

Water Security in Coastal Region of Bangladesh: Would Desalination be a Solution to the Vulnerable Communities of the Sundarbans?

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***Abstract:** Salinity is one of the major problems that the coastal region of Bangladesh has been facing over the last couple of decades. Due to sea level rise, frequent natural disasters, changes of climate patterns and man-made alteration of natural settings, the situation is becoming more vulnerable day by day. It has also been observed that both natural and man-made changes can alter the patterns of poor peoples' lives and livelihoods. Faulty development policies and economic interest of the rich, such as promoting shrimp farming in a saline-prone zone, could make the environmental settings more vulnerable. The future of the coastal communities of Bangladesh depends on the sustainable development and disaster management policies of the government; and efficient and 'techno-natural' use of water could generate lifeblood for its coastal economy. The new hydrological development in the West, especially in the USA, Israel and Spain, brings new inspiration on water desalination venture. The purpose of this research work is to study the reasons for water salinity in the Sundarbans region of Bangladesh and examine the prospect as well as drawbacks of desalination venture in the context of Bangladesh's current development policy.*

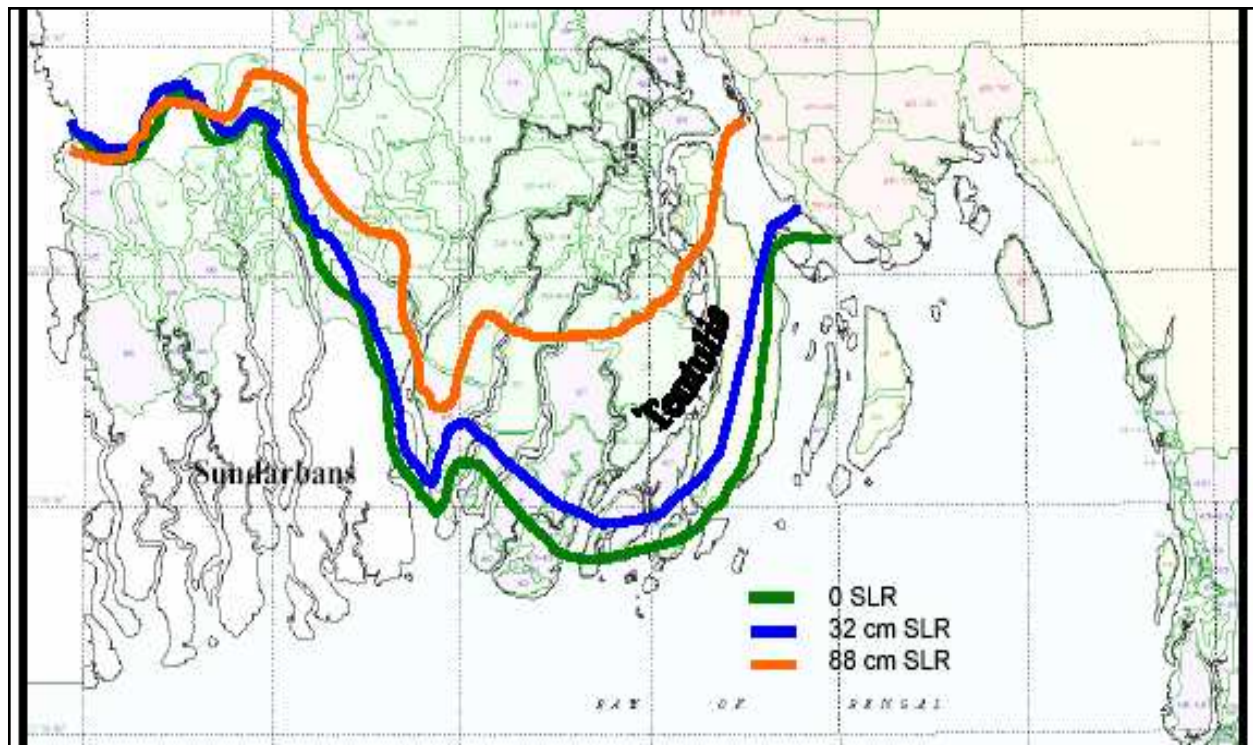
Introduction

Bangladesh is a deltaic country with a total land area of 147,570 Sq.km and a population of over 156 million (CIA Factbook, 2010). It is often called the 'land of rivers' where more than 700 rivers and their tributaries form a large network of hydro-system that has a length of 21,140 km. The three major rivers of Bangladesh, the Padma, the Meghna and the Jamuna, which bring large flows of water and the alluvium mostly from the Himalayan-Tibetan plateau, play a lifeblood role in the economy and culture of Bangladesh. These rivers serve as the main water source for cultivation and major arteries for commercial transportation, as well as supply enormous amount of fish. However, continuous exploitation of river-water system due to man-made changes, industrial pollution and dumping of household-waste, most of the rivers have lost their quality. Besides, the geophysical changes of natural water flow carried out by neighboring India for its own interest, has already created a huge water scarcity in the southern-eastern part of Bangladesh. In many points, the country's main river the Padma has lost its natural water flow and its tributaries dried out and started the process of desertification.

The reasons of water salinity:

The upstream reduction of natural water flow is contributing to increasing level of salinity problem in coastal areas of Bangladesh. Both water and soil salinity have increased in an alarming rate during the last couple of decades. The factors which are influential for increasing level of water and soil salinity include global climate change and sea level rise (CCSLR) and man-made destruction due to widespread commercial shrimp farming. Rise of sea level will naturally affect the ecosystem and biodiversity of the coastal region of Bangladesh. Saline water intrusion into the inland fresh water sources is causing severe threat to the lives of the species living around the world's greatest mangrove forest, the Sundarbans. Moreover, rapid growth of unplanned brackish water shrimp cultivation seals off the capacity of natural resistance against increased level of water and soil salinity in the Sundarbans.

