



Water Security

The Threat Facing Bangladesh

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ISSUE BRIEF

Water is considered as one of the most crucial non-traditional security issues. Water security is an elusive concept, but consensus is beginning to emerge in the world community. Water security is essential for human access for health, wellbeing, economic and political stability. It is essential to limit risks of water related hazards. A complete and fair valuation of the resource, sustainability of ecosystems at all parts of the hydrologic cycle and an equitable and cooperative sharing of water resources is very necessary.

It is a great irony that our planet that has 70% of its surface covered with water is facing an acute water crisis. It is alleged that the next world conflict would be for water. Water is very important for a nation to survive and to ensure their existence. Water is a strategic resource in the globe and an important element in many political conflicts. The world civilization started from the bank of Tigris, Euphrates and Nile rivers. To sustain a civilization water is the basic need. That is why it has been synonym as "life". Among the 70% water that our planet contains 97.5% water is ocean water which is salty. Among the remaining 1.725% is in glaciers, snow and permafrost. 0.075% is ground water, and 0.025% is in the lakes, swamps and rivers⁽¹⁾

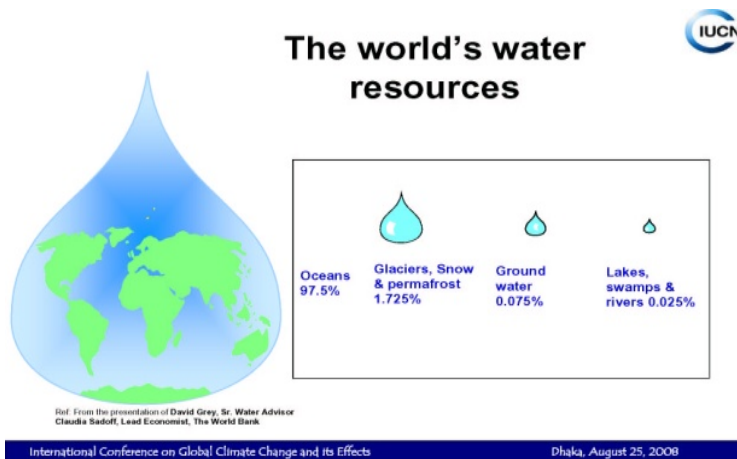


Figure:1 Source: International Union for Conservation of Nature (IUCN)

The World Water Assessment Program, released World Water Development Report (WWDR, 2003), published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), indicates that within next 20 years the availability of water would decreased to everyone by 30%. Less than 40% has the availability of hygiene water. In 2000 more than 2.2 million people died of water diseases for contaminated water. In 2004 the UK charity Water Aid reported that one child die in every 15 seconds for water-related diseases. ⁽²⁾

According to the Human Development Report 2006, the underlying causes and consequences of a crisis leaves 1.2 billion people without access to safe water and 2.6 billion without access to sanitation. ⁽³⁾ The United Nations Environment Program (UNEP) reported in 1999 that 200 scientists in 50 countries identified water shortage as one of the most worrying problems for the new millennium. Out of our total water availability we use about 70% water for agriculture. By 2020 we shall need 17% more water than is available if we are to feed the world. ⁽⁴⁾ In appreciation of water's importance, the UN General Assembly has declared March 22 as World Water Day.

This scarce resource is of the utmost necessity for the survival of every individual human being. This is why its scarcity bears profound implications for global food security, protection of human health and the maintenance of aquatic ecosystems. Bangladesh, because it is one of the world's largest and dynamic deltaic countries, is particularly vulnerable to this threat.

Case of Bangladesh

The sources of water in Bangladesh are rivers and ground-water. Bangladesh is a lower riparian, river-reign country. There are 808 rivers in Bangladesh where most rivers rise from Himalayan reign and falls into the Bay of Bengal. ⁽⁵⁾ There

are 57 trans-boundary rivers that Bangladesh shares with her neighboring countries; 54 with India and 3 with Myanmar.

Each year about 2.4 billion tons of sediment from the Himalayas is carried by the rivers of Bangladesh to the Bay of Bengal. This sediment is deposited on the continental shelf causing accretion of land to the coast of the country. The high sediment load results in a net accretion about 35 square kilometers of land per year to Bangladesh. Bangladesh has been formed over tens of thousands of years through the settling down of sediment on the bed of the Bay. Only about three thousand years back one of our seaports was near Gopalganj in Faridpur district.⁽⁶⁾

Bangladesh is situated in the deltaic part of the region. Huge volume of water enters into the country from outside and flow into the Bay of Bengal through three mighty rivers and their tributaries and distributaries, namely the Ganges, the Brahmaputra and the Meghna drain. The Ganges, the Brahmaputra and the Meghna river systems drain a total catchment area of about 1.72 million sq km through Bangladesh into the Bay of Bengal. Out of this large catchment area, only 7% lies in Bangladesh. The other co-riparian countries are India, Nepal, Bhutan and China.⁽⁷⁾

