangladesh is in alarming situation, as most the reserve forest of Bangladesh is decreasing day by day due to the natural and man made reasons. But the most alarming news for Bangladesh is that the condition of Sundarban is going to be worsening day by day. The important reasons behind it are the decrease of water level in the Sundarban and the increase of salinity. The water diversion through the Farakka Barrage by the India is causing both the decrease of water and the increase of salinity. The effect of Farakka Barrage can be described in the context of forest in two grounds:

- The decreasing of wood and forest resources- indicates the decrease of non-renewable resources in Bangladesh.
- The decreasing of capability of forest to sustain or keep balance the environment that called the non-renewable resources.

Due to the water diversion of Farakka Barrage a great amount of forest of Bangladesh especially the Sunderban are at stake. According to the Special Studies the Sundarban, the world's largest mangrove forest (6,000 km²) that is situated at the adjacent north of the Bay of Bengal and criss-crossed by a number of the Ganges distributaries is severely affected by flow regulation at Farakka. Reduction of perennial channel flow and increases the salinity levels and threatens the integrity of natural habitat. Many native species like Sundari (*Heritiera fomes*), Gewa (*Excoecaria agallocha*) and Keora (*Sonneratia apelata*), Goran (*Ceriops decandra*) and many other native species are now endangered. In particular, the most adverse effect of inadequate flow and increased salinity in the Ganges basin is observed for the 'Sundari' the main species (73% of available forest). It is also predicted "this valuable forest plant will be disappeared if the salinity goes above the tolerance limit" (Nishat, 2001: 90). The total economic loss from forest sector is reported to be substantial. For instance, Mirza states that "the timber production loss from 'Sundari' is about 1.3 million cubic meter for the period 1976-82 and a total financial loss from forest sector is about US\$ 320 million since the operation Farakka Barrage" (Mirza, 1998: 720). Most experts agree that due to direct and indirect impact of human

interventions, far-reaching changes are taking place slowly but steadily -- affecting the delicate Sundarbans ecosystem. Much of such changes are not clearly visible. Direct human impacts are further worsened by the less-readily detected but perhaps more menacing impacts which threaten the mangrove ecosystem. The changes in freshwater flushing are visibly caused by gradual eastward shift of the flow of the Ganges River. The change is acknowledged as being historical in nature although the more recent impact of the Farakka Barrage in India and subsequent siltation in the Gorai is accelerating the process. It is believed that the changes affecting the salinity, flood intensity and periodicity, erosion, siltation and sedimentations may all be factors for perplexing and worrisome loss to the world's largest mangrove system (Nishat, 2001). A number of species like Javan rhinoceros (*Rhinoceros sondaicus*), water buffalo (*Bubalus bubalis*), swamp deer (*Cervus duvauceli*), gaur (*Bos gaurus*), hog deer (*Axis porcinus*) and marsh crocodile (*Crocodilus palustris*) became extinct during the last 100 years from the Sundarbans. The Royal Bengal Tiger is an inseparable part of the legend attached to the Sundarbans. The tidal mangrove forest is a rare habitat for this tiger species. But today they have been pushed due to habitat shrinkage. The SRF tiger population estimate in the past 20 years remained in the range of 350 to 400, the largest discrete population of the species in a single tract of natural habitat in the world. But the preservation of the Royal Bengal Tigers is, by far, the most important challenge for those concerned for the protection of Sundarbans bio-diversity. Incidental mortality due to diseases, illegal hunting and subtle changes in the Sundarbans ecosystem poses a serious risk for the survival of the Royal Bengal Tiger. Besides this, the interaction with humans in the area, particularly the killing of humans by tiger, complicates the management of the area. International Union for the Conservation of Nature (IUCN) has listed it as an endangered species in its Red Book. The marsh crocodiles, once abundant, are already extirpated. The salt-water crocodile (*Crocodylus porosus*) still survives in low densities and like the marsh crocodiles its population is being reduced through indiscriminate hunting and trapping for skins, quite apart from the immediate conflict with men. Despite an apparent reduction in illegal trade in its skin, the population shows little sign of recovery. Some 30 species of snakes have been recorded in the SRF and there appears to have been a general decline in densities or at least in their sighting particularly in the past two decades. The Rock Python (*Python molurus*) is one of the valuable SRF snake species, which is said to have declined over recent years. International Union for the Conservation of Nature (IUCN) has listed it as a

"vulnerable species." The results of four independent inventories undertaken over the past seventy years indicate that the overall volume of wood per hectare has decreased. Moreover, closer analysis of three inventories undertaken in 1959, 1983 and 1996 indicate a marked reduction in total standing volume for the two principal species of economic importance, Sundari and Gewa.

According to studies carried out at different times by the forest department, British ODA and UNDP/FAO sponsored Forest Resource Management Plan, the mean volume per hectare of the Sundari tree was 34.5 in 1959. The volume was reduced to 19.9 in 1983 and 17.8 in 1996. In case of Gewa, the mean volume per hectare was 8.7 in 1959, which was reduced to 4.6 in 1983, and 2.1 in 1996.

The dramatic decrease is blamed on their over exploitation, legally and illegally, because of their commercial value and subtle changes in the ecosystem. A number of issues related to the Sundari, Gewa and Goran trees have emerged for immediate concerns of the foresters. According to experts, the reasons for the decline in Sundari (*Heriteria fomes*) are two fold:

- First, as a valuable timber species with real commercial value, it has been subject to heavy exploitation.
- Second, increasing salinity as a subsequent impact of the subtle ecological changes, noticeable increase in salinity and siltation have resulted in hostile anaerobic conditions in which the Sundari finds it difficult for healthy respiration.

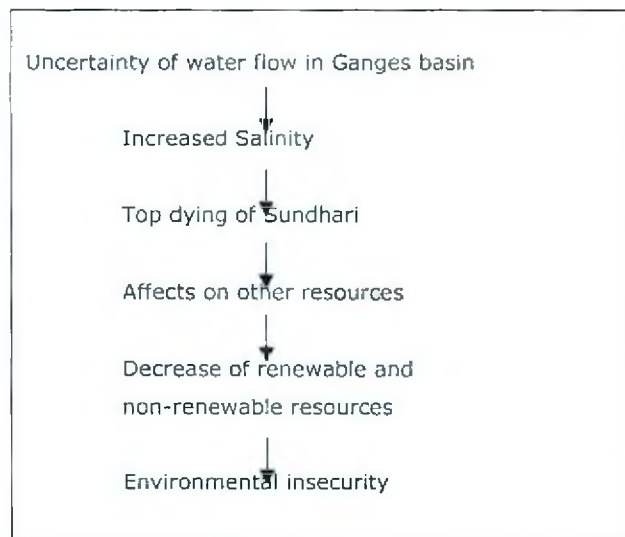
Whatever the possible reasons for decreasing the resources in Sunderban the most important reason I think is the reduction of the natural flow of water in the Ganges basin and consequently in the distributaries in the nothe western region in Bangladesh. This situation is very much alarming for the environment of Bangladesh.

6.3.5 Salinity causes top-dying disease of 'Sundari'

Increased salinity in waters in the country's south-west region and deposit of silts on the roots of plants preventing their process of photosynthesis are the two principal causes of top-dying disease that victimizes the valuable 'Sundari' trees in the Sundarbans. Experts made this observation at a meeting held on June 3, 2005 at the Ministry of Forests and Environment. They said this was caused by the adverse affect of the Farakka Barrage in India, according to an official handout (Daily Star: June 4,

2005). The ministry convened the meeting of the policymakers and experts to evolve ways and means to resolve this menacing problem faced by the "Sundari" trees and also to protect the bio-diversity of the world's largest mangrove. Chief Conservator of Forests M Anwarul Islam, Country Director of International Union for the Conservation of Nature (IUCN) Bangladesh Dr Ainun Nishat, and Chairman of FEJB Quamrul Islam Chowdhury, Chairman of the Department of Wood Technology and Forestry Discipline of Khula University Dr Abdur Rahman and Heads of Forestry Departments of Dhaka, Chittagong and Jahangirnagar Universities attended the meeting. They called upon the botanists to evolve and effective formula to protect the Sundari trees from the deadly top-dying problem keeping in mind the socio-economic and environmental aspects of Bangladesh (Daily Star 4, June, 2005). Actually this problem is being created in Sundarban due to the lacking of natural flow of water and the increasing salinity both in water and land of the concerned areas. This problem has a far-reaching impact on the environment of the concerned area and consequently will affect the total environment of Bangladesh. This top-dying problem is being caused by different sources but among the sources the uncertainty of water flow in this region is an important reason. The water diversion by India after the operation of Farakka Barrage is causing this problem significantly and considerably. This situation has produced a huge environmental insecurity in Bangladesh both in the context of non-renewable and renewable resources. We can represent this matrix using the following figure:

(Figure-11: Increased salinity and environmental insecurity)



According to a leading water expert Prof. Ainun Nishat, Country Director of IUCN over 60 percent of Sundari trees are dying in the Sundarbans mangrove forest with high salinity prevalent in Khulna and Jessore regions due to severe lack of sweet water flow from upstream points coupled with negative impact of the Farakka Barrage (Nishat, 2001). That water is being withdrawn in the upstream of Farakka Barrage in the Uttar Pradesh, northern region and Bihar. He said lack of sufficient water not only hampers cultivation but also creates negative impact on fish resources in the rivers. Prof. Nishat said Sundari wood is more valuable than normal wood. Lack of sweet water contents in the Sundarbans mangrove forest kills Sundari trees, he said. Hydrologists told BSS that the water level fell by three feet at Hardinge Bridge point in December 2004. They said similar fall in the water level was also noticed at Gorai railway bridge point. The hydrologists of Bangladesh Water Development Board (BWDB) said Bangladesh received 145,000-cusec water at the Hardinge Bridge point on December 1, 2004 (Nishat, 2005). He referred to the field reports and said the country received 107,000-cusec water on December 18, which means that the volume of fall stands at 38,000 cusec further. Continuous dredging is underway to ensure navigability of the waterway. The fall of water level has caused disruption in the ferry service. Many shoals are also visible on the Padma near Rajshahi city. Most of the shoals are being converted into farming space. Local farmers are using those chars for cultivation of sugarcane, rice and other crops. The in-take channel of Ganga (Padma)-Kapotakkha Irrigation Project has become blocked with the deposit of massive silts. Last year dredging machines had removed 193,000 cubic meters of silts from the mouth of the in-take channel. Officials of the GK (Ganga-Kapotakkho) Project said the farmers in its command area need sufficient water to irrigate some 116,000 hectares of land. They said during the dry season the farmers could grow crops on only 15,323 hectares (Nishat, 2005). The tributaries of the mighty Padma are facing adverse effects following withdrawal of water at Farakka point in India. Flows of water have dwindled in most rivers, eventually affecting the plying of river vessels. The reduced flows have also caused extinction of common fish species. Rivers in Kushtia, Chuadanga, Meherpur, Faridpur, Madaripur and Shariatpur districts have registered falls and the experts are afraid that different upazilas outside the GK command area will face serious water crisis for irrigation. Lawmaker and Kushtia Zilla BNP president Professor Shahidul Islam told BSS that the Farakka Barrage has caused adverse effects on the environment in the northern,

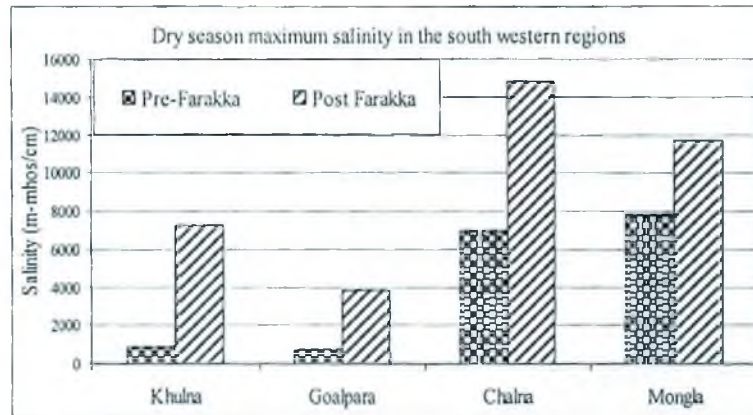
southern and western regions of the country. He said irrigation in the GK project area was hampered while salinity in the southwestern Bangladesh increased due to the sharp fall in the water levels (Daily Star, 3, 2005). The ruling party lawmaker demanded due share of the Padma waters from India under the International laws and said India as a member of SAARC and a good neighbor should come forward to resolve the existing water issue.