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Source: IWM Bangladesh, www.iwmbd.org

It is noticeable that the National Adaptation Program of Action (NAPA), which presented unique policy paper of Bangladesh government to fight against climate change, does not clarify the role of shrimp farming and its consequence brackish water intrusion into the coastal districts because of increasing water and soil salinity. In fact, very little attention has been given on water salinity as a whole. The report mostly indicates sea level rise (SLR), change of climatic patterns and upstream withdrawal of fresh water as the main reasons of water salinity in coastal Bangladesh. However, contemporary researches show that beside other physical factors, unplanned brackish water shrimp cultivation also influenced the rising salinity level over recent years (Haque and Saifuzzaman 2002; Primavera, 1997: 821).

Sundarbans: A place where water is scarce:

The Sundarbans is the largest mangrove ecosystem in the world. It has been declared as a World Heritage Site by the UNESCO in 1997 due to its tremendous ecological importance to world heritage. It extends across Bangladesh and the Indian state of West Bengal with a total area of approximately 10,000 square km. The Bangladeshi part of the Sundarbans comprises 60 % of the whole area which is largely a flat coastal land formed across the area of ancient Ganges delta (ADB, 1998: 1). According to Chowdhury I. Quamrul and others, the most important physiographic feature of the Sundarbans is its wetlands and water bodies which create a unique reservoir of bio-diversity (Chowdhury I. Quamrul et al., 2001:5).

The natural hazards that SRF (Sundarbans Reserve Forest) face year after year are cyclonic storms, storm surges and coastal flooding during the high tide period. Storm surge and coastal flooding bring the saline sea water into the flat land which increases the salinity level. During the monsoon season because of heavy rainfall the salinity level is lowered due to the onrushing fresh water from the

upstream region, and the vice-versa scenario occurs during post monsoon season (Chowdhury I. Quamrul et al., 2001: 6). Cyclones generally occur in October to November and March to April periods each year and cause severe ecological damage within SRF boundaries. The two recent cyclones: Sidor and Aila caused enormous damage to SRF and its surrounding areas.

Despite the importance of SRF in the Bangladesh economy, it has been seen that over-exploitation of SRF by the surrounding communities and invaders caused severe damage to its ecosystem during the last 30 years. This process accelerated particularly after the introduction of shrimp farming in this region. According to the local people, wide scale shrimp farming enhances the opportunity of over-exploitation in the Sundarbans region. The Chokoria Sundarbans, the second largest mangrove patch in Bangladesh, has seen devastated by man-made destruction in 1990s due to the intrusion of shrimp industry. After its introduction in 1975, most of the 7500 ha. of mangrove flora has been cleared for shrimp farming, leaving only 973 ha. of scrub forest by 1988 (Choudhury, Quadir and Islam 1994). Shrimp cultivation also affects the surrounding environment of the Sundarbans. The use of saline water in shrimp culture contaminates the source of drinking water and thus it fosters salinization process. This process further creates the conversion and salinization of rice and other agricultural lands which also leads to marginalized coastal rural communities (Primavera, 1997: 821).