In the case of ground-water resource the presence of Arsenic in ground-water is affecting the people of rural areas those who are largely dependent on this source of water for drinking, agriculture, feeding fisheries and livestock. Thus there is a pressure on fresh water as the fresh water supply is not adequate according to the population demand. Bangladesh being a river-reign country is largely dependent on natural sources of water for living. Thus the scarcity of water is a threat towards the sound life of the country people. Again the contaminated water and the increased salinity is affecting human health and living massively. Water that synonym life, is causing lives in terms of not being adequate according to the demand and again for being abundant in the form of flood. Bangladesh's huge dependency on water shows the grievous picture of destabilizing the survival of the country which can crumble down the country and make the region unstable. So there is the need to understand the study of water from security perspective.

This paper gives a glimpse on the causes of water security challenges that Bangladesh faces besides being a river-reign county and analyze the security threats, its impact on the most dynamic deltaic country Bangladesh, in a national and regional level. Then the paper discusses a few recommendations to solve this atrocious threat towards the nation.

Causes of water scarcity in Bangladesh

As the demand for water increases, share of water per person will decrease, gradually it would result in greater demand for water. It was reported in media that 80 rivers are about to die out in Bangladesh, while 100 have lost their natural characteristics due to withdrawal of water in the upstream by structures, such as dams and barrages in India. Water scarcity in Bangladesh has various dimensions. An external dimension has the impact for being a lower riparian country, the upper riparian country like India can withdraw water by creating dams and embankments. The internal dimension of water scarcity addresses contaminated ground and surface water. Ground water supply 80% of water that people use. For constant floods, shortage in surface water, inadequate tree plantation, the level of under-ground water is depleting. This increases arsenic presence in under-ground water. Pollution caused by throwing waste into the water, continues the pressure on water that is yet available. The society that Bangladesh has is quiet biased for their elite class. Tax that citizen pay for water is same for all in the society but the availability of water varies in various classes. This creates a class division reaction which can be harmful in the long run. There is again regional dimension on scarcity of water by withdrawal of water from other upper riparian countries like China, Nepal. So considering the causes of water shortage in Bangladesh there are various causes. A glimpse of the causes has been addressed bellow.

Sharing water of trans-boundary rivers:

During each monsoon season of June to September, one third of Bangladesh is gripped with flood calamities; two thirds of the country is vulnerable to flood. During the dry months water flow in major rivers decrease drastically. Fresh water becomes scare for use in agriculture, fisheries, navigation, industries, drinking or domestic purposes. As India surrounds Bangladesh from three sides, all the main rivers, especially the Ganges-Brahmaputra-Meghna gets water that comes from Himalayan reign and flow through India, then enter Bangladesh. Thus the total water system of Bangladesh depends on sharing water with India. Rivers of Bangladesh are both snow-fed and rain-fed, which is the cause of getting water flow into these rivers during the lean season.