6.3.6 Increased land and Water Salinity

Salinity is a factor of unusual importance in Bangladesh. The coastal zone is extensive and in most areas heavily populated. This area is directly affected by salinity. The coastal aquifers have high salinity. Therefore, any increase in salinity means incurring more expense exploring deeper tube-wells and sharply increased pumping costs. Often, a suitable layer of freshwater is not available, which renders development virtually impossible. The recharge zone for these deep coastal aquifers is located far from the coast along the Ganges. Activities in these inland areas that decrease recharge, such as river diversion or flood prevention works, would affect the dynamic balance within these aquifers between the saltwater and freshwater interface. This balance is of critical importance to Bangladesh. Any change in the quantity, timing, or direction of flows in inland areas can affect surface and sub-surface salinity in the coastal zone. Activities in the Ganges Basin that decrease freshwater flow into the estuary are bound to increase the penetration of salinity inland and impair water quality. Diversion of low flows at Farakka has increased the inland penetration of salinity. Salinity levels increase rapidly and curve northwards in the area affected by the withdrawal of Ganges water in the low-flow season. Salination of soils in lower riparian areas due to reduction of flows by upstream diversion is an issue, which has not fully appreciated in discussions about water sharing. For example, if river flow were reduced to nil in the dry summer months, half of the Lower Ganges Basin would be salinized. This condition would lead to a massive loss of agricultural production. And the result would trigger the migration of at least 20 million people and the collapse of a quarter of Bangladesh's urban and industrial infrastructure. It is proved that the salinity ingress is directly related to river flow. Therefore, the most devastating effect of low discharge is observed in surface and ground water as well as soil salinity in the southwest region of Bangladesh. A severe reduction of dry season flow let the highly saline water

penetrating into inland through estuaries. In this regard, Nishat told that the salinity front of 500 micro-mho/cm moved through the Passur Estuary from 90 miles to about 136 miles inland (lower reach of greater Jessore district) after the diversion (Nishat, 1996: 71). Reduction of the Ganges flow through the Farakka Barrage has severely affected the downstream river regime of the Ganges-Padma. For the Ganges-Padma River at Hardinge bridge, the ratio of maximum and minimum discharge during pre-Farakka days and post-Farakka days are roughly 70 percent and 27 percent respectively, which is far greater than the ratio of ten percent of maximum discharge required for maintaining a stable river regime. After the commissioning of the Farakka Barrage, Ganges-Padma River velocities during post-monsoon and dry season are not adequate to transport the sediment load discharged downstream. Consequently, maintenance of the river regime has become almost impossible. The Ganges dry season flows have been notably reduced since the construction of Farakka. Consequently, saline intrusion has moved farther inland within the coastal areas, and the opportunity to expand irrigation is much lower. In addition, the natural and progressively deteriorating cycles of dry season flows in the Gorai have been made worse. Lowering water levels in the Ganges and other rivers and streams have seriously affected the groundwater level. The Department of Public Health Engineering conducted a survey in 1992 that shows the water table has dropped to 23 feet from its pre-diversion level. This drop has affected the greater districts of Rajshahi, Pabna, Faridpur, and Kushtia. Since the area includes the coast however, a saline-fresh water interface takes place. A risk is always present in such circumstances that groundwater development will cause the inland movement of the saline front. Evidence exists that this process is occurring in the water supply wells at Khulna. This salinity in both the land and water has been increased remarkably after the operation of Farakka Barrage and the aftermath when India unilaterally has diverted water through this barrage for her internal purpose ignoring the interest of the neighboring countries most particularly Bangladesh. The following figure will show an actual figure of the increase of salinity in land and water in Bangladesh.

Figure 12: Comparison of pre and post-Farakka period salinity for dry months

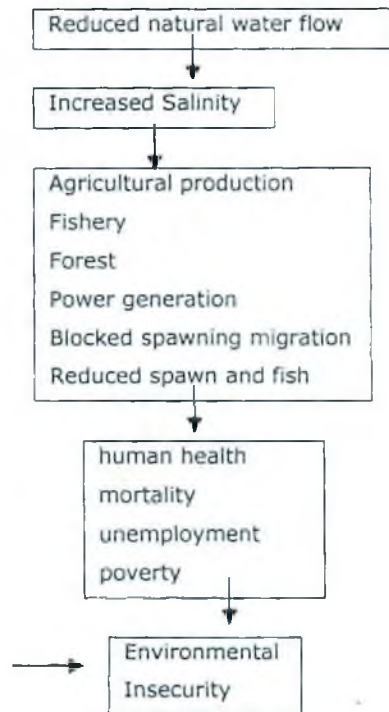


(Source: Mirza, 1998: 718)

The comparative statement in the above figure illustrates that the salinity level for four stations southwestern region has been increased enormously from pre-dam to post-dam period. The most alarming rate of increase of about 1800% is recorded in Khulna station. The highest salinity of 29,500 m-mhos/cm ever recorded in April 1992 (Nishat, 1996: 73). The present salinity level particularly in the coastal belt has exceeded the crop tolerance limit of agriculture and household uses. Therefore, the salinity directly affects on agricultural production, industry, fisheries, forestry, and power generation. For example, "the saline encroachment into delta habitat, blocked spawning migrations of fish and spawn species and reduced downstream aquatic habitat during the dry season" (Smith, et. al., 2001: 330); reduced agricultural production (annual loss of US\$ 650 million); stopped plants growth and timber production, deteriorated water quality and finally, salinity pose a long term impacts on human health, mortality, unemployment, poverty as well as total economy and ecosystems of country.

This existing literature proves that the increase of salinity due to the construction of Farakka Barrage has had tremendous environmental impact on Bangladesh. On the basis of Homer Dixon model mentioned above we can represent the causal model of reduced water flow, increased salinity and environmental insecurity in Bangladesh.

(Figure- 13: Causal model of the reduction of natural flow of water and environmental insecurity)



6.3.7 Endangered Way of Life Due to Lack of Pure Water

In the villages of the 16 upazillas of the southwestern coastal districts of Khulna, Satkhira and Bakersheet there is acute shortage of drinkable water. Around 5,000,000 people are affected. Children and women rush from village to village for a pitcher of water. Long queues form before tube wells and for PSF water. In some villages, the only sources of sweet water are one or two ponds. Children and women have to travel at least 2 kilometers to get a pitcher of water. In some villages, the distance traveled is 5 or 6 kilometers. To meet the daily average requirement of 3 pitchers for a family, people have to walk at least 6 to 12 kilometers. People drink less water than its adequate or drink saline or arsenic contaminated water. Due to taking impure water people are victim of various kinds of skin diseases, stomach disorders, dysentery, fever, diarrhea, etc are on the rise. Malnutrition among women and children, reproductive problems of pregnant women, blackening of the skin, reddening of hair, raising of blood pressure, physical weakening and mental distress have increased. Due to scarcity of sweet water, agriculture suffers; various kinds of trees diminish in number; trees unable to withstand salt die out; local fish tend to disappear; sweet water fish farming is endangered; land becomes more sterile; the world-famous mangrove forest, the Sundarbans, suffers; natural beauty fades away; and other environmental problems occur. This total picture represents an alarming

impact due to the water shortage in this region. There is no clear-cut answer of these sufferings. But the diversion of water from the Ganges is more or less important factor to create these problems.

6.3.8 River System dying

The river system is regarded as the sole contributor of total economy and the environment of Bangladesh. But the river system in Bangladesh is now dying. This is partly due to the follies of human interventions in its catchment areas and riverbeds and partly due to nature's consequent readjustment of its dynamic equilibrium. Reduction of the Ganges flow through the Farakka Barrage has severely affected the downstream river regime of the Ganges-Padma. For the Ganges-Padma River at Hardinges bridge, the ratio of maximum and minimum discharge during pre-Farakka days and post-Farakka days are roughly 70 percent and 27 percent respectively, which is far greater than the ratio of ten percent of maximum discharge required for maintaining a stable river regime. After the commissioning of the Farakka Barrage, Ganges-Padma River velocities during post-monsoon and dry season are not adequate to transport the sediment load discharged downstream. Consequently, maintenance of the river regime has become almost impossible. Four main factors have been identified as dominating the current trends in this region's changing environment:

- The diminution of dry season flows through the Ganges distributaries and, thereby, the dying of distributaries streams from the Ganges as sediment bars increase at the off take;
- The northwest movement of the saline wedge as tidal movements meets less and less resistance from dominant freshwater flows;
- Increased sedimentation; and
- Growing human population.

25 of the 230 rivers in the country are either dead or dying out, with many more dozens drying up and reduced to water pockets. Natural causes paired up with indiscriminate and ill-planned human interventions have been strangling the rivers, lifelines for many a towns and villages. Agriculture, transportation, trade and commerce, socio-economic development, environment and lifestyle of the localities are also changing accordingly. Flood Control and Information Centre Director Dr Selim Bhuiyan official of Water Development Board (WDB) mentioned that excessive

siltation has been cutting down the water-bearing capacity of the rivers, which is why they now burst the banks more frequently and with less water flow than they did previously. Water Development Board (WDB) officials warn all the 25 rivers, parts of which have already turned into stagnant waters, will dry up completely in a few years. Farmers now cultivate crops in the dry riverbeds during the dry season of winter and spring. They also breed fish in the stagnating river areas. The WDB says these 25 vulnerable rivers once were connected with the three major river systems of the Ganges, the Jamuna and the Brahmaputra. But the water flow in the systems from upstream India started to dwindle decades ago, drying and sealing up their infalls or connecting points with the rivers. The Director of WDB says that continued deposition of silt, erosion of crop-field soil and massive encroachment as well as lack of dredging are some other major afflictions pushing these rivers to extinction. The total length of river courses in Bangladesh is approximately 20,000 kilometres, covering 9,770 square kilometres or 7 percent of the country's area. According to the river map of WDB, 54 of the country's 230 rivers flow down from India and three from Myanmar. Water experts say dams and barrages constructed upstream in India on most of these international rivers are choking the water flow to Bangladesh. The 17 rivers a WDB report terms dead are Narasunda (Kishoreganj), Bhubaneswar (Rajbari and Faridpur), Bibiyana and Shakha Barak (Habiganj), Palang (Shariatpur), Burinadi (Comilla and Brahmanbaria), Harihar and Mukteswari (Jessore), Hamkura (Khulna), Morichap (Satkhira), Bamni (Lakshmipur and Noakhali), Manos (Bogra), Baral and Chiknai (Natore and Pabna), Hisna (Kustia), Musakhan (Rajshahi and Natore) and Bhairab (Kushtia, Meherpur, Chuadanga, Jhenidah, Jessore, Khulna and Bagerhat). The rivers marked as near-dead are Karatoa (Panchagarh, Nilphamari, Rangpur, Bogra and Sirajganj), Ichhamati (Pabna, Manikganj, Dhaka and Munshiganj), Kaliganga (Kushtia, Jhenidah, Magura, Narail, Pirojpur), Kumar (Kushtia, Magura, Faridpur, Jhenidah, Madaripur), Chitra (Narail, Chuadanga, Jhenidah), Bhadra (Jessore, Khulna), Someshwari (Netrakona) and Nabaganga (Narail). The receding water flow has shrunken the ailing rivers to mere canals. Numerous chars have emerged in some main rivers. Salinity has increased in the coastal zone that threatens the Sundarbans, a world heritage site. A government source claims over 80 rivers have dried up in the last three decades due to the Farakka barrage built in 1974 on the Indian side of the Ganges, some 17 km off the border (Bangladesh Observers, 2005). Bangladesh government scientists estimate that even a 10 to 20 percent decrease in the water flow to Bangladesh could dry out

vast areas for much of the year, with 100 more rivers in the Ganges, Brahmaputra and Meghna basins also dying out (Nishat, 1996).

6.3.9 Loss of Inland Waterways

As a riverine country, waterways were the principal mode of transportation in Bangladesh over the ages. Since the operation of Farakka Barrage, the waterways, which are dependent on the Ganges flow, have been severely affected. A total of 685 km of waterways, which were navigable during pre diversion era, have been reduced to 230 km. As a consequence, the Bangladesh Inland transports Authority (BIWTA) ferries are facing problems (Nishat, 2001: 71). For instance, at pre-Farakka time, the Padma River at Goalanda was deep enough to carry vessels (steamers) between Goalando and the other river ports of the country. The flow retention in the Ganges has made Goalando as a land-locked communication system, which was once totally disrupted. Considering the communication necessity, Bangladesh extended the railroad from Goalando to Daulatdia as well as established road transport. During the pre-diversion period, large steamers could navigate the Ganges even in the dry season. Today these are rarely observed. The same fate of low flows and unfit for navigation is true for the main distributaries, the Gorai and others too. Similarly, the Bhairab, Madhumati, Arial Khan, Kopotakha, Mathavanga all these distributaries are now only navigated by country boat instead of steamers. Even the main channel, the Ganges can be crossed on foot for 5 to 7 months of the year due to low flow in the dry season. Nishat states, "the mass deterioration of water ways in the south-western rivers is a direct consequence of the upstream water withdrawal" (Nishat, 1996: 71). The following figure represents that the dry season flow is too little that water remains in few scattered pools and the river course becomes shallow enough to cross on foot.

Figure 14: Dry and died riverbed of the Ganges near Hardinge Bridge provides facility to people cross on by foot. In the same place the maximum discharge ever recorded is 80,229 usecs during devastating flood 1998



This situation is not alarming not only for the navigation but for the most part of the environmental resources i.e. renewable and non-renewable which is the life blood for the development of Bangladesh.