Impact of Water Salinity on livelihood operation:

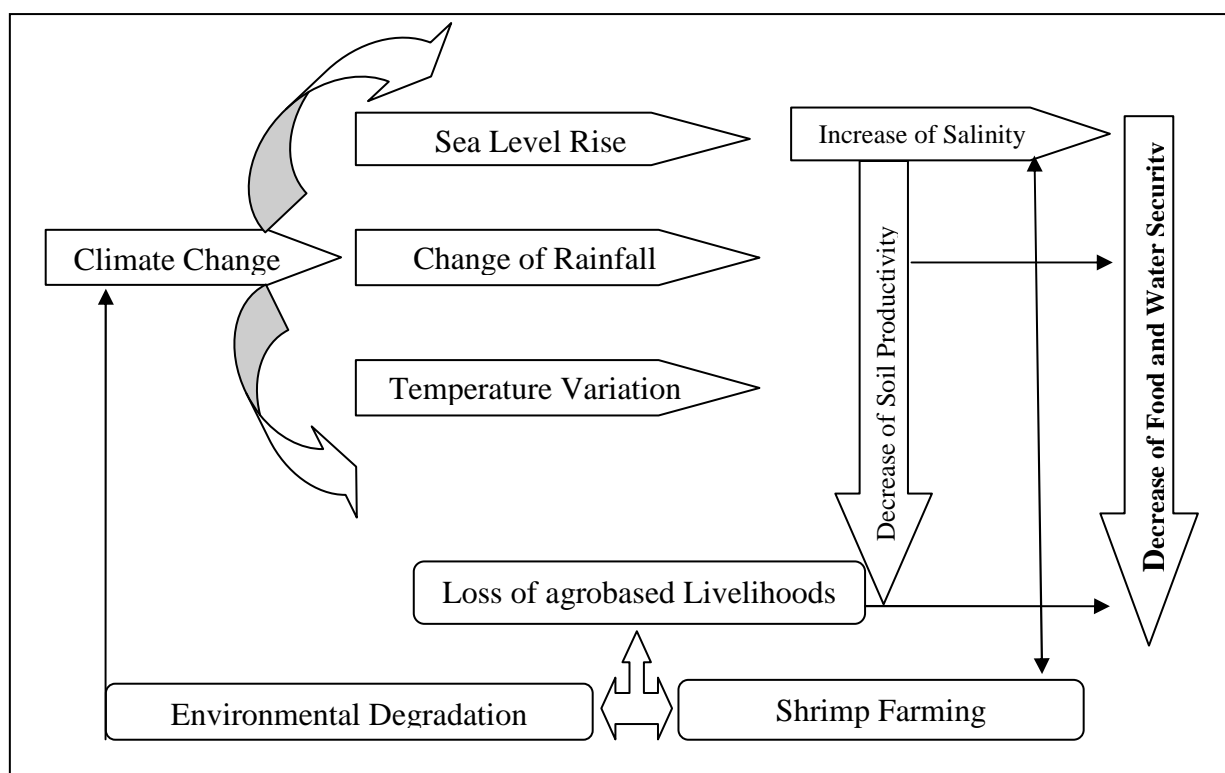
The increase level of water salinity is impacting on the livelihood operation in several ways. First, it is making the whole coastal belt's water availability insecure and pushing poor people's lives to a more vulnerable position than before. Near about four million people in the Sundarbans and its surroundings is now water insecure. Nowadays, saline water becomes the only means of potable water.

Second, water salinity also causes an increase in soil salinity which further decreases the agricultural productivity and brings enormous pressure on food security. And lastly, it destroys the ecosystem of the Sundarbans, causing massive threats to the lives of various species living in this natural wonderland.

How severe is the salinity problem in the Sundarbans?

The salinity problem in the Sundarbans and its surroundings became more severe after the two great cyclones Sidor and Aila and the consequential tidal surges, which took place in December 2007 and May 2009 respectively. The Sundarbans and its surrounding regions are the most affected and were devastatingly inundated by sea-saline water after cyclone Aila. Till today, a large number of areas in the Sundarbans region remain inundated by saline water. Millions of people living around this region are struggling with high level saline water and so far very little efforts have been given by the governments and non-government organizations to restore the place to normality.