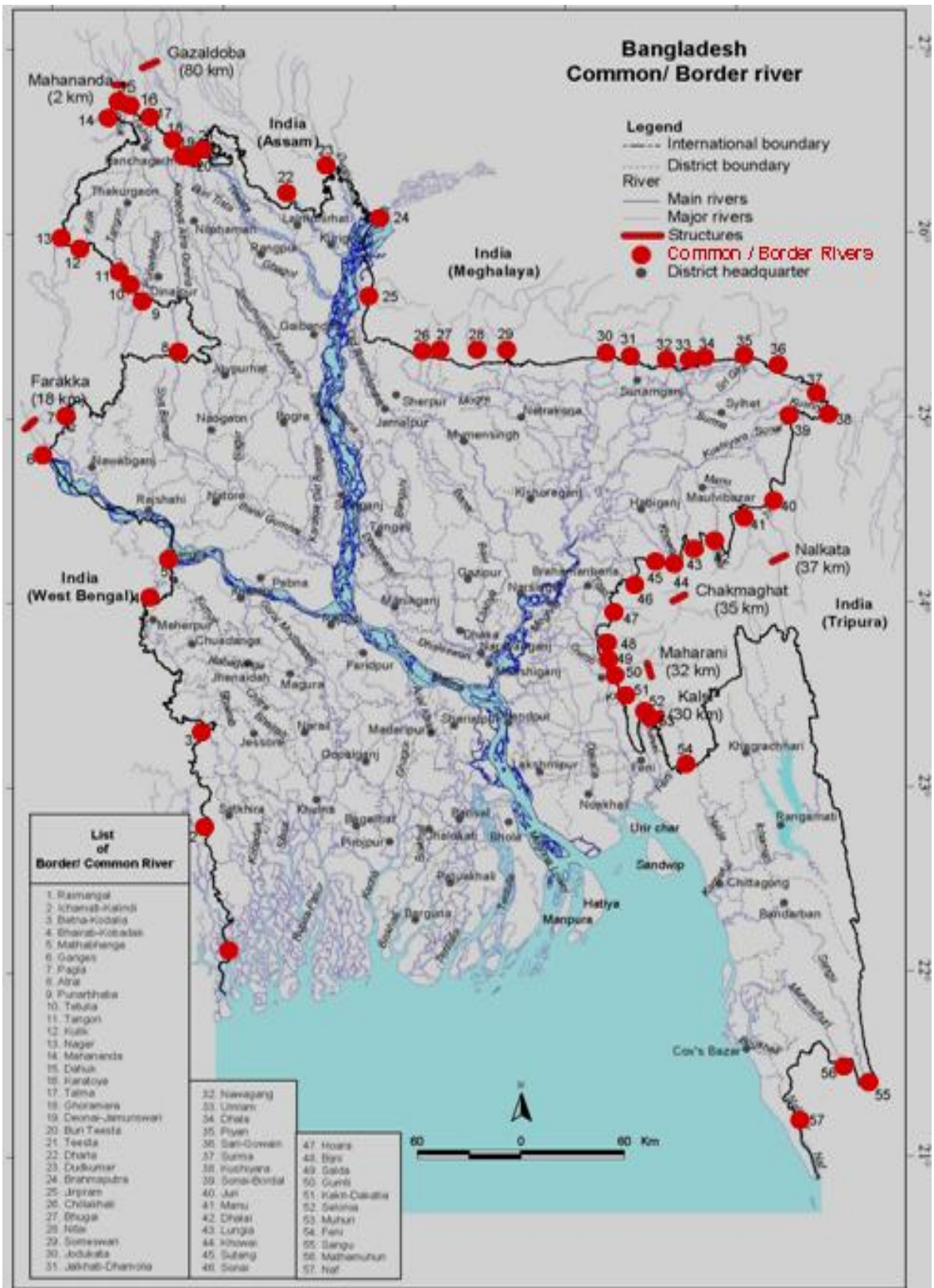


Figure:2 Red balls in the map shows the common/ border rivers of Bangladesh

South Indian Rivers like: Krishna, Godavari and Narmada are only rain-fed, for which they become dry during the lean season. India supplies water to these rivers by creating dams, embankments and linking the rivers to transfer the flow. Thus most of the rivers of Bangladesh do not get the proper flow of water that she supposed to get in her rivers. As a result the alluvial land of Bangladesh is getting barren. It also affects massively the population those who are directly or indirectly related to the rivers for their livelihood and living. The main problems with sharing water of trans-boundary rivers are related to Ganges water sharing, India's plan for Tipaimukh dam, India's river linking project.

Ganges water agreement

The River Ganges, originating from the glaciers of the Himalayas at a height of about 7,000 metres, flows 2,550 km down through the Indian states of Uttar Pradesh, Bihar and West Bengal before joining the Jamuna (Brahmaputra) at Goalandaghat in Bangladesh. Its length in Bangladesh is 260 km. It flushes a total area of 1,087,001 sq km of which 860,000 sq km falls in India, 147,181 sq km in Nepal, 33,520 sq km in China and 46,300 sq km in Bangladesh. India first planned to build a barrage at Farakka in 1951, and since then Pakistan government began to point out its likely adverse effects on East Pakistan (Bangladesh).

After the liberation of Bangladesh in December 1971, to ensure an equitable sharing of the water resources of the region, the Bangladesh Prime Minister Bangabandhu Sheikh Mujibur Rahman and the Indian Prime Minister Indira Gandhi made a joint declaration on 19 March, 1972 to set up a permanent Joint River Commission. In pursuit of that declaration a Joint River Commission was formed in November 1972.

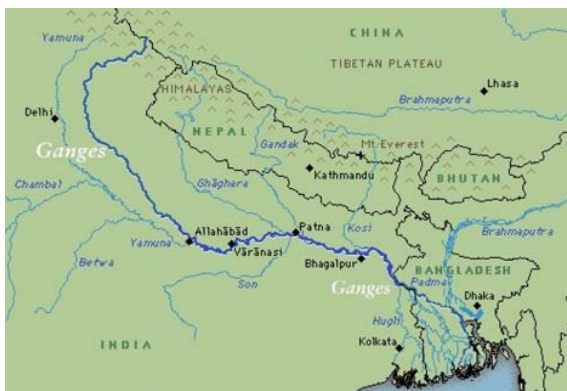


Figure:3 The map shows the flow of Ganges river in blue

In May 1974, the prime ministers of the two countries in a joint declaration acknowledged that there was a need to augment the dry season flow of the Ganges at Farakka to meet the full requirement of Bangladesh and of Kolkata

port. Before the Farakka Barrage was put into operation there was a need for an acceptable agreement between the two countries. In 1975, an interim agreement was signed to allow India to operate the feeder canals of the barrage experimentally for 41 days from April 21 to May 31.