6.3.10 Hydrological Impact: Reduction in supply of surface water

The daily minimum discharge for the dry period has been decreased considerably since 1975. For instance, the daily pre-Farakka minimum discharge of 1,460 cumecs has been reduced to 135 cumecs, which is about 1100% less than pre-diversion period. A minimum flow of 55,000 -60,000 cusecs (1,600 – 2,000 cumecs) is critical during the dry period of the year to meet the demand for water for agriculture and industrial development as well as to maintain ecology, navigability and control salinity intrusion (Chadwick and Datta 2002: 15). However, about half of the year the discharges were less than critical requirement and therefore, the duration of dry period have been increased significantly after the flow regulation that considerably affects the entire hydrological regime of the basin. Due to inadequate discharges, most of the Ganges distributaries have no flow at all during dry season. For instance, the discharges in the Garai which is the only source of fresh water supply to southwestern region and pushing salinity back towards sea and keeping overall environmental balance are only ~ 10 cumecs while there were 1500 cumecs in the Ganges (Nishat, 1996: 66; Rahman, et al, 1999:36). This dry and died river condition significantly affects all other potential sectors of Bangladesh. The following figure shows the fissured Ganges bed during lean season, when discharge is far

below the critical requirement. Therefore, the majority of the Ganges basin's districts are widely contaminated by arsenic.

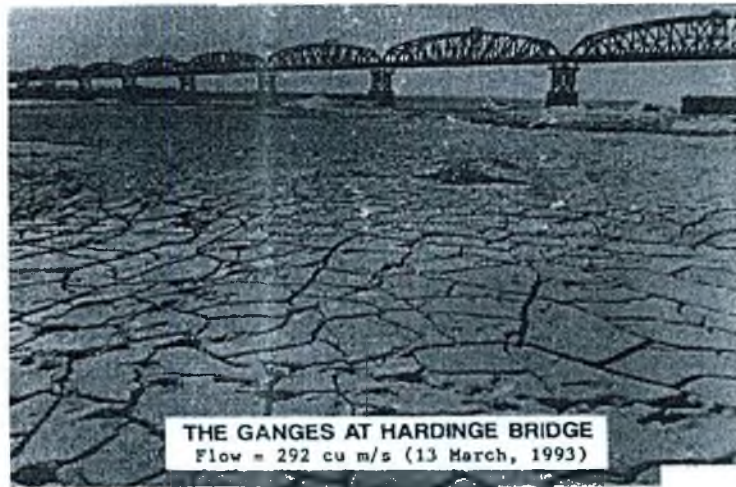


Figure-15: Dry and fissured Ganges bed, high soil porosity and latent heat led arsenopyrite oxygen get into ground water and concentrated to the top of the aquifers (Source: Adel, 2001: 360).

6.3.11 Groundwater Depletion and Arsenic Contamination

According to the Ground Water Task Force Report (GWTF, 2002), the surface water is the main sources of ground water. However, due to the inadequate surface water availability, the ground water table has been depleted significantly. Moreover, global climate change and potential evapo-transpiration during dry season has been increased that triggered the dry season groundwater dropping 4 metre below the wet season level (Adel, 2001: 364). Along with water table depletion, water quality has also been deteriorated remarkably. For instance, according to Nishat 'Total Dissolved Solid (TDS) has been increased from 300 ppm in 1986 to 1000 ppm in 2000 (some places >3200 ppm) against the satisfactory level of <500 ppm for water use (Nishat, 1996: 70). It is also reported that the soil porosity has increased due to inadequate flow and that allows arsenopyrite air get into the groundwater level (Adel, 2001: 366). This is not the single instance rather many places in Bangladesh are under this devastating situation. Recently it has been observed that the weather and the atmosphere of some area particularly the Jessore, Kuistia, Chuadanga have been remarkably changed from its original shape. These areas are so hot during the dry season and so cool in winter season even in the rainy season these areas get the

Geomorphologically, Bangladesh is located at the meeting point of three major rivers: the Ganges, Brahmaputra and Meghna (together known as GBM system), which carried of about 2.4 billion metric ton of which 67% (1.5 billion metric ton) carried by the Ganges (Khalequzzaman, 1993). A study carried out by DFID (2002) shown that about 12-km² land has been reclaimed per year at the mouth of GBM River system. According to Khalequzzaman (1993), a delta can only grow seaward and upward against rising sea level when river borne sediment is adequate. He also noted that the present rate of 4-5 mm/yr sedimentation is not adequate to keep pace with the rate of relative sea level rise of 7 mm/yr in the Bay of Bengal. However, the flow regulation at Farakka reduced water and sediment supply to Bangladesh, curtailed delta growth and led coastal erosion. From the above findings, it can be predicted that if the sedimentation in the coastal areas is reduced further, then a relative sea level rise in the Bay of Bengal will curtail delta growth that led submergence of a significance proportion of Bangladesh. Optimum flow in the Ganges is therefore vital for sedimentation as well as the existence of the country.

6.3.13 Increase Occurrences of Worst Floods

In a riverine country Bangladesh, 20-25% of total land has been flooded every year at normal flood cycles during pre-dam era. These floods provided nutrients and water supply that essential for supporting productive floodplain, agriculture and fisheries. However, these regular flood events have been absent after flow regulation, while the frequency of severe floods has been increased substantially. For instance, there were only 2 severe floods of over 50,000 cumecs in the pre-dam era, which increased to 24 in post-dam era. Similarly, the severity of 25 years flood increased from 55,000 cumecs to over 77,000 cumecs due to flow diversion. The following figure will show the evidence of the change:

Table 9: Flood frequencies at different threshold level

Threshold (cumecs)	Pre-Farakka Period		Post-Farakka Period	
	Total event	Average (event/yr)	Total event	Average (event/yr)
Below 1,000	----	---	21	0.86
Below 2,000	91	0.90	31	1.30
Over 25,000	20	2.00	58	2.42
Over 30,0000	16	1.60	52	2.17
Over 45,000	6	0.60	28	1.17
Over 50,000	2	0.20	24	1.00

Source: Calculation based on BWDB's (2000) discharge data through CUAPAK program/ Tazkara Khatun, 2001)

There are a lot of arguments whether the water diversion is directly related to worst flood events or not. Because, these unusual flood not only increase in the Ganges Basin but also increased to all over Bangladesh and many other factors like climate change and local sea level rise, heavy rainfall during monsoon, synchronization of flood peaks, upstream large scale deforestation, un-planned urbanization and land use pattern, construction of embankment are identified as responsible factors for severe flooding in Bangladesh. These conditions are, of course, the result of the water diversion through the Farakka Barrage.

6.3.14 Freshwater Fisheries

The most common and popular dialogue of 'mache vate Bangali' (e. i. 'Bangladeshis are known as a nation of fish and rice') about the Bangladeshi has been drastically changed due to the lacking of availability of fishes in the watercourses of Bangladesh. There are many reasons behind it but the most common reason of it is to reduce the water availability in the watercourses. The water diversion by India through the Farakka Barrage from the Ganges under this condition is responsible for the lacking of water in the watercourses of Bangladesh. Before dam era the Ganges water had been the breeding and raising grounds of about 109 native fishes including the national fish Hilsha. People would fish almost throughout the year to supplement their income and dietary intakes (Adel, 2001). However, the water diversion at Farakkaa, significantly reduces the permanent wetland and fresh water fish production in this basin. Therefore, most of the common fish species are extinct in the basin. It is also observed that the extinction rate is higher for those species which are used to habit in rivers and breed during August to April than those of habit in ponds, canals or ditches and year round breed. For instance, the Master Plan Organization (MPO) estimated loss of 37 kg/hectare. The Hilsha (*Hilsha spp*), the most popular and national fish of Bangladesh is reduced by 99% in the upstream and in Bangladesh it is now an anadromous fish (Nishat, 2001). Even biologists predicted that after 100 years from now only a skeleton of this favorite fish would remain in museum for visiting school children (SOS, 2004). The following two villager's statements can explain the deterioration of the fisheries sector better.

- Momana, a village woman narrates, "our home used to be surrounded and inundated by water. During monsoon, the water would over flow from the rivers into the canals and beels (wetlands), and reach every nook and cranny of our villages. So many species of fish, vegetables used in flourish in the water bodies which are now almost vanished".
- A landless farmer says, "only well to do farmers cultivate fish in ponds, eat fish to their heart's content but we do not own a pond so cannot even dream eating fish".

(The Researcher visited the Jessore and interviewed the fisherman and farmer and received the response, 7 December, 2005)

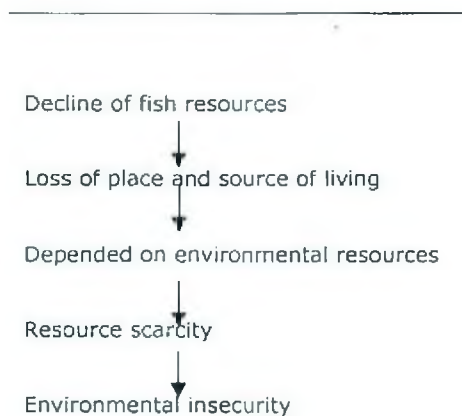
In addition of fish extinction, many beneficiary species like frogs, snails, turtles, reptiles are extinct due to the upstream water extraction in the of Ganges. For instance, the annual mortality rate of well-known Ganges dolphin (*Platanista gangetica*, local name susu) is over 10% (present population only 1200- 1500, IUCN, 2004). This un-wanting situation happening due to the water diversion and the changing pattern of agriculture has been creating huge environmental degradation in the northwestern region of Bangladesh. This degradation has created environmental insecurity in Bangladesh.

6.3.15 Depletion of Fish Resources

Besides water pollution, river management projects also wreak havoc among the fishes living in these waters. These projects adversely affect the fishes, which are migratory from the nature source. Dams and barrages act as barriers in their migratory paths and several species have either already become extinct or are facing extinction as they breed in a particular type of water while inhabiting in a different sort. The Farakka barrage has over the years acted as a barrier to the migration of marine fishes leading to the near absence of several popular varieties in the entire northern India. As the waters of several rivers of northern states directly or indirectly flow into the Ganga, there is a similarity in the types of fishes found in the rivers. There are many fishes (for instance prawn) that inhabit in fresh water but breed in marine water. Likewise, there are other species - like Hilsa - that inhabit in marine water, but have migrated upstream to breed. The Ganga once used to have plenty of Hilsas but this has changed as the fish is no longer able to breed leading to the near extinction of the Hilsas in the Ganga upstream of the Farakka Barrage. It has been estimated that there has been an overall decline of 75 per cent in the entire

population of fish upstream of the Farakka Barrage. Large fishes, once found in abundance in the Ganga are no longer available and millions of traditional fishermen who have made their living for generations by catching fish now face destitution. This not only makes the market more cash driven, but also alienates traditional fishermen from their ancestral profession in a situation where they do not have the training to do other jobs. Finding no other alternative way to provide their livelihood people frequently depends on the natural resources, which are very essential to preserve the environmental security of Bangladesh. This condition also led people to migrate one place to another place where they can have their way of life. This situation result a complex nature of environmental insecurity of Bangladesh that can be represent through the following figure:

(Figure-16: The relationship between the decline of fish and environmental insecurity)



6.3.16 Loss in Industrial Sector and environmental concern

Khulna, the third biggest and second largest industrial city of Bangladesh is situated on the bank of the River Pasur where dry season salinity level is about four times higher than permissible limit of 2,000 micro-mho/cm due to inadequate natural flow in the Ganges distributaries. Therefore, all industries of Khulna and nearby areas have suffered severely from inadequate supply of freshwater and increase in salinity because these industries need much water for their operation. For instance, the operation of Khulna Newsprint Mill requires 300 tons of fresh water daily. Due to low flow and disruption of power supply to the industries in Khulna and Jessore belt

caused losses in production and labour time. According to Mirza "the estimated total loss in the industrial sector is to be US\$ 37 million for the period 1976-93 (Mirza, 1998: 720). This economic loss is not enough to estimate the consequences of water diversion by India through Farakka Barrage. The dependence of the industries on the ground water for its operation put enormous pressure over the environment of Bangladesh.