The situation looks worse when one compares the pre-Aila and post-Aila living conditions and livelihood. During my field visit in July 2009 in Shymnagar, for conducting my master's thesis work, I saw the devastating images of post-Aila condition first hand. The cyclone caused major damages in



Source: Basar, 2010, Master Dessertation.

Figure 1: Food and Water Security Cycle

Shymnagar Upazila of Satkhira district and largely destroyed the available sources of potable water. Small ponds, canals, wells and tube wells are now filled by salty sea water, which makes all the water sources unusable.

While talking with the local people at Shymnagar Upazila of Satkhira district, I came to know that salinity is affecting their lives in various ways. First, it has reduced their economic opportunity by degrading their land quality and reducing productivity. Secondly, it is lessening the security of food and water. They said that water has become the most precious commodity of their daily life. Lack of pure drinking water is the greatest challenge that they are facing and they do not know when and how they could recover from this terrible situation.

Government and NGOs have made some water storage tanks in several places of Aila affected areas but those do not cover all their needs. However, to get a bucket of water from those sources one has to wait several hours and travel a long way to fetch it. Those who are unable to fetch pure water, have to rely on saline water. A middle-aged woman showed me her *Sharee*, which has faded and

become stiff and flimsy because of continuous washing with saline water. Living with saline water is also causing several health problems, including cholera, diarrhea, kidney and several skin diseases.

Government and development organizations: What is their observation?

Water salinity issue so far did not get much importance in the government's disaster management policy; even development organizations seemed less interested in this subject though this issue is becoming one of the major challenges against achieving millennium development goal (MDG) for Bangladesh. The National Adaptation Program of Action (NAPA) briefly explains the causes and impacts of water salinity on the coastal economy whereas much greater focus was given on climate change and sea level rise. The future of water security for the poor coastal inhabitants is much neglected. While describing coping strategy for Bangladesh government, the NAPA suggests and popularizes different adaptation mechanisms. Not a single word was written on to the techno-natural (Swyngedouw, 2007:9) use of saline water; rather this policy paper relies on existing adaptation thoughts. According to this report, the saline prone zone should learn the technique of using rain water in a more sustainable way. It says,

“Increasing salinity has exacerbated the problem of drinking water availability in the coastal zone. Rain water harvesting is an adaptation measure in such circumstances” (NAPA,2005).

But this does not reflect the demand of the present circumstance. Because of climate variability, rain also becomes irregular in monsoon season and that is why rain will never be able to provide drinking water for the vast population.

While describing key priority activities, the NAPA initiates a series of projects which would assist the government to combat climate change and its consequential hazards. Out of 15 projects two projects are directly linked with water issue where one of them particularly focused on drinkable water supply to coastal communities who are vulnerable due to high water salinity. The implementation cost of these two projects was estimated at about \$3.5 million. The other project focuses on capacity building for infrastructure designing, conflict management and land water zoning for water management institutions. Four projects exclusively focus on coastal salinity problems and prioritize government actions for mitigating the problem. But none of these projects could explore the needs for the future, rather they relied on traditional methods of water treatment which seem incompetent, inefficient and worthless for present demand.

According to the project “Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise”, the main objective is to find out alternative sources (rain water harvesting, surface and ground water treatment etc.) of safe drinking water which will ensure the needs of the present and future generation of coastal Bangladesh. Here we can see the government's desires for developing new alternative sources of safe drinking water but unfortunately, the methods they have indicated are entirely conventional. They never mention the term of techno-natural use of hydro-system-- no mention about desalination of sea water. It seems that the concept of “desalinated sea water” is still “unknown” in Bangladeshi policy papers.

Desalination: A new prospect towards water security?

Desalination is the process of removing salt and other minerals, especially from sea water to produce potable water for household or irrigation purpose (AHSD, 2002). This process of water purification from brackish water has become very popular in recent times. According to International Desalination Association, up to 2008 there were 13,080 desalination plants all over the world producing more than 12 billion gallons of water per day (www.idadesal.org). The intense water crisis all over the world due to population growth, wasteful use of water, pollution, diversion of international river flow and climatic change related with global warming played an influential role for promoting desalination methods all over the world (R. Einav et al, 2002:142).