In 1976 and 1977, India unilaterally withdrew the Ganges water despite strong protests from Bangladesh. The efforts at negotiation broke down in September 1976, and Bangladesh decided to internationalize the issue. It was first raised at the Islamic Foreign Ministers' Conference in Istanbul in May 1976, and then at the summit of Non-Aligned Movement (NAM) in Colombo in August of the same year. Bangladesh's decision to raise the issue at the 31st session of the UN General Assembly in 1976 led to a flurry of diplomatic activities. At the request of Senegal, Australia, and Sri Lanka, the Political Committee of UN General Assembly urged upon India and Bangladesh to settle the issue amicably. At the initiative of Syria, Egypt, Sri Lanka, Algeria and Guyana, both India and Bangladesh agreed to sit at Dhaka for talks. But negotiations produced no positive results.

Following the formation of the Janata Dal government in Delhi a more favorable atmosphere for talks was created and in November 1977, a five-year treaty with the Ziaur Rahman government of Bangladesh on water sharing was concluded. The term of the treaty expired in 1982. On 4 October 1982, the government of General Hussain Muhammad Ershad signed with India a memorandum of understanding (MOU) on water sharing for two years.

On 22 November 1985 another understanding for three years was signed. As still there was no agreement on augmenting the flow, India did not agree to a further extension of the accord. India reduced the river's dry season flow for Bangladesh in 1993 to lower than 10,000 cusec in place of around 34,500 cusec in the last accord. In the absence of an agreement, India continued to deprive Bangladesh of its rightful share of the Ganges water. As there was little progress in negotiations with India, the BNP government raised the issue once more at the UN General Assembly. In October 1993, it was also raised at the Commonwealth summit in Cyprus.

Following the formation of the Awami League government, negotiations resumed and finally, a 30-year treaty on sharing of the Ganges water was signed between India and Bangladesh on 12 December 1996 in New Delhi. According to the treaty, the Ganges water would be distributed from Farakka for the two countries between January 1 and May 31 each year on the basis of an agreed formula, and that India would make every effort to maintain the flow at Farakka at the average level of previous 40 years. At any critical period Bangladesh would get the guaranteed flow of 35,000 cusec. The two countries also agreed to the need for mutual cooperation in augmenting the flow of the Ganges on a long-term basis, and for entering into similar accords in sharing the flows of other common rivers.

This long-term treaty defined for the first time India's pre-condition for augmenting the flow of the Ganges and established Bangladesh's right as a lower riparian to an equitable share of its existing flow. It removed the tense relation between the two countries, and opened the way for their wider cooperation in sharing the water resources of the entire region.

The implementation of the treaty has the prospect of allowing Bangladesh to receive a fairly good flow of water into the Ganges-Kobadak Irrigation Project in greater Kushtia and into the Gorai river that drains the southwestern districts, thereby saving agriculture, aquaculture, industries and the world's largest mangrove forests in Sundarbans by preventing salinity from the Bay of Bengal.⁽⁸⁾



Figure:4 Impact of water scarcity in North of Bangladesh

In spite of the long term treaty Bangladesh still do not getting the amount of water that she supposed to get according to the treaty. The Gorai, which is the main tributary, carrying water to the south west region becomes totally dry at the beginning of lean period.

Inter- River Linking Project:

India initiated the Inter-River Linking Project which created controversies even in India. The huge inter river linkage program has been taken to link 37 rivers by thirty one 9,000km long lakes to give water access to 150 million lands within India. According to this plan the water of Brahmaputra would be taken to Ganges, from Ganges to Mahananda and Godabari. Water from Godabari would be taken to Krishna and from there to Penar and Cauvery river. The water of Narmada would be taken to Sabarmati. In dry seasons Bangladesh gets 85% of its sweet water flow from Brahmapurta and Ganges water. Only from Brahmaputra she gets 65% of her water flow. ⁽⁹⁾

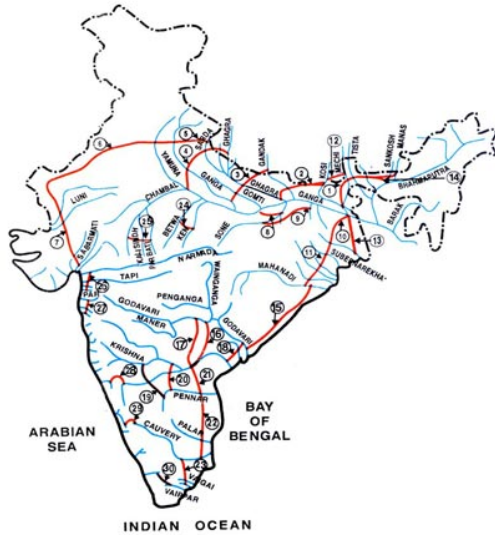


Figure:5 The map shows the Inter-River Linking Project of India

This project would keep Bangladesh to an acute straiten towards her socio-economic and environmental ecology. Rather there would be structural changes to the rivers.