6.3.17 Loss of Traditional Professions and environmental concern

Apart from farming, the basin's people were employed as fishermen, pottermen, boatmen and boat-makers, fishing equipments makers, fishing technologists, and providers of hackney carriages. Due to the water diversion, flow reduction and loss of fishing activities, these cottage industries have become extinct and fishermen and farmers have become jobless and poor. Therefore, a large number of people are now involved with non-river-based activities like, rickshaw pulling. A survey conducted by Adel (2001) found that the number of these professionals dropped significantly but the most significant dropping and rising are respectively observed in the traditional professions of fishing and rickshaw pulling. For instance, the fishermen dropped from 6% to only 0.5% while rickshaw pullers increased from 1.3% to 5.9% (Adel, 2001). This is not good sign for Bangladesh because the naturally ousted population from their natural occupation is increasingly putting pressure over the sundarban and its natural resources. And even they are not hesitated to destroy the reserved forest of this area. This consequent situation is very much alarming for the environmental security of Bangladesh. Ashok Shawn has explained this situation in his book "An Environmental Trap-

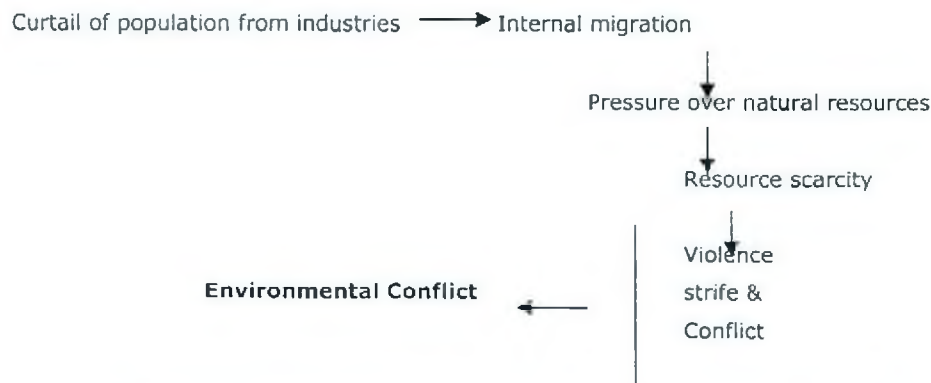


Figure-17: Deprive of traditional living and environmental conflict

6.3.18 River Bank erosion

River bank erosion is the most important concern for Bangladesh because it not only erode the bank of the river but also erode the livelihood of the people. Erosional processes along the rivers render landless many of the one million or so people exposed annually to them. In badly affected districts like Faridpur, Barisal, and Noakhali, the proportion of landless households due to river bank and char erosion is 33, 37 and 42 percent of total households, respectively, whereas the national average is 28 percent of the affected households seem to move within 3 km of their original home, and become under-employed labourers. Only 25 percent of riverbank displaces move much further a field. Counter-balancing loss of land through erosion is the deposition of silt and the creation of new lands for settlement (Hofer T. & Messerli B., 1997: 32). However, erosion-induced landlessness has a more immediate adverse impact than the positive impact of a deposition-induced settlement. The following figure is the example of riverbank erosion.

Figure-18: Picture of river bank erosion



River bank erosion is very much devastating for the environment of Bangladesh. It destroys the land, tree, environmental resources and livelihood of the people. It also creates the homeless people who finding no other alternative way migrate one place to another place to sustain themselves. The land less people then create tremendous pressure on the environment and the environmental resources

that consequently create environmental conflict. This situation has best been illustrated by Home Dixon (1994). He explained:

6.3.20 Soil degradation

The second area of agricultural impacts from agriculture is soil degradation not from non-agricultural land uses such as shrimp farming, but from the cropping and soil management practices themselves. Common categories of land degradation are erosion, waterlogging, salinity, and depletion of nutrients. All these are found in Bangladesh (Brandon and Ramankutty 1993, 117). Although, relatively little quantitative data exists on the scope and extent of soil degradation in Bangladesh, these are some approximations: about 10 per cent of the net cultivated land suffers from medium and high salinity in the dry season; another 10 per cent in the hilly areas is considered highly eroded; and a very high percentage, over 50 per cent, of the total has impeded drainage and suffers from waterlogging and poor aeration (Karim 1993). Over the last 20 years, growth in total agricultural output in Bangladesh has been only 2.1 per cent, and average rice yields have increased 2.5 per cent, although these growth rates may have fallen slightly in the past two to four years (World Bank, 1995). In Jessore and Khulna region this soil degradation and water logging is very acute.

6.3.21 Health Impacts

The people, who heavily depend on surface and ground water for their daily livelihood are suffering from water related infectious diseases like typhoid, paratyphoid, fever, bacillary, dysentery, amoebic dysentery, diarrhea, cholera, hepatices, stomach disorder, schistosomiasis, drocontiasis, guinea worm, roundworm and hookworm" (Adel, 2001: 363). However, no comprehensive survey and statistics have yet been made for the indirect effect of water shortage on human health. However, it is found that one in every four families and 10% of the families are commonly considered as asthma patients. It is also reported "an adult daily inhales 20 mg of dust with 20 m³ of air in Rajshahi region because aridity prevails in northern region and aerosol dust has been uplifted in the air due to indirect impact of low flow in the Ganges" (Adel, 2001: 365). The changing nature of environment and its different consequences like increase of temperature, heat, loss of moisture of land, fresh water shortage and arsenic contamination has imposed a serious effect

on the public health of Bangladesh. But what are the factors acting as an important cause to originate this type of environmental hazard is commonly accepted. The construction of Farakka Barrage and its after math situation have caused the environmental problem in Bangladesh.

6.3.22 Global Warming and Floods

Bangladesh is like any South Asian country cursed with monsoon floods and tornadoes. Bangladesh being close to the sea bears the brunt directly. Incalculable damage is done to agriculture caused by annual recurrence of floods. In 1988 Monsoon floods in Bangladesh killed several thousand people, leveled 2 million homes, devastated 4 million acres of cropland and cost the impoverished nation US \$ 1.5 billion. Nature it seems had declared war on Bangladesh. The world's attention was drawn towards Bangladesh after these devastating floods. The year 1990 was declared as the 'Year of Environment' and the 1990's as the "Decade of Environment". A draft environment policy was also prepared in 1990, with one of the first priorities being spreading awareness among the people. Floods affect 18% of the total land area. There have been at least 14 devastating floods in the last 40 years. But it important mentions here that Bangladesh is not the fertile land of flood. It is widely believed both in Bangladesh and out side of Bangladesh that Flood is not the dampened in Bangladesh due to the natural causes but the intension of particular country plays a significant role to occur flood. The water diversion by India through the Farakka Barrage during the dry season and water pushing in the rainy season is one of the important causes of flood in Bangladesh. Global warning too would affect Bangladesh tremendously. Bangladesh Center for Advanced Studies conducted a recent survey and they made the following results of global warming be affected in Bangladesh.

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- Bangladesh is witnessing rise in sea level.
- 11% of the population will be displaced by the effect on the Bangladesh's coasts.
- The complete inundation of 17.5% of the total land area.
- A decline of 13% in the GDP owing to losses to agriculture and hence a further fall in the per- capita income.
- Affect the major port of Mongla, some 85 cities and towns, more than 800kms of roads and 4,200kms of coastal embankment.

- The extinction of the sunder bans one of the worlds largest mangrove forests, covering 5,770 sq. kms

6.3.23 Climate Change, Ecology and Environment

Climate change, ecology and environment are incalculable. Its impact significantly extends to entire Bangladesh through degrading soil, weakening the agro-ecological zone, reducing the biological potentiality, increasing salinity, extending tidal water limit (zone). For example, one-third species of the mangrove forest are in endangered and therefore, the 'World Heritage (WH)' of Sundarban is now under a great threat, whether it should be protected or not (DOE, 2001). More importantly, Adel states "an analysis of climatic data reveals that the summertime pre-dam maximum temperature has been risen from 37^o to 43^o C. and winter-time minimum temperature has been dropped from 8^o to 4^o C. in the post dam era" (Adel, 2001: 365). Similarly, the relative humidity is recorded as 1.6 times lower than before and the frequencies of above 100 mm rain events have dropped considerably. Many environmental scientists therefore, predicted that 'the lack of water might ultimately change the region into a sub-humid ecosystem with concomitant collapse of the present agro-ecosystem and the creation of an economically irreversible scenario' (Nishat, 1996: 78). Farakka Barrage is directly or indirectly responsible for crating these environmental changes and the consequent environmental insecurity in Bangladesh.

6.4 Co-relation between the effects and environmental insecurity

Environmental security is a new concept. With the expansion of peace research to meet the challenges of 21st century the concept environmental security came into light and in recent time this has become a discussed issue. But the question is that how far the impact of Farakka Barrage is related to the environmental security of Bangladesh. To discuss this basic question we have already mention the theoretical ideas of environmental security and the major impacts of Farakka Barrage. Now we will put forward the argument to prove the correlation between environmental insecurity and effects of Farakka Barrage.

6.4.1 Linking Security of environment and water diversion

There are, at least, according to Nina Greger, four clear reasons for making a critical and operational linkage between security and changes in the environment caused by human activity:

First- environmental degradation is in itself a severe threat to human security all life on earth.

Second- environmental degradation can both cause and consequences of violent conflict

Third- predictability and control are essentials of military security considerations, and these are also important elements in the safeguarding of the environment. Under this circumstance irreparable environmental degradation or ecological system in dramatic change may increase the livelihood of violent conflict (Nina, 1996: 110-111).

On the basis of the above assumption envisaged by Nina, we can certainly say that the impact of Farakka barrage over Bangladesh is multidimensional but the effects over the environment are predominating. The fresh water diversion, siltation, salinity in water, soil degradation, occasional and sudden flood due the water diversion and water flush causes serious environmental effects in Bangladesh. This environmental degradation not only affect the livelihood of the people but also put enormous pressure over the ecosystem and life supporting system of the future generation.

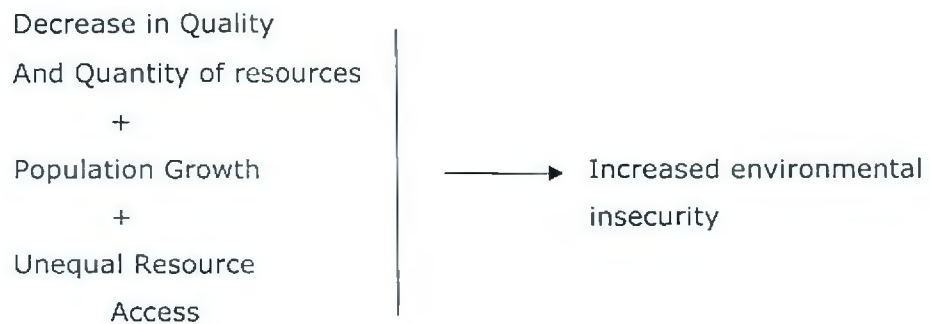
According to Levy, the term environmental as referring to issues involving biological or physical systems characterized by significant ecological feedback or by their importance to the sustenance of human life (Levy, 1995: 39). On the basis of the definition we can say that the biological and physical system of Bangladesh is mostly depended on the fresh water comes from the Ganges basin. And this environmental security concern contains intake as long as the human intervention does not intervene in the natural ecosystem. But the unilateral withdrawal of water from Ganges basin through the construction of Farakka Barrage is increasingly damaging the ecological and biological character of Bangladesh. Stern specifies the types of environmental values most likely to be perceived as a security threats in the following admittedly anthropocentric terms:

- Threat to human health- such as highly contagious bacterial or viral diseases
- Threat to essential resources which support life in human ecosystem (e.g. air, water supply and food production), and

- Threat to the integrity of valued non human ecosystem and local/global biological diversity (Stern, 1995: 240).

On the basis of the above theoretical model given by Stern, we can see the causal relationship between the water diversions by India through Farakka Barrage and environmental insecurity of Bangladesh. Homer Dixon in his book "Environment, Scarcity, and Violence" has mentioned that in recent years, a number of analysts have argued that human-induced environmental pressures might seriously affects national and international security (Dixon,1999: 3). He also says that environmental security encompasses an almost unmanageable array of sub-issues. In this category both the renewable and non renewable resources are included. Once these resources are somehow influenced by human made intervention like the Farakka Barrage the environmental insecurity is bound to be happened. This situation can be illustrated by the following figure:

Figure 19: Decrease resources and environmental insecurity



From the figure mentioned above it is obvious that the water diversion through Farakka Barrage caused severe effects on the environment and consequently creates environmental insecurity in Bangladesh.

6.3.24 Conclusion:

Nearly 35 million people in about one-third of the total area of Bangladesh are directly dependent upon the Ganges for their livelihood. Hence, the impact of water availability can have far-reaching consequences. The diversion of Ganges waters by India and the resulting decrease in flow through Bangladesh has disrupted fishing and navigation, brought unwanted salt deposits into rich farming soil, adversely affected agricultural and industrial production, changed the hydraulic character of the

rivers, and brought about changes in the ecology of the Delta. These impacts are not well calculated and widely published due to the lack of research and political will of government came in power in different time. The environmental security of Bangladesh is very much connected with these far reaching impacts of Farakka Barrage. Now environmental security being the hot issue has been attracted the attention of the people of the whole world. The security concern in Bangladesh, thus, has also been touched many researchers and policy makers and academicians in different sectors.