The common technologies for desalinating sea water are based on two main processes: evaporation and membrane separation. It is perceivable that any form of evaporating process requires large amount of energy source and, therefore, this method of desalination only becomes feasible for a country that has cheap energy source and has continuous supply of that (R. Einav et al, 2002:142). Due to low energy consumption and production cost, a new method of desalination, Reverse Osmosis (RO) or a new technology of so called membrane process, has become the most efficient desalination mechanism for the present time (R. Einav et al, 2002:142). The other technology of membrane process includes Electro Dialysis (ED), Multi Stage Flash (MSF), Multi Effect Distillation (MED) and Vapor Compression Distillation (VCD). One of the world's largest desalination plant Jabel Ali in United Arab Emirates is using MSF technology to produce 300 million cubic meter of water per year. On the other hand, the world largest state-of-the-art desalination plant, the Ashkelon seawater reverse osmosis (SWRO) of Israel produces 330 million m³ of water per year and provides around 13 % of Israel's domestic demand with world's lowest ever price (www.water-technology.net).

The most important users of desalinated water are in Middle East, mostly Saudi Arabia, UAE, Kuwait , Qatar and Bahrain, who consume about 70% of world capacity, while United States consume 6.5 % of worldwide production and becomes the world largest user of desalinated water. Besides these countries, other prominent countries who are joining the race include Australia, Israel, Libya, Spain, Morocco, Tunisia, Korea, Japan, Singapore, Greece, Cyprus, Trinidad and Tobago etc.

In South Asia, India became the pioneer country for producing desalinated water for its own domestic use. In 2005, it introduced world's first Low Temperature Thermal Desalination Plant (LTTD) in Kavaratti which supplies 1 million liters of water per day (GOV of India PIB, 2005). Indian Government has also plans to set up other desalination plants all around its southern coast to face upcoming water challenges. Pakistan is also implementing several desalination plants which will come in operation within the next few years and provide a modest amount of water supply to its arid regions.

All these efforts of water desalinating plans represent an acute concern of future water crisis of different states. These countries are pioneering in planning cost effective desalination projects to meet their future needs and present crises, subsequently reducing dependency on other natural and

non-natural factors, such as rainfall , river water flows, ground water availability, international river water sharing etc.

Pros and Cons of Desalination: Any solution for minimizing cons?

Desalination has lots of pros and cons that one needs to consider before one proceeds. The countries, which are water stressed and have long coastline with available source of sea water are obviously suitable for this kind of venture. Desalinating sea or brackish water certainly reduces country's dependency on ground or surface water, and assures water sustainability of a country. This process of water purification can also promote agriculture in saline-prone coastal zone and can reduce the loss of agro based livelihoods.

However, desalination is not entirely an eco-friendly solution for saline water treatment. The main adverse effect of desalination comes from its concentrated brine which comes out as a byproduct of desalinated water. The disposal of this brine to the sea could damage the surrounding marine environment (Einav R. et al. 2002:143). The use of energy and the method of energy production is also a vital factor for environment. Desalination process requires a large amount of energy for producing electricity for its plant. Electricity production often depends on oil, coal, gas or non-renewable sources which cannot impact our environment positively. Furthermore, this operation requires high pressure pumps which produce unpleasant noise and that is why in many countries the plants were built in remote places away from city centers (Einav and Lokiec, 2003:80).

It is true that initially desalination technologies did not focus enough on economical and environmental aspects of desalination, but continuous research on these issues and innovation of modern technologies have opened up new prospect of desalination in the world. The use of renewable energy instead of fossil fuel would reduce both cost and hazards of desalination. Furthermore, it would eventually enhance the sustainability of desalination process (Rodriguez L.G., 2001:104). The concentrated brine can be diluted with waste water stream before pumping it out to the ocean. In that way the salt concentration could be reduced.

The lesson for Bangladesh: Could desalination become a solution for salinity-prone coastal region?