Tipaimukhi Dam:

Another ominous factor for Bangladesh is the Tipaimukhi Dam which was initiated in 1948. Indian President Manmohan Singh established the foundation stone of this project in 23 November 2005. A high capacity dam would be created in the Tipaimukhi Hydroelectric project of India having a height of 162.8 meter. The water containing power of this dam is 15.5 billion cubic meter and electricity produce capacity is 1,500 megawatt. 226 big dams would be created in their convenient places in south east of India to produce 99,000 megawatt electricity within the next 50years. It would be created align the border of Karimganj of Assam above the River Borak. This Borak River is the main stream of the branch rivers; Surma and Kushiara. Both these rivers conjointly created the big Meghna in Bangladesh. This river has a high speed stream and a high capacity to contain sand than the River Padma. India took a target to produce 50,000 megawatt of electricity by 2012. The Tipaimukhi High Dam is situated very adjacent to Bangladesh border. ⁽¹⁰⁾

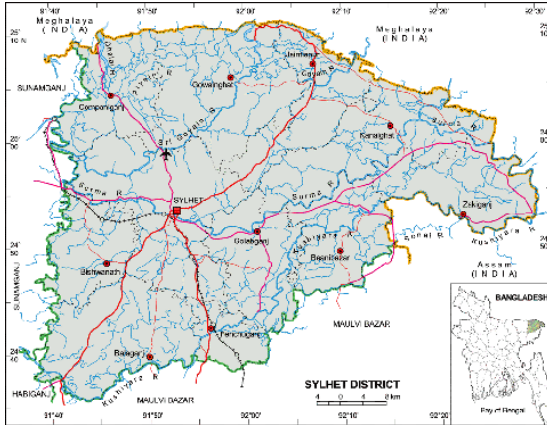


Figure:6 The map shows the part of Bangladesh that would get affected by the Tipaimukh Dam Project by India

This project would result gathering massive collection and flow of sand under river, sudden flood, floods. All this reactions would be seen at the north-east region and especially at the Haor localization. Total scenario of this area would be changed drastically. All the Haor, marshy lands, ponds rivers, embankments would be filled with sand of this region within 10-15 years. The fertile land of the Haor would turn into desert. Agriculture would be destroyed. Rice grains like Boro, Shail and Aman would loose its regional diversity. Biodiversity of this region would be lost. Plants, aquatic plants, traditional fish, and the infrastructure of this region would be in vain. The total ecosystem of this region would be jeopardized. If the rivers Surma and Kushiara dies there would be no Meghna River in Bangladesh. Thus it is not only Sylhet and the Hawor localization that is in danger but also the localization around Meghna is in big risk. Economy of the country and the normal life of the people of Bangladesh would be paralyzed.

Population:

Bangladesh has a population of about over 150 million in a land of 133,910 square kilometers. In Dhaka, the capital city of Bangladesh, the daily need for water is about 2100 million liters. But the actual supply is nearly 1,600 million liters. The situation in Khulna is even worse. Only 6 million gallons of water are being supplied in Khulna city on daily basis, where the daily demand is almost 30 million gallons. The situation in other cities does not differ from this. ⁽¹¹⁾

Further, human activities alter global water systems. These activities are traditional burning, deforestation, overgrazing, agricultural practices, chemical disturbance, air pollution, over-pumping of groundwater, urbanization, industrialization, and dams and reservoirs. Irrigated agriculture and industry use about 70% and 23%, respectively, of the water used worldwide, while households only use 8%. World's population is about 6.3 billion and in the next 25 years there will be 2 billion more people coming onto the earth. As population

grows, demand for water grows. It has been reported that between 1970 and 1990, available per capita water supply decreased by one third. ⁽¹²⁾



Figure:7 River erosion

Consequently India's population and the demand of water would also grow accordingly. By 2050 the population of Bangladesh would be over 220 million where 79.85% is the rural people. Thus the need for water would make the states try to grab more water for there population.

Diminishing under-ground water:

Under-ground water is the second large source of fresh water for Bangladesh. Before the discovery of arsenic contamination in Bangladesh, in 1994 (officially) groundwater used to be considered a safer source of drinking water. People get 80% water of their total need from underground. Annual ground water produced in Bangladesh is 21.09 km-cube/year and the surface water is 83.91 km-cube/year. ⁽¹³⁾ Nearly 97% people are dependent on groundwater sources. Arsenic contamination of groundwater in Bangladesh is now considered the world's largest case of water pollution. Groundwater in Bangladesh is also polluted by a number of anthropogenic and natural sources. The most widespread anthropogenic sources are the infiltration of industrial and urban wastes disposed on the ground or in surface water bodies. ⁽¹⁴⁾ Also intrusion or infiltration of saline water contaminates groundwater. Extensive use of agrochemicals can lead to groundwater pollution. Leaking sewers/septic tanks/pit latrines also cause groundwater pollution.