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CHAPTER-SEVEN

MANAGEMENT PROCESS AND THE RECOMMENDATIONS FOR ENVIRONMENTAL SECURITY

7.1 Introduction

The Ganges river dispute has been one of the longest lasting and most interesting of international water disputes. The river itself feeds down from the Himalayan Nada Devi range and incorporates the nations of India, Bangladesh, Bhutan, Nepal and China as riparian states (Hafiz and Islam, 1996: 5-6). Regarded as one of the world's great rivers the Ganges has an economic, social, and spiritual importance for over half-a-billion basin inhabitants who are dependant upon the river for the provision of hydro-electricity, industry, agriculture, navigation and various other aspects of regional life (Nishat, 1996: 69-79; N. Islam, 1992: 215-223). The river itself flows for over 92% of its course within India, before entering the Brahmaputra and Meghna rivers in Bangladesh before flowing out into the Bay of Bengal (indeed the Ganges-Brahmaputra-Meghna system is responsible for the existence of Bangladesh itself which is a delta formed from systems silt deposits) (Hafiz and Islam, 1996: 8; Nazem, 1991: 103). The debate centers around the competing claims of India and Bangladesh for the limited dry season flow of the Ganges, and the redistribution of the rivers flow at the Farakka Barrage. Farakka lies a few kilometres within Indian territory, and it allocates or diverts the entire flow of the Ganges along either the Hooghly system within India, or Bangladesh's Padma system. India's reasoning for diverting is to help flush out the port of Calcutta which is becoming silted up (Swain, 1993: 429-431).

Overall relations between India and Bangladesh have been harmed by the dispute, especially after the initial good relations following the 1971 independence war (Bhasin, 1996: 347). As early as 1975 Bangladesh was publicly criticising India's Farakka policy (M.R. Islam, 1987: 921), and despite a run of agreements (1975, 1977 and 1996) and Memorandums of Understanding (1982 and 1985) there has still been no permanent resolution to the problems of the Ganges allocations at Farakka during the dry season.

Both nations have issued White Papers offering suggestions for overcoming the problem of augmenting the river, yet both have stubbornly dismissed each others' suggestions as unworkable (M.R. Islam, 1987: 922-923). It has been problems and inter-relations such as these, which have been the substance of the Ganges debate. Discussions and action have incorporated unilateral and bilateral actions; while at various stages there have been calls for multilateral involvement within discussions. The Indo-Bangladesh conflict over the Ganges has incorporated all three methods of overcoming riparian disputes; that of unilateral, bilateral and multilateral processes to overcome or settle riparian disputes. Not only the Ganges water dispute resolutions but some policies are needed to follow strictly to ensure available water flow and also to maintain the environmental security of Bangladesh. Some recommendations have been put forward here analyzing existing legal positions and different initiatives undertaken by the government in different time.

7.2 Theoretical Dimensions

To illustrate the resolution process of the water sharing problem between India and Bangladesh we need to explain the theoretical dimension of conflict resolution concerning the water sharing problem. There are some major theories most prominent to analysis the water sharing between the down stream and up stream states.

7.3 International Environmental Law relating water Sharing

The policy makers undertook many treaties and laws regarding the water sharing and protecting environment in different time. These theories are:

- *Absolute Territorial Sovereignty*: a state may dispose freely of the waters flowing or located in its territory without concern for the damage which such acts may cause to another state.
- *Absolute territorial Integrity*: a state has the right to demand the natural flow of water from another state.
- *Positivistic Theory*: where no binding agreement exists, a state is free to utilize water in accordance with the theory of absolute territorial sovereignty. This is the principle frequently uphold by upper riparian states.
- *Jusnaturalistic Theory*: even where binding agreements do not exist, a state is entitled to receive from an upper riparian state an amount of water

corresponding to historical or acquired rights. This principle is often followed by lower riparian states.

- *Equitable Utilization theory*: each basin state is entitled to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin. This principle of joint co-operation was evolved in detail by International Law Association (Crow and Others, 1995: 23-24)

7.4 International Water Disputes and Processes to Overcome Conflict

Now I shall focus on the methods of dispute resolution that exist within the international system, with regards to international water-sharing conflicts. The aim is that a general picture of water-sharing disputes can be demonstrated, including critiques of the methods of resolution and modes of process pursued during water conflicts. These conflicts are heralded as one of many environmental and security concerns facing the globe (Dupont, 1998: 59; Homer-Dixon, 1994: 6). Environmental concerns and resource scarcity have both been identified as probable sources of widespread conflict in the new century (Homer-Dixon, 1994: 6; Gurr, 1985: 58). It is in this context that the importance of water-sharing disputes becomes evident. Water is both an environmental concern and a human resource necessity, and therefore has an increasingly high priority on global, regional and domestic stages. Water also has a highly-transboundary character, which has resulted in it being seen as a potential source of conflict. However, water disputes are by no means a recent development. Water has been a source of conflict or weapon of conflict since history has been recorded.

As potentially large source of international tension, water conflict has also been the focus of numerous international forums, and is increasingly becoming subject to international laws and agreements. These agreements include the United Nations General Assembly Charter of Nature (1991), the Bern Protocol (1977), the Environmental Modification Convention (1977) (M.R. Islam, 1996: 929-930). The recent International Law Commission of the Law of Non-Navigational Uses of International Watercourses has promoted many of the ideals of international law in regards to water sharing in its 32 articles. The Commission called for

- The equitable utilization of water resources,
- The prevention of significant harm to other states through actions regarding international watercourses,

- An obligation to notify and inform all other riparian states of intended actions regarding the common waterway,
- An obligation to share non-sensitive waterway data,
- The organization of co-operational management of the waterways, and
- An obligation to resolve issues of dispute peacefully (Gleick, 1998: 210-230).

The international law, agreements and forums have all pointed towards the importance of achieving a dispute resolution regarding water-sharing disputes. There are three main types of dispute resolution; unilateral, bilateral and multilateral. Before analyzing the application of these theories in Ganges water dispute case, first, major theories of water sharing should be discussed.

7.4.1 Unilateral:

The attempt of unilateral action in water-sharing disputes is not a productive mode of action. Instead of carrying of positive result this theory can lead to increase interstate tensions and conflict. Unilateral action does not solve a dispute, but simply sees one nation enforce its will over another. According to this theory a powerful state put force an agreement or situation upon its weaker neighbors. This theory is more applicable if the bigger state is an upper riparian position. And if the larger state is lower riparian it has to resort to threats or aggressive action to implement the changes that it demands. So this theory results on aggression and an unfavorable result for other riparian state. Unilateral pursuit of an action can lead to a quick, if unfair, resolution. However, it also can serve to only heighten tensions to the point of open violent conflict or drawn out periods of continual debate.

7.5.2 Bilateral

This is a theory to settle down the conflict between and among the countries through discussion and agreement. Bilateral theory is always more favorable than unilateral decision-making. This by no means guarantees a resolution or even a peaceful dispute process. Bilateral relations in regards to water sharing will always be better served between two friendly nations, and will always be tougher between two nations with a tense political relation and history. These tensions can be eased or exasperated according to whether the situation could be mutually beneficial or pit each states interest up against each other. And this theory produces better solution and carry good faith if the situation is mutually beneficial. There are many obstacles

7.5.1 The Unilateral Process within the Ganges Case study

It has been mentioned that unilateral action results generally when the debate exists between two states that are not of equal size and strength. And the Indo-Bangladesh situation falls clearly within this parameter. India is a prime example of a larger, upper riparian state. India, thus, can impose its will over smaller, lower riparians. India is in a strong position in regard to regional politics, and this has allowed it to pursue an at times unilateral policy to water sharing with Bangladesh (Hafiz and Islam, 1996: 66-67). India being the active participant in Bangladesh's liberation war tried to apply the unilateral approach. And it assumed that Bangladesh, whom it had helped so much in 1971, would not disagree with India's withdrawals from a river that mainly fell within Indian territory. However, Bangladesh made objection and has claimed at various stages (1975-77 and 1988-1996) that India had intentionally pursued a policy of unilaterally withdrawing Ganges water at will, and ignoring Bangladesh's lower riparian rights to an international river (M.R. Islam, 1987: 921). Indeed, India has withdrawn vast amounts of water from Farakka without any bilateral agreement. India also has made massive withdrawals at various points further upstream, before the Ganges even reaches Farakka (Sarkar, 1994: 29).

The most important fear of unilateral action is that this results on huge sufferings and casualties. And in this connection Bangladesh is not exceptional one. After the operation of Farakka Barrage Bangladesh have been experienced untold sufferings and casualties. Salinity and salt-water incursion, caused by the declining strength of the Ganges' freshwater flow, have had devastating agricultural, forestry and environmental destruction. The water-based sectors of fishing and agriculture (rice and jute production) were also heavily affected (Baxter, 1993: 234). Bangladesh's subsequent appeals to various international institutions resulted in official concerns being expressed by the UN, Commonwealth, Non-Aligned Movement, Islamic League and the World Bank (Swain, 1993: 432). There were fears that India was neglecting its 'jus cogens' (Caponera, 1987: 374-375) through pursuing a unilateral policy behind the mask of a procrastinating bilateral policy.

B.M. Abbas in this regard felt that India was merely being a regional bully who was doing what it wanted, and using Farakka as a political leverage over Bangladesh in an attempt to gain various concessions (Abbas, 1987: 528; Hafiz and Islam, 1996:

269). Claims such as these are not uncommon in international disputes, with increased frustration angering many victims of unilateral action.

India has displayed anger at Bangladesh's actions in its approaches to Nepal, the UN and various other 'outsiders'. As a result Bangladesh has been held hostage by India's actions at Farakka, with Bangladesh being dependent upon India's water allocations. These are both results from unilateral actions in a water-sharing dispute. India - the more powerful state - has approached relations with its smaller neighbor with an at times inflexible attitude. India's concerns rest primarily with the wellbeing of its own populace, and it is in a position in which it can gain its aims. Bangladesh on the other hand is between a rock and hard place. It is the smaller of the states, the lower riparian and heavily dependant upon the Ganges flow. These international interventions would not be welcomed by India, as it would dilute India's position of power in the dispute. For these reasons unilateral actions within the dispute have been on the whole harmful to the process of mediation and a quick and permanent resolution, which will satisfy both sides.

7.5.2 The Bilateral Process within the Ganges Case study

Bilateral is more favourable and less aggressive than the unilateral approach. It is important to note that the bilateral involvement has been born out of an insistence by India, who benefits from the power it has in one-to-one relations with smaller states (Hassan, 1991, 51-52), but this does not diminish the fact that bilateral actions have overwhelmingly been the method of choice for resolution of the dispute for both India and Bangladesh. However, even though it has been the most common process does not necessarily mean it is the best. However, bilateral process is a popular mode of disputes resolution in water conflict. Indeed, both nations have largely favoured the bilateral approach since the 1971 Treaty of Peace and Friendship provided the basis for the Indo-Bangladesh Joint Rivers Commission (JRC). The dispute has officially remained an Indo-Bangladeshi affair; however there have been developments to involve Nepal (as a member of a riparian agreement, not a third party mediator), as pushed by Bangladesh and Nepal itself (M.R. Islam, 1987: 922-23). However, Nepal's involvement has remained both informal and bilateral (Nishat, 1996: 84). Nepal has not officially been invited to provide an input or become involved in the dispute, and its only formal involvement has been through its own bilateral discussions with India or Bangladesh respectively (Nishat, 1996:

84). The result is that the topic has remained bilateral and not multilateral due to Nepal's outside and informal-at-best involvement.

Regarding the Indo-Bangladesh bilateral process there can be little doubt there have been productive periods where the governments have collaborated and generally worked towards a decision (such as in 1971, 1976, 1984 and 1996). But it is widely believed that these periods have only been in favourable political circumstances and even then there have been no longstanding agreements. Such is the political situation that an agreement between the neighbours can be praised one year and dismissed outright shortly afterwards, as shown by the constant periods of hostility that follow periods of friendliness.

The agreement to put forward suggestions came out of a productive period of relations in the mid-1970s, and resulted in two starkly different suggestions. India's suggestion was for a Brahmaputra-Ganges link canal, Bangladesh suggested water storage centers in the Nepalese and Indian highlands along the river. Instead of pursuing a common agreement or compromising between the suggestions, India and Bangladesh have both stuck to their original proposals. Periodically there is a move to exchange data or jointly survey suggestions, but these progressive aims are often quickly drowned out by uncompromising attitudes towards the proposals brought out by periods of hostile relations.

Reasons for the problems in bilateral discussions between India and Bangladesh are by no means unique. There are strong domestic concerns, as well as feelings that the other side is merely holding out to gain a deal which favours them more. India has heavy concerns from its domestic governments in West Bengal, Uttar Pradesh and from the populace of Calcutta (N. Islam, 1992: 211). These regions want the water diversions for their own needs and would see any costly concessions to Bangladesh as a betrayal by the central government. Indeed as it has grown as an issue it has developed increased feelings of nationalism, which in turn have made it increasingly difficult for the Indian government to justify to its own people why they should concede anything to Bangladesh.

A similar situation exists in Bangladesh where increasingly political fervour has developed in response to the water-sharing dispute. Political parties increasingly are critical of any government concessions to India, which may harm Bangladesh's interests perhaps ignoring the realities of the situation in an attempt to gain political or nationalistic capital (Kamaluddin and Bailay, 1996: 16). Even when Bangladesh appealed to the UN for support, there was political criticism from opposition parties

who suggested that the action was too late. The opposition claimed that these sentiments should have been stressed earlier towards India and did not go far enough. These criticisms all generally ignore that Bangladesh is in a delicate and weak position in relation to the dispute. And she must tread warily to get what it wants. There are even suggestions that the water-sharing dispute has partially led to the assassination of Mujib Rahman (Swain, 1993: 431).