Salinity induced coastal region definitely warrants some concerns on desalination process. The coastal region of Bangladesh covers about 29,000 sq.Km which is 20 % of its total land area. Out of that 53 % of is under medium to high level of salinity (Haque, S.A., 2006: 1359). Near about 40 million people are directly affected by water and soil salinity and another 20 million are at risk. Furthermore, sea level rise and diversion of river water by proposed Indian dams would deteriorate the situation in near future. In that case, alternative solutions for potable and agro-water need to be explored. Desalination process could be one of the alternatives for Bangladesh to fight against present and future water crisis. It is true that this process requires a lot of investment and energy sufficiency that Bangladesh lack; but new financial models of Public Private Partnership (PPP) or Build, Operate and Transfer (BOT) would minimize government's investment and production cost subsequently (Busch,

M. and Mickols, W.E., 2004:300). Use of renewable sources of energy, such as solar, air or tidal power would also minimize overall cost and ensure sustainability of the project. Besides, small reactor (CAREM) based nuclear desalination plant (IAEA Proceedings, 2007:383) might become workable for Bangladesh. In fact the most viable desalination solution for Bangladesh could be the Tunisian model of small-scale desalination plant which could produce 100 liter of water per day and can meet up around 5 families' daily demand of household water for drinking and cooking (Elfil, H. et al, 2006: 320). The treatment plant use RO method for desalinating saline water and consume limited energy resource. This small desalination unit cost around €300 which is approximately Tk.300,000 in Bangladeshi currency in current value (2010).

Conclusion:

Due to intense water crisis in coastal region of Bangladesh, especially in the greater Sundarbans region, Bangladesh government needs to focus on alternative fresh water production methods. In that case desalination process could bring some relief to its vulnerable communities. The absence of knowledge of desalination in government policy reflects a complete ignorance of international developments regarding water crisis. The impending water crisis of Bangladesh can never be met with traditional solutions; rather a more techno-natural use of water becomes necessary to ensure its water security.

References

- AHSD (The American Heritage of Science Dictionary), 2002, Houghton Mifflin.
- Asian Development Bank, 1998, *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance Grant to the People's Republic of Bangladesh for the Sundarbans Biodiversity Conservation Project*, ADB, Manila.
- Basar, Asiful, 2010, Master's Dissertation on "Climate Change, Loss of Livelihood and the Absence of Sustainable Livelihood Approach: A Case Study of Shymnagar, Bangladesh."
- Busch, M. and Mickols, W.E., 2004, "Reducing energy consumption in seawater desalination", *Desalination* 165, 299-312.
- Choudhury A.M., Quadir D.A. & Islam M.J. (1994) Study of Chokoria Sundarbans using remote sensing techniques. *ISME Mangrove Ecosystems Technical Report 4*. 1-22.
- Chowdhury I. Quamrul, Haque. Mahfuzul and Chowdhury I. Shahidul, 2001, The Sundarbans: Overview of an Amazing Ecosystem, in Chowdhury I. Quamrul (ed) *State of Sundarbans*, Forum of Environmental Journalists of Bangladesh (FEJB), Dhaka.
- Elfil, H., Hamed, A. and Hannachi, A., 2006, "Technical evaluation of a small-scale reverse osmosis desalination unit for domestic water", *Desalination* 203, 319-326.
- Haque, S.A., 2006, "Salinity Problems and Crop Production in Coastal Regions of Bangladesh", *Pakistan Journal of Botany* 38(5): 1359-1365.
- Haque Zahurul and Saifuzzaman Md., 2002, Social and Environmental Effects of Shrimp Cultivation in Bangladesh: Notes on Study Methods, in Motiur Rahman (ed) *Globalization, Environmental Crisis and Social Changes in Bangladesh*, Winnipeg, Canada.
- National Adaptation Program of Action (NAPA), Final Report 2005, Ministry of Environment and Forests Government of Bangladesh, Dhaka.
- Primavera, J.H., 1997, Socio-economic Impacts of Shrimp Culture, *Aquaculture Research*, 28, 815-827.
- R. Einav, Harussi K, Perry D, 2002, The footprint of Desalination Process on the Environment, *Desalination* 152, 141-154.
- Rodriguez, Lourdes Garcia, 2001, Seawater desalination driven by renewable energies: a review, *Desalination* 143, 103-113.
- Swyngedouw, Erik, 2007, Technonatural revolutions: the scalar politics of Franco's hydro-social dream for Spain, 1939-1975, *The Geographical Journal*, London.

Internet Sources

Government of India Press Information Bureau, May 23, 2005, access on 17th October 2010, at 8:30 PM.
<http://pib.nic.in/release/release.asp?relid=9439>

CIA World Factbook, 2010, access on 17th October, 2010 at 8 PM.
http://www.theodora.com/wfbcurent/bangladesh/bangladesh_people.html

Water-technology access on 17th of October, 2010 at 9 PM,
<http://www.water-technology.net/projects/israel/>