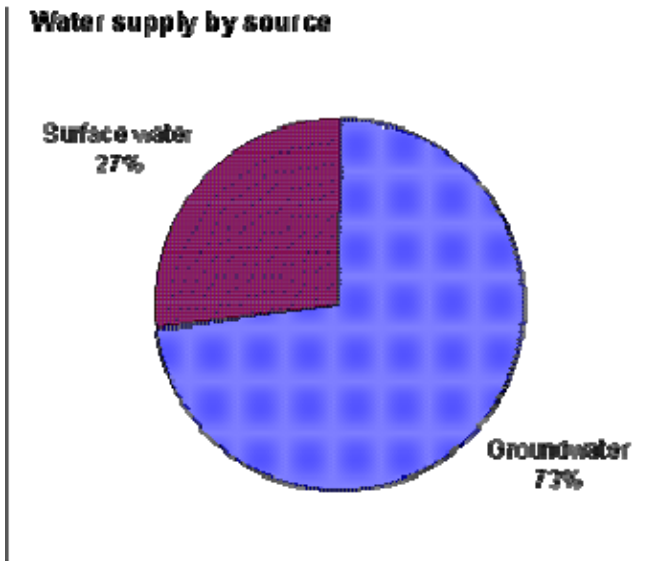


Figure:8 Water supply by source

Heavy withdrawals of ground water for irrigation have also lowered the water table in many areas below the effective reach of hand tube-wells. It has been reported that across Asia, Africa and Latin America, ground water level are dropping as much as 3 meters a year.

Pollution:

Pollution is one of the important and alarming elements of water scarcity. We have a short supply of water hence that is being contaminated for many reasons. Therefore the scarcity and the demand for fresh water are increasing. Water gets polluted by wastes from industry, agriculture and human generated wastes. About 2 million tons of wastes are dumped everyday into rivers, lakes and streams, with one liter of waste water sufficient to pollute about eight liters of fresh water. ⁽¹⁵⁾ Seepage of agro chemicals also pollutes the water for human and animal consumption.

An UN report estimated that there are about 12,000 cubic kilometers of waste water across the world, which is more than the total contained water by world's 10 largest river basins. If the pollution keeps growing at this rate the world will lose 18,000 cubic kilometers by 2050, which is almost nine times the amount all countries will lose for irrigation. ⁽¹⁶⁾

Studies by Bangladesh University of Engineering and Technology (Buet), Design Planning and Management Consultants Limited (DPM), the Institute of Water Management (IWM), and Aqua, found concentration of diluted ammonia in Saydabad Water Treatment Project (SWTP) treated water reaching up to 5.7 milligram (mg) per liter compared to the WHO 0.5mg per liter safety limit set. ⁽¹⁷⁾

This is a result of excessive disposal of domestic wastes, which fall into the river from various canals and drains. According to a (WASA) report May 2006, 3,500 cubic meters of wastewater contains waste of 1,850 kilogram (kg). The dumped effluents deplete the oxygen level in the water bodies to a point when no living creature may survive. Industrial wastes containing toxic heavy metals such as chromium, lead, cadmium, and magnesium mix into the river water. Consuming such chemicals may cause serious kidney, liver, lung, stomach diseases and even cancer. To treat contamination of water high volumes of Chlorine, lime and aluminium sulphate are used, where another study says that high concentration of chlorine in water has a 94% chance of badly affecting corneas of humans. It also causes chlorine induced diarrhea. ⁽¹⁸⁾

Sources of pollution are factories, power plants and sewage treatment plants because they emit pollutants at discrete locations, usually through a pipe that leads to a lake or stream. Cropland, forests, urban and suburban lands, roadways, and parking lots are the sources of a variety of substances including dust, sediment, pesticides, asbestos, fertilizer, heavy metals, salts, oil, grease, litter, and even air pollutants washed down from the sky by rain.

Natural pollution can also be accentuated by human activities. Pollution takes place in all the three main sources of water, ie rain water, surface water and groundwater.

Acid rain damages forests and may cause significant decrease in productivity. Acidification of soil may also impair soil bacteria that play an important role in nutrient cycling and nitrogen fixation. However, due to extensive air pollution in Dhaka city, it is very likely that rain water in Dhaka would be more acidic than rain water in rural areas.

Thus it is seen that the much water is available to us becomes of scarcity due to contamination, for which the urge for fresh water becomes even more contrasting acute reservoir.