In bilateral resolutions there needs to be a common profit to which both nations work together. The essential problem with the Ganges bilateral situation is that it has largely been a zero-sum situation (Abbas, 1987: 537-538). Both India and Bangladesh have remained largely inflexible, and it is only in times of favourable political circumstance that they even reach temporary and limited agreements. While both nations hold out, the prospects of a permanent and successful bilateral resolution are at best remote. Indeed, there are suggestions that bilateral action is futile and unrealistic in the Ganges case study, as it does not feature the prerequisites of long-term friendly relations and a mutually beneficial situation. Due to this position of bilateral agreement Bangladesh is in favour of multilateral discussion. But India ignoring that claim is always in favor of bilateral agreement. Because, India has been treated the problem as a bilateral dispute. And Bangladesh has not been able to oppose India strongly enough, due to its regional size and power. India understandably assumes that it is in a better position to get what it wants if it works bilaterally. It is the bigger nation, it is the upper-riparian, and therefore it can push to get the domestic aims that it sees as vitally important. Bangladesh is also trapped into this way of thinking. It has little option but to attempt to pursue bilateral gains, as it has neither the strength nor riparian advantage to unilaterally gain what it wants. Though Bangladesh is in favor of multilateral intervention it does not want to anger India, as this would be highly unproductive. It also feels compelled to push for international assistance as it assumes, most probably correctly, that it needs help to gain concessions from India. Bangladesh is under immense pressure. Domestically it is suffering from the dispute, and this is being converted into political disharmony and increased fundamentalism. Yet, Bangladesh is a comparatively small, weak and poor country. It needs outside help, and has at times in the dispute attempted to move from its bilateral discussion stance to get this help. It is these characteristics that often can force to pursue what they perceive as their only option - multilateral involvement.

7.5.3 The Multilateral Process within the Ganges Case study

Multilateral involvement at a regional or global level provides all the benefits of greater involvement, fairer resolutions and greater capacity to enforce decisions. It is these ideals coupled with potential personal gain that India wishes to bring into the dispute to help overcome India's bilateral supremacy and unilateral abilities. However, throughout the Ganges dispute there has never been a high level of international involvement. But Bangladesh has been emphasized on multilateral process to settle down the existing problem. Initially there was little chance of international involvement as India vetoed Pakistan's 1960s attempts to go to the UN, International Court of Justice or the International Bank for Reconstruction and Development (M.R. Islam, 1987: 927). India, like any nation, has had and continues to have difficulty with multilateral processes because of the perceived loss of sovereignty over decision-making.

But it is fair to say that India did not want to involve these multilateral institutions (perhaps fearing more concessions such as those over the Indus dispute [Bhasin, 1996: 1632-1642]), and the international society was not going to force it. Nor did India favour regional level discussions. Bilaterally hegemonic India could dominate - yet in a discussion forum it could be out voted. India either had to accept international intervention or international intervention had to be willing to force itself into the issue. But the international politics and the internal condition of Bangladesh led India to accept the multilateral process. The devastating flood and the rising environmental degradation have had the attention of the world leaders to be sympathized to Bangladesh. Reasons for this have ranged from increased international focus drawn by the devastating floods in Bangladesh, to the increased pressure being put on India by varied lobbyists including governments, environmental activists, and humanitarian groups (Abbas, 1987: 522).

It is these groups that are often brought into an international dispute to encourage fair resolutions to disputes. In water conflict disputes the other parties brought in are often other regional or riparian states. An example of this has been the involvement of the riparian, Nepal. Initially Bangladesh wanted Nepal's involvement but Indian pressure kept Nepal out. However, Nepal has increasingly gained an informal involvement through various discussions with both states, and its involvement as a possible augmenting actor. Nepal has even gone so far as to suggest Bangladeshi involvement in Indo-Nepalese discussions over the Ganges. Nepal has a vested interest in the Ganges and, while unlikely to mediate, wants to be

involved in a basin wide agreement (Swain, 1996: 704). It is this increased focus, which could be seen as an important step in getting all the Ganges riparian states involved in the resolution to the dispute.

7.6 Initiatives undertaken by India-Bangladesh to manage the problem

The above theoretical dimensions were somehow followed by both countries to resolve water-sharing problem. But for our proper understanding we need to explain the actual initiatives undertaken by both countries.

7.6.1 Pakistan Period

The first round of expert-level meetings between India and Pakistan was held in New Delhi from 28 June-3 July 1960, with three more to follow by 1962. While the meetings were still in progress, India informed Pakistan on 30 January 1961 that construction had begun on the Farakka Barrage. After this declaration a series of attempts by Pakistan to arrange a meeting was undertaken. In 1963, the two sides agreed to have one more expert-level meeting to determine what data was relevant and necessary for the convening of a minister-level meeting. The meeting at which data needs were to be determined, the fifth round at the level of expert, was not held until 13 May 1968. After that meeting, the Pakistanis concluded that agreement on data, and on the conclusions which could be drawn, was not possible, but that enough data was nevertheless available for substantive talks at the level of minister. India agreed only to a series of meetings at the level of secretary, in advance of a minister-level meeting. These meetings, at the level of secretary, commenced on 9 December 1968 and a total of five were held in alternating capitals through July 1970. After these meetings Pakistan proposed that an agreement should provide for:

- Guarantee to Pakistan of fixed minimum deliveries of the Ganges waters on a monthly basis at an agreed point;
- Construction and maintenance of such works, if any, in India as may be necessary in connection with the construction of the Ganges Barrage in Pakistan;
- Setting up of a permanent Ganges Commission to implement the agreement;
- Machinery and procedure for settlement of differences and disputes consistent with international usages.

India again argued that such an agreement could only take place after the two sides had agreed to "basic technical facts." The fifth and final secretaries-level meeting was held in New Delhi from 16-21 July 1970, resulting in three recommendations:

- The point of delivery of supplies to Pakistan of such quantum of water as may be agreed upon will be at Farakka;
- Constitution of a body consisting of one representative from each of the two countries for ensuring delivery of agreed supplies at Farakka is acceptable in principle;
- A meeting would be held in three to six months time at a level to be agreed to by the two Governments to consider the quantum of water to be supplied to Pakistan at Farakka and other unresolved issues relating thereto and to eastern rivers which have been subject matter of discussions in these series of talks.

Little of practicality came out of these talks, and India completed construction of the Farakka Barrage in 1970. Water was not diverted at the time, though, because the feeder canal to the Bhagirathi-Hooghly system was not yet completed.

7.6.2 Bangladesh Period

Bangladesh came into being in 1971, and by March 1972, the governments of India and Bangladesh had agreed to establish the Indo-Bangladesh Joint Rivers Commission, "to develop the waters of the rivers common to the two countries on a cooperative basis." A meeting was held on 16-17 July 1973, where the two sides agreed that a mutually acceptable solution to issues around the Ganges would be reached before operating the Farakka Barrage, and a meeting between foreign ministers on 13-15 February 1974, at which this agreement was confirmed. The prime ministers of India and Bangladesh met in New Delhi on 12-16 May 1974 and, in a declaration on 16 May 1974, they:

- Observed that during the periods of minimum flow in the Ganges, there may not be enough water for both an Indian diversion and Bangladeshi needs;
- Agreed that during low flow months, the Ganges would have to be augmented to meet the requirements of the two countries;
- Agreed that determining the optimum method of augmenting Ganges flow should be turned over to the Joint Rivers Commission;

- Expressed their determination that a mutually acceptable allocation of the water available during the periods of minimum flow in the Ganges would be determined before the Farakka project is commissioned.

After that a series of meeting and agreements and treaties have been signed between India and Bangladesh to settle down the problem but little has been attained due the some complicities and unfriendly nature of India. Before mentioning some recommendation to settle down the problem and ensure the environmental security endangering due to the diverting water through the Farakka Barrage we need to mention the treaties signed between India and Bangladesh.

7.6.3 1975 Agreement

At a minister-level meeting in Dhaka between 16-18 April 1975, India asked that, while discussions continue, the feeder canal at Farakka be run during that current period of low flow. The two sides agreed to a limited trial operation of the barrage, with discharges varying between 11,000 and 16,000 cusecs in ten-day periods from 21 April to 31 May 1975, with the remainder of the flow guaranteed to reach Bangladesh. Without renewing or negotiating a new agreement with Bangladesh, India continued to divert the Ganges waters at Farakka after the trial run, throughout the 1975-76 dry seasons, at the full capacity of the diversion -- 40,000 cusecs. Their were serious consequences in Bangladesh resulting from these diversions, including desiccation of tributaries, salination along the coast, and setbacks to agriculture, fisheries, navigation, and industry. Four more meetings were held between the two states between June 1975 and June 1976, with little result. In January 1976, Bangladesh lodged a formal protest against India with the General Assembly of the United Nations, which on 26 November 1976 adopted a consensus statement encouraging the parties to meet urgently at the ministerial level for negotiations, "with a view to arriving at a fair and expeditious settlement."

7.6.4 1977 Agreement

At 18 April 1977 an understanding was reached on fundamental issues, which culminated in the signing of the Ganges Waters Agreement on 5 November 1977. In this agreement the following outcomes were attained:

- Sharing the waters of the Ganges at Farakka, and,

- Finding a long-term solution for augmentation of the dry season flows of the Ganges.

The following were the most important article of the agreement between India and Bangladesh:

- **Art. I.** The quantum of waters agreed to be released would be at Farakka.
- **Art. II.** The dry season availability of the historical flows was established from the recorded flows of the Ganges from 1948 to 1973 on the basis of 75% availabilities. The shares of India and Bangladesh of the Ganges flows at 10-day periods are fixed, the shares in the last 10-day period of April (the leanest) being 20,500 and 34,500 cusec respectively out of 55,000-cusec availability at that period. In order to ensure Bangladesh's share in the event of any lower availability at Farakka, Bangladesh's share should not fall below 80% of the stated share in a particular period shown in a schedule annexed to the agreement.
- **Art. III.** Only minimum water would be withdrawn between Farakka and the Bangladesh border.
- **Art. IV-VI.** Provision was made for a Joint Committee to supervise the sharing of water, provide data to the two governments, and submit an annual report.
- **Art. VII.** Provisions were made for the process of conflict resolution: The Joint Committee would be responsible for examining any difficulty arising out of the implementation of the arrangements of the Agreement. Any dispute not resolved by the Committee would be referred to a panel of an equal number of Indian and Bangladeshi experts nominated by the two governments. If the dispute is still not resolved, it would be referred to the two Governments, which would, "meet urgently at the appropriate level to resolve it by mutual discussion and failing that by such other arrangements as they may mutually agree upon."
- **Art. VIII.** The two sides would find out a long-term solution of the problem of augmentation of the dry season flows of the Ganges. The Agreement would initially cover a period of five years. It could be extended further by mutual agreement. The Joint Rivers Commission was again vested with the task of developing a feasibility study for a long-term solution to the problems of the basin, with both sides re-introducing plans along the lines described above.

The end of the five-year life of the agreement had worked out no solution. In the years since, both sides and, more recently, Nepal, have had years of greater and less success at reaching towards agreement.

Since the 1977 accord many attempts between India and Bangladesh were undertaken in pursuit of achieving a sustainable solution of this problem. The followings are some most important initiatives:

- A joint communiqué was issued in October 1982, in which both sides agreed not to extend the 1977 agreement, but would rather initiate fresh attempts to achieve a solution within 18 months -- a task not accomplished.
- An Indo-Bangladesh Memorandum of Understanding (MOU) was signed on 22 November 1985, on the sharing of the Ganges dry season flow through 1988, and establishing a Joint Committee of Experts to help resolve development issues. India's proposals focused on linking the Brahmaputra with the Ganges, while Bangladesh's centered on a series of dams along the Ganges headwaters in Nepal.
- Although both the Joint Committee of Experts and the Joint Rivers Commission met regularly throughout 1986, and although Nepal was approached for possible cooperation, the work ended inconclusively.
- The prime ministers of Bangladesh and India discussed the issue of river water-sharing on the Ganges and other rivers in May, 1992, in New Delhi. Each directed their ministers to renew their efforts to achieve a long-term agreement on the Ganges, with particular attention to low flows during the dry season. Subsequent to that meeting, there has been one minister-level and one secretary-level meeting, at which little progress was reportedly made.

No new accord has been reached since the last agreement lapsed in 1988. Since that time, India has granted Bangladesh only a portion of the flow of the Ganges, with no minimum flow guaranteed, and no special provisions for drought years. Each side has kept roughly to its positions as stated above, with little room for compromise. Regional schemes have been proposed, often providing benefits not only to India and Bangladesh, but also to Nepal, landlocked but with tremendous hydro-power

potential which might be traded for access to the sea. These incentives have thus far failed to move the parties to overcome their differences.

7.6.5 The 1996 Agreement

The 1996 Indo-Bangladeshi agreement has been heralded, as an important step in Indo-Bangladeshi relations. In a period of good relations the Prime Ministers of the two nations signed a 30 year agreement organizing the division of water supplies, creating a binding agreement and effectively ending the opportunity for India to withdraw unilaterally (Salman, 2000: 9; Kanaluiddin and Bailey, 1996: 16).

7.6.6 Main features of this treaty

- The flow at Farakka was calculated on the basis of average flow (50% dependable flow) for the period of 1948 to 1988.
- Proportion of sharing between Bangladesh and India is 45:55 and in some cases the proportion will be 30:70
- During the period from 1 March to 31 May the sharing will be on the basis of so called hydraulic cycle when one side will have 35000 cusec guaranteed flow and the other side will receive rest of the flow. In such a cycle when the flow is 50,000 cusec when India will receive 35,000 cusec and Bangladesh will receive only 15000 cusec.
- When the flow falls below 50,000 cusec no sharing principle will exist, Bangladesh and India will sit immediately to decide equitable sharing
- The same principles will be applied to the sharing of flow of other common rivers

7.7 Lessons learned from the initiatives

We have already discussed about the different treaties signed between India and Bangladesh. But if we scrutinized all efforts undertaken by India and Bangladesh we can see some good lesson. These are:

- **Unequal power relationships, without strong third-party involvement, create strong dis-incentives for cooperation:** India, the stronger party both geo-strategically and hydro-strategically, has little incentive to reach agreement with Bangladesh. Without strong third-party involvement, such as

that of the World Bank between India and Pakistan on the Indus, the dispute has gone on for years.

- **Requests for increasingly detailed data clarifications can be an effective delaying tactic. Agreeing on the minimum data necessary for a solution, or delegating the task of data gathering to a third party may speed the pace of negotiations:** India used the veracity and detail of data as an effective tactic in postponing a long-term solution with Bangladesh. Interestingly, India was able to surmount this problem on the Indus by stipulating that data could be used in an agreement, without agreeing to its accuracy.
- **Likewise, insisting on bilateral negotiations, as opposed to watershed-wide negotiations, favors the party with greater power:** India has insisted on separate negotiations with each of the riparian of its international rivers. It was thus able to come to arrangements with Nepal on Ganges tributaries without considering Bangladeshi needs. Agreeing early on the appropriate diplomatic level for negotiations is an important step in the pre-negotiation phase. Much of the negotiations between India and Pakistan and, later, India and Bangladesh, were spent trying to resolve the question of what was the appropriate diplomatic level for negotiations.

7.8 Recommendations for management the problem

There is no set method, which is best for all water-sharing agreements. Unilateral actions can be seen as understandable or devastating. Bilateral actions can be seen as highly effective or virtually a waste of time. Meanwhile multilateral actions are seen as an attractive option, but are not necessarily attractive to the parties involved. Even if the multilateral approach is taken, should it be in the form of a third-party mediator, regional body or global institution. Since 1971 the Indian and Bangladeshi governments have at stages entertained the idea and use of all of these solutions, ranging from unilateral withdrawals; to the involvement of Nepal; to appeals to the UN. However, the dispute remains up in the air. As its result the security most particularly the environmental security is at stake. If this situation continues Bangladesh will fall in deep trouble and the future would be bleak and devastating. So the management of this problem is mandatory instead of intensifying or remaining it in deadlock or any other shape except coming into compromise with India. Peace researchers from the very beginning of the

development of this literature formulated many of the theories and techniques to resolve, terminate or manage the problem. With the development of Peace Research different peace researchers and other policy makers have approached world wide different alternative theories for conflict resolution. Analyzing this literature we will tend to proceed to find out the reconciliatory process to manage the problem and ensure the environmental security as well.

7.8.1 Create win-win situation

In conflict literature theory win-win approach is very common. The realist in international relations applied this theory. This theory signifies the complete win of a particular country and the complete loss of another county. In the present situation this is not possible. The water sharing problem between India and Bangladesh never encourages this approach rather lead to accept the win-win approach. Both India and Bangladesh co-operate very extensively in the regional forum such as SAARC and it shall be our endeavor to take this co-operation forward so that a new and a more constructive framework of relationships can be built up in our sub-continent to the mutual benefit of the people of all countries.

7.8.2 Discuss in regional forum

These developments have also heralded greater regional scrutiny and involvement. A further multilateral process would be a regional commission or forum, which could be used to air dispute grievances and suggestions. The formation of SAARC has potentially created such a regional forum and, while currently bilateral discussions cannot be discussed as of yet, there have been informal regional discussions and increasing promotion of SAARC as a regional mediator (Swain, 1996: 436; Bhasin, 1996: 704). The use of SAARC would ensure India did not lose face, and could help establish a more general regional solution to what is basically a regional river undergoing bilateral processes. A regional agreement is an attractive option to many parties and could be in a similar mould of general consensus as the Rhine, Danube or Mekong agreements (Abbas, 1987: 538; Caponera, 1987: 377).

7.8.3 Global Involvement

Even more attractive an option from an outsider's point of view would be a global involvement in the decision-making and dispute resolution. Bangladesh has stimulated the early phases of this through her appeals to international society for

support. The recent flooding, which devastated Bangladesh and killed tens of thousands, has sharpened this international focus on the region. The global attention has increased foreign governmental and non-governmental assistance to help overcome under-development and water problems in poverty-stricken Bangladesh. There has been increased lobbying of both India and Bangladesh as various international actors (ranging from states to institutions) to try to promote successful dialogue. As a result there is increased international pressure pushing for a permanent resolution of the problem. Indeed, even the Rio Conference issued calls for discussions into how to overcome the increasing environmental problems threatening the Ganges (Hafiz and Islam, 1996). However, there has still been no long-term or official global process in regards to solving the Ganges situation. The UN has relented to India's claims that it is a bilateral issue, and many of the forums to which Bangladesh has appealed have only released statements claiming that they hope India and Bangladesh work hard towards a resolution (M.R. Islam, 1987: 927-29). Despite the reluctant nature of the international community at least has been seen this issues seriously and from the environmental concern. They have seen as positive that at least they are being informed, and are showing interest through the appearance of the Ganges dispute on the agendas of these forums and institutions. Such involvement is increasing and can help lead to process of settlement by fostering further discussions and involvement. All of this is leading to an increased importance being placed on international water law, such as the Helsinki Rules or the recent Non-Navigation Water-Uses Treaty. The Ganges is an international river and there are increasing calls to make is more susceptible to international laws. However, who is going to enforce these international laws? International law has been set up to guide debate, but the Ganges example has raised the important issue of what happens when one side simply dismisses or ignores the laws (such as India's denouncing of the 1921 Barcelona Convention (Abbas, 1987: 519). The dispute has remained, so far, generally free of permanent and highly influential multilateral involvement - with no third party mediator, regional consensus or global decree being issued. Is this a possible reason for there being no permanent agreement, as a permanent agreement would require both states to agree and a third party to enforce the provisions of such an agreement?

7.8.4 Follow the international environmental law

Both countries have to follow the international law regarding water sharing as well as the international environmental law. India being a strong country and having in favorable position always try to influence the policy regarding the water sharing. But this unfriendly nature not only downfallen the bilateral relation but also violate the environmental law. According the environmental law, Convention on the Protection and Use of Transboundary Watercourses and International Lakes - strengthens national measures for the protection and ecologically sound management of transboundary surface waters and ground no country has any right to create bar against environmental context. But what India is doing is definitely violating the international environmental law.

7.9 Proposals by Bangladesh Paribash Andolon (BAPA)

Bangladesh Poribesh Andolon (BAPA) has suggested the following proposals to resolve the water conflict between India and Bangladesh.

7.9.1 Commercial Approach should not be considered

Commercial approach is never conducive for ecological balance and environmental protection. So, commercial approach should be avoided. The following arguments are important.

- Noting that rivers are one of the most important elements of nature;
- Observing that rivers are pro-genitors of eco-systems, and each river gives rise to a unique eco-system in its basin;
- Recognizing that diversity of the eco-systems is an integral characteristic and possibly the most attractive aspect of nature;
- Realizing that industrialization has greatly enhanced human technological and engineering capability to intervene in nature;
- Observing that enhanced technological capability of industrial societies has led to the *Commercial Approach* to rivers according to which rivers need to be 'conquered' and 'consumed' at any economic, social, human, and environmental costs;
- Noting that the Commercial Approach has led to the tragic notion that 'any river water passing to the sea is a waste';
- Observing that the Commercial Approach led to structural interventions into major rivers in the form of dams, barrages, and canals for abstraction of large volumes of water, and that the benefits of such interventions have been

associated with huge and unjustifiable costs, as brought out by the *World Commission on Dams (WCD)*.

- Noting that the large-scale interventions inspired by the Commercial Approach lead to centralized decision making, depriving the river valley populations of their rights to determine the best use of the river resources;
- Noting that the Indian River Linking Project (IRLP) is a culmination of the Commercial Approach, and that it beats all other river intervention projects in terms of its scope and size as it envisages simultaneous interventions in several major rivers of the world;
- Observing that the Himalayan component of IRLP directly involves such transboundary rivers as the *Brahmaputra* and the *Ganges*;
- Realizing that the Commercial Approach leads to a situation of 'Beggar-Thy-Neighbor' rivalry among co-riparian countries (states), often characterized by a vicious race to abstract water as much possible, a race that proves to be a 'race to kill' the rivers, causing serious injustice to the river valley populations and having adverse impact on the downstream areas;
- Noting that the Commercial Approach to rivers leads to 'Tragedy of Commons' situation for sea, because the 'race-to-kill' the rivers leads to serious diminution of water flowing into the sea, causing severe damage to the marine eco-system, giving rise to sea-ingress leading to increased salinity of both land and water;

7.9.2 Ecological approach should be introduced

Environmental problem is not the problem for a particular country but the problem for the whole world. So the environmental destruction for Bangladesh will not only affect Bangladesh but also affect the whole south Asian countries. So every country should follow the ecological approach. The following points are important here:

- Observing that in view of the mostly negative experience, a realization has dawned that large scale nature-defying interventions in rivers ultimately do more harm than good, and based on this realization a new *Ecological Approach* to rivers has emerged in the developed countries;
- Noting that the Ecological Approach does not negate use of rivers as resources and instead urges harvesting river resources in a sustainable way within river basins without contravening the natural course and flow of rivers;

- Observing that adoption of the Ecological Approach can actually be a better way in reaping the benefits of river;
- Observing that the *Farraka* barrage, while causing irreparable damage to the economy and ecology of Bangladesh, has proved to be hardly of any benefit to India in terms of increased navigability of the *Kolkata* port; that *Farakka* instead has now become an engineering and financial liability; that *Farakka* is disrupting the pre-existing ecological balance in the *Bhagirathi-Hoogly* basin and is often creating water-logging; that, by creating upstream water pressure, *Farakka* has now become the source of flooding in Bihar, so much so that there is now a strong people's movement there to demolish *Farakka* barrage; that *Farakka* has become a sore point in Indo-Bangladesh relationship, serving as a stumbling block on the way to fruitful cooperation between these two countries in many other areas;
- Noting that the South Asian people have a long and deep tradition of revering rivers as mothers; that the river *Ganges* is worshipped by many in India; that Bangladesh itself is called a '*nodimatrik desh*,' i.e., a country which was born of rivers; that the name of the river *Brahmaputra* means '*Son of Brahma*,' the Hindu God of creation; that the economy and culture of much of South Asia have evolved around rivers and center around land, water, and forests of the river basins;
- Observing that while the Commercial Approach and the efforts inspired by this approach to block and divert water have led to sub-regional conflicts within a country (such as conflicts among states within India), and that similar efforts have made transboundary rivers a source of contention among neighboring countries, the Ecological Approach can make these rivers bonds of neighborhood friendship and mutual benefit;

7.10 Recommendations

Bangladesh Poribesh Andolon (BAPA) recommends the following main points:

7.10.1 At the International Level

- That all countries of the world abandon the Commercial Approach to rivers and adopt the Ecological Approach.