Climate Change:

Climate is a very significant factor as Bangladesh is an agro-based country and is largely dependent on nature. The fertile land and soil helps to grow grain that feed the huge population. Lives of people are largely dependent on climate, as a huge population lives in river banks and coastal areas. Thus any reaction of the environment would create a large number of environmental refugees that would destabilize the country. The Himalayan glacier is melting which increases water flow of the rivers. But India's withdrawal of water from trans-boundary rivers do not let the rivers of Bangladesh get proper flow of water. As a result the sedimentation is increasing and rivers are getting dried up. In various cases rivers are changing their actual path. For global warming sea level is rising and

inadequate flow of sweet water in to the river is not being able to push back the saline water. Thus the salinity is increasing and the south part of the country is getting affected. It affects the whole natural infrastructure which is hampering the lives of people and the livestock as well. With a 4% population of the world United States of America produces 25% of its greenhouse gases. Carbon-dioxide emission and greenhouse gases are a great cause of climate change of the planet.

The World Water Development Report, published in March 2003 reveal, that by the middle of this century (2050), 7 billion people in 60 countries including Bangladesh are likely to face acute shortage of water. Only 50cm rise in the sea level would engulf two-thirds of the country. A rise of only 1.5 m would have the impact on Bangladesh a 17 million (15%) affected population and 222,000 km-square (16%) affected land. ⁽¹⁹⁾

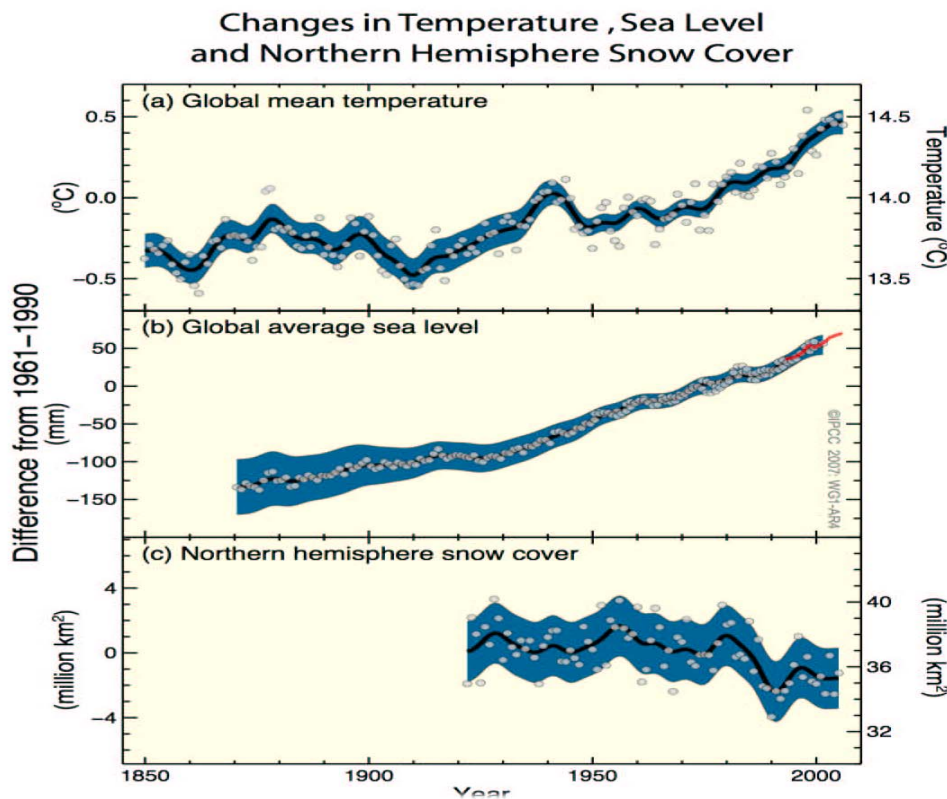


Figure:9 Graph shows change in temperature (top), sea level rise (middle), melt in snow (bottom)

The Intergovernmental Panel on Climate Change (IPCC) The global watchdog on climate change has identified South Asia as the most susceptible region in the world to climate change. The international community also recognizes that Bangladesh is especially vulnerable due to hydro-geological and socio-economic factors that include: geography, flat deltaic topography with low elevation, extreme climate variability governed by monsoons, high population density,

poverty, dependency on crop, agriculture, highly influenced by climate variability and change.