- That multilateral lending agencies, mostly based in developed countries, refrain from promoting and funding water projects inspired by the Commercial Approach to rivers;
- That international efforts are strengthened to protect the rights of co-riparian countries, in particular the rights of the lower-riparian countries;
- That international efforts are made to minimize abstraction of river water and to retain as much as possible of the natural flow of river water to the sea;
- That more close connections be built up among various national and regional movements working for the Ecological Approach to rivers;

7.10.2 At the Regional Level

- That countries of South Asia abandon the Commercial Approach to rivers and embrace the Ecological Approach;
- That the South Asian countries undertake a thorough review of the benefits and costs (including human and environmental costs) of their already implemented Commercial Approach inspired river intervening projects in order to determine which of these need to be decommissioned; that in conducting such reviews repercussions beyond individual nation states are given due consideration;
- That the government of India undertakes a review of the *Farakka* barrage, including the issue of its decommissioning;
- That India refrains from proceeding with other water diversionary projects on transboundary rivers along the border of Bangladesh;
- That India addresses legitimate concerns of Nepal regarding transboundary rivers shared by the two countries;
- That Bangladesh puts on hold the idea of a *Padma* Barrage, and instead tries to persuade India to restore the natural pre-*Farakka* flow of the *Padma* river;
- That in the meantime the countries of South Asia try to reap the benefits of the rivers following the Ecological Approach, harnessing thereby the water, land, and forests of the river catchment basins beginning with the smallest unit in the watershed and limiting it to the river basin in such a way as to ensure minimum displacement of people and environmental damage;
- That even in implementing Ecological Approach consistent water projects, governments of all South Asian countries followed the principle of prior informed consultation of the local communities requiring the project

- authorities to demonstrate public acceptance; that in each case various options to utilizing river water be assessed, and only such option be adopted that has no or minimum socio-ecological harm and that is most effective in fulfilling the developmental goals of equity, justice, energy-security, and ensuring food, water, and shelter; that the project-affected populations in a river valley is rehabilitated, with alternative livelihood and habitat, before undertaking any project entailing displacement of people;
- Those in particular South Asian countries emphasize water conservation through appropriate choice of crops to grow, method of irrigation (with particular emphasis on sustainability and potentiality of rain-fed agriculture), settlement pattern, life-style, industrial technology, etc.
 - That people-to-people contact among South Asian countries be enhanced;
 - That in order to facilitate and sustain people-to-people contact and to foster the Ecological Approach to rivers in South Asia, an alliance of peoples' organizations agreeing on this approach be launched, and that organizations belonging to this alliance will promote a sustainable, equitable, and decentralized approach to water management, asking for more equitable and restrained distribution and utilization of water resources, reducing the losses and settling the priorities correctly;

7.10.3 At the National Level

- That Bangladeshis be made aware about the importance of rivers for her economy and ecology and the threat that these rivers face;
- That while demanding fair treatment from the upper riparian countries, Bangladesh realizes that she has much to do right with respect to her rivers within her own borders;
- That, in particular, Bangladesh stops immediately further pollution of her river by industrial effluent, chemical runoff from agriculture, urban waste, etc.
- That, in particular, Bangladesh stops immediately further encroachment, legal or illegal, of rivers and other water bodies;
- That Bangladesh makes the best use of the monsoon precipitation occurring within her own borders so as to minimize her dependence on the inflows carried by the transboundary rivers;

(Source: Bangladesh Poribesh Andolon (BAPA), In the light of the International Conference on Regional Cooperation on Transboundary Rivers (ICRCTR), December 2004)

A wind of change appears to be blowing in the area of regional cooperation on water and power sharing initiatives. The two-day ministerial-level Joint River Commission's meeting, held last week in Dhaka on September 20-21, and the SAARC ministerial-level meeting scheduled the week after the next in Islamabad on October 1, augur well for the long-term prospects of such cooperation. After the ministerial-level water talks between Bangladesh and India, the Indian water resources minister, Priya Ranjan Dasmunshi, said they had gone a step forward on the issue. He said the secretary-level Joint Experts Committee would work out the modalities for sharing Teesta's water and would hand its recommendations over to the JRC. The 35th JRC meeting, held in New Delhi in 2003, had also referred the issue to the JCE.

'We take time due to our obligations. But I do not want to see the river drying up on one side when the river on the other side is full of water.

Both the water resources ministers, Dasmunshi of India and Hafiz Uddin Ahmed of Bangladesh, expressed lofty hopes about a positive impact of the two-day talks. The basis of optimism on Bangladesh's side rests largely on the dramatic assurance by Dasmunshi:

'We (India) are not incorporating the Ganges and the Brahmaputra in the river-linking project as it will harm some Indian states, including Bihar and West Bengal, and then the neighbour, Bangladesh. We will not implement the Ganges and Brahmaputra components of the project. The Brahmaputra part of the river-linking project will not be implemented in the next 2,000 years.'

The Indian Minister also said the two sides had agreed in principle to review the Ganges water-sharing treaty, signed in 1996.

We, the two ministers, have decided to jointly visit the bordering rivers, which frequently threaten the territorial boundary between the two countries by erosion, and to make spot decisions.'

(Source: Holiday, Friday, September 23, 2005)

7.11 Integrated river basin development

Integrated river basin development may be the one of the most important solution nfor Bangladesh to protect the water and to save the environmental. Many successful internatioanl efforts to regulate and develop international rivers have been undertaken in different parts of the world. This policy can also be benifited for

Bangladesh. We have to remember that land and water are the two basic integrals in the development equation. India, Bangladesh and Nepal together have to take integrated water resource policy to resolve the existing problem in this region.

7.12 Role of Financial Institutions

World Bank, I.M.F and other international financial institutions have got the involvement and are the direct beneficiaries of this catastrophing situation. The adverse affect of the globalisation on ecology and environment, the Bengaladesh is the worst victime. Bengaladesh's major economy is based on the agriculture. Wihout water for irrigation and over flooded situation made Bengal one of the poorest countries of the World. Whole social, economic and political systems are directly co-related with this Farakka Barrage. So we have to raise our voice and influence the major institutions so that they can interfere and take necessary actions to resolve the problem na also can can necessary action to ensure environmnetal security. The institutions should not provine financial help to any country which would be designed to create adverse effect on environmnet of any adjacent country.

7.13 Government Concern

Government should internally some policies to tackle the problem because the government should realize that self -defense is the best defense. In this context the following initiatives are important:

1. Efforts to increase the productivity of water use—output per unit of water—are key to defusing tensions as water stress worsens. Measures such as drip irrigation (a highly efficient technique that delivers water directly to the roots of crops), shifts in cropping patterns, recycling and reusing wastewater, and water-thrifty household appliances enable cities and farming regions to do more with less water. Since agriculture accounts for two thirds of water use worldwide, and 80 to 90 percent in many developing countries, increasing the productivity of irrigation water is particularly critical. Several water-short urban areas, including greater Los Angeles and Beijing, are investing in conservation improvements on nearby farms in exchange for the water those investments save. The farmers stay in production, the city obtains additional water supplies at a reasonable cost, and cooperation replaces competition. Moreover, where

water conservation and productivity improvements eliminate the need for a new dam or river diversion, or allow a big project to be scaled down in size, they also address a major source of tension and conflict. As the costs of desalination decrease, the desalting of contaminated aquifers and of seawater may generate new drinking water supplies and thereby ease tensions in water-scarce regions as well.

2. Stronger policies are needed in most countries to regulate groundwater use, to price irrigation and urban water in ways that encourage thriftiness instead of waste, and to protect rivers and lakes from degradation. Greater assistance to governments from international agencies in carrying out these policy and management reforms could help lessen the likelihood of future water conflicts. Letting globalization loose in the form of poorly regulated privatization of water services or unconstrained private funding of dam construction will likely cause more problems than it solves. In this regard, the 2000 report of the independent World Commission on Dams, which establishes recommendations for more socially responsible planning and assessment of dams, is an important step forward. Among other things, the report calls for an open decision-making process that includes all those affected by a proposed dam; a thorough examination of the full range of alternatives to determine if a dam is really the best choice; negotiations with and adequate compensation for those adversely affected by dam construction; and, where international rivers are concerned, regional cooperation and collaboration. While some governments have publicly endorsed the commission's recommendations, others—India, for instance—have disavowed them.
3. Strong institutions make a difference. Treaties that provide for effective monitoring and enforcement are often remarkably resilient, holding even when the signatories are engaged in hostilities over non-water issues. The Indus Waters Treaty survived two wars between the signatories and allowed each to pursue its agricultural and economic plans without risking the ire of the other. Long-term programs of joint fact-finding, technical cooperation, and other initiatives that establish a climate of cooperation among countries can pave the way for resolving disputes when they do arise. The U.S. State Department, other donor countries, and a number of U.N. agencies have established a Global Alliance for Water Security aimed at coordinating

assistance in priority regions, which may help countries get ahead of the crisis curve.

4. Most of humanity's long history with water management has focused on developing ways to capture and deliver water in ever-greater quantities to people, industries, and farms. We have more or less mastered the technologies that enable us to bend nature to our will. This success, however, has not created a water-secure world. Together, more effective technologies, policies, and international institutions can help prevent and resolve water disputes. But the stresses on rivers and water supplies are now so great and so widespread that we cannot wait for these measures to gradually evolve. We must implement them before long periods of verbal threats, hostilities, environmental degradation, and human suffering engulf more regions of the globe.

7.14 International cooperation.

Water policy reform must transcend national boundaries. In many regions, long-term solutions will require international cooperation between countries sharing scarce water resources. Intergovernmental activities to settle conflicts over shared bodies of water have had mixed success. A 1977 agreement between India and Bangladesh allocated 63 percent of the dry season flow of the Ganges at the India/Bangladesh border to Bangladesh. However, the agreement has not been in effect since 1996, and water disputes remain a serious source of conflict. More significant headway has been made on talks between Jordan and Israel over the Jordan and Yarmuk Rivers and on shared groundwater resources. However, the lack of participation of Lebanon and Syria in these talks has made it difficult to reach comprehensive settlement on the use of water from the Jordan and Yarmuk Rivers. Cooperation between countries sharing the same water basin will become increasingly important as water becomes scarcer. Reconciliation is cheaper than armed conflict. A key to defusing potential international conflicts over water is national water policy reform to ensure the most efficient use of available water supplies. Countries must therefore begin the painful process of reforming national water policies and treating water as a scarce resource.

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7.14 Conclusion

From the above discussion we can say that Bangladesh is in security predicament in terms of natural resources and ecological balance. The natural outlook which ensures the agricultural system and other life supporting system is in serious danger due to both manmade and natural causes. But the most important cause or actor is the construction and the operation of Farakka Barrage. India actualized this masterminded plane and now diverting water in the name of meeting her need. But Bangladesh as the lower riparian country is depriving its proper share to sustain her ecological balance. The rural Bangladesh is faced with severe crisis of land and water, caused by rapid population growth, environmental change and political compulsions in resource distribution and economic development. The situation is further worsened by frequently recurring natural disasters. The social impact of worsening environmental crises is manifested in increasing landlessness, unemployment, declining wages and income, an environment unfit for human habitation and in growing income disparities. Population growth is also added an new dimension in this context. Homer Dixon has rightly mentioned that ecological marginalization occurs when unequal resource access combines with population growth to cause long term migrants of people dependent on renewable resources for their livelihood. Then they move to the ecologically fragile regions such as steep upland slopes, areas risk of desertification, tropical rain forest, and low-quality public land within urban areas (Dixon, 1999: 177). Bangladesh is not exceptional one under this equation. The poor, with low and declining standards of living, unable to satisfy their needs and aspirations in the country, often try to move to India where their prospects appear to be reasonably better. They often fail to achieve their goals by regular and legal means. As a result, they cross the border clandestinely often risking their lives. In the face of unprecedented environmental crises and the consequent socio-economic pressures faced by the people and the inadequate measures taken by the state to address the same, it can be concluded that the flow of population from Bangladesh to India will continue unabated, perhaps at an even greater pace. Not only the cross boarder influx of people but also huge internally migrated people pose a serious threat to the environment, national economy and social cohesion of the society. In this context we must remember that the hungry people are angry people and they can not hesitate to sell their blood to sustain. This is very hard word. But the effect of Farakka Barrage on Bangladesh has proved this hard reality. It has already been pointed out by Dixon that environmental

degradation along its social effects cause simple scarcity conflict, which increase the probability of resort to inter and intra-state violence. Bangladesh as the close neighboring country has yet to violate this limit but some cross boarder conflicts are visible in all time after the liberation. Different types of mistrust and disharmony between these two countries are also been originated for the water sharing problem. The sufferings and future devastating effects might aggravate this situation. Thus solution of this problem is mandatory. Many attempts were undertaken which created a long-term agreement. It has increased relations and, thus, can be viewed as productive in international affairs. It has also increased the likelihood for further bilateral developments. However, there still remain several important flaws, which need to be overcome before the dispute can even be regarded as partially solved. In this context it mentioned here that there is no set method which is best for all water-sharing agreements. Unilateral actions can be seen as understandable or devastating. Bilateral actions can be seen as highly effective or virtually a waste of time. Meanwhile multilateral actions are seen as an attractive option, but are not necessarily attractive to the parties involved. Even if the multilateral approach is taken, should it be in the form of a third-party mediator, regional body or global institution. Since 1971 the Indian and Bangladeshi governments have at stages entertained the idea and use of all of these solutions, ranging from unilateral withdrawals; to the involvement of Nepal; to appeals to the UN. However, the dispute remains up in the air. The problems involved are many and varied, but the final goal dictates the need for resolution. These characteristics are by no means unique to the Ganges conflict, and are becoming more and more pressing. Pressures on the global freshwater supply dictate that further clashes are around the corner, while old conflicts continue to present new problems. Indeed the solution itself may well need a greater involvement than merely that of bilateral talks. The importance of global and regional acceptance and the need for enforcement may all require multilateral intervention and involvement. Above all India as a big neighboring country must follow the "Environmental Approach" in taking further step in the context of bilateral relation. Above all we the people of Bangladesh must be sincere regarding environmental degradation and future policy to protect the environmental security.

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