Sea Level Risks - Bangladesh

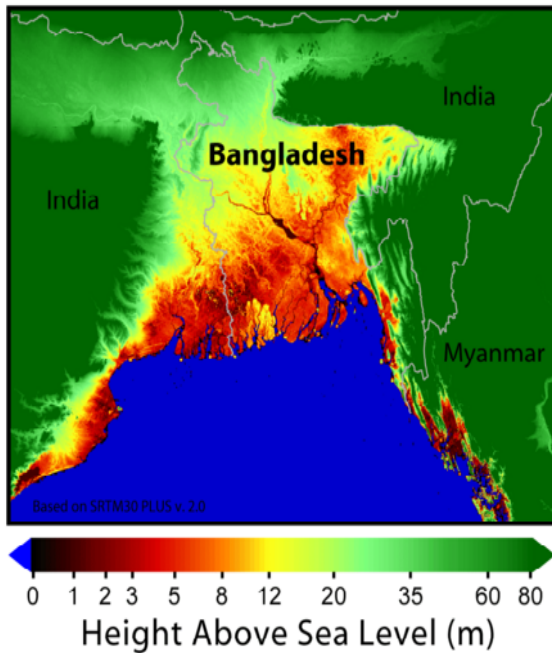


Figure 10: The map shows the affect of sea level rise Source: globalwarmingart.com

IPCC addressed in a report published in March 2001 that worldwide temperatures have climbed more than 0.5⁰ C. This slow but steady warming has had an impact on no fewer than 420 physical processes, animal and plant species on all continents. ⁽²⁰⁾

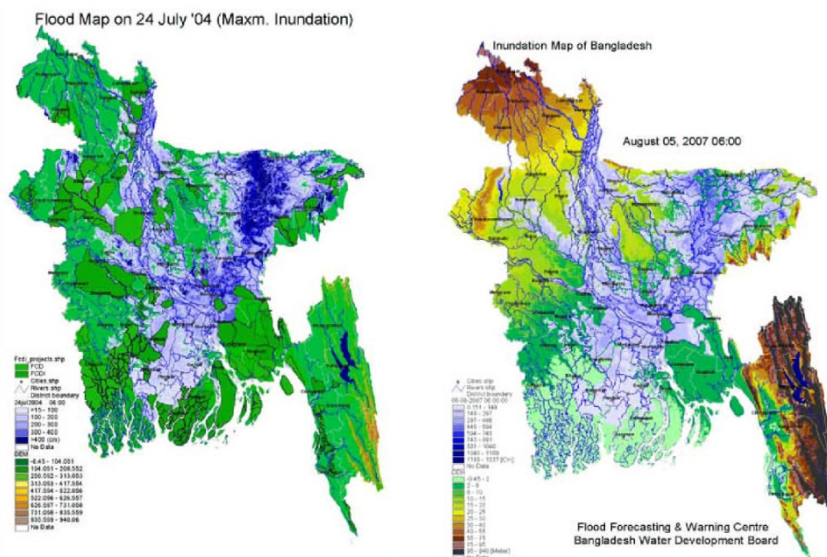


Figure:10 The map (Right) shows the 04' flood affected areas, (left) shows flood forecasting and warning areas

Mount Kilimanjaro has lost 75% of its ice cap since 1912. The ice on Africa's tallest peak could vanish entirely within 15 years. Coral reefs are dying off as the seas get too warm for comfort. Drought is the norm of Asia and Africa. Lake Baikal in eastern Siberia now freezes for the winter 11 days later than it did a century ago. Venezuelan mountaintops had six glaciers in 1972, now it has only two. Rising seas would contaminate water supplies with salt. Higher level of urban ozone, the result of stronger sunlight and warmer temperature, could worsen respiratory illnesses. The warmer temperature is carrying rodents and bugs, like mosquitoes and ticks increasing the incidence of dengue fever, malaria, encephalitis, and other afflictions.

IPCC said that by 2100 the average temperature will increase by anything between 1.4°C and 5.8°C .⁽²¹⁾ The changes could have severe implications with storms getting more frequent and intense, droughts more pronounced, coastal areas even more severely eroded by rising seas, rainfall scarcer on agricultural land and ecosystems thrown out of balance.

The climate change threat for Bangladesh is related to development, which causes the most threatening impacts on the natural, social, and economic systems of the country. The impact on the Bangladesh economy of climate change would be extremely adverse: an annual loss of \$1 billion of GDP by 2010, \$5 billion by 2070. It would have adverse impact on the ecosystem of the country as well. A wide range of mammals, birds, amphibians, reptiles, crustaceans, and above all the Royal Bengal Tiger will face extinction in Bangladesh due to climate change.

A UN Environment Program report indicates that global warming would cause more than 40 glacial lakes to burst in the next few years.⁽²²⁾ That means the rivers which come from the Himalayas will have less snow-fed waters.

Unplanned Urbanization:

The way to development in name of urbanization creates pressure on water. For the process of urbanization and growing population increases houses and high rises, which is created by filling marshy lands, ponds or lakes. The wastes from housing constructions creates blockage in the drains, which hampers rain water flow during rainy season and causes flood. The improper planning of sewerage and dumping domestic wastes are also a cause of pressure on water. Domestic waste is dumped in the rivers around the city which are polluting water, air, filling up the ponds and lakes. Industrial uses of water like for dyeing, washing also contaminate water. For urbanization population density is not equal in every area of the country. The cities, those are more developed contains more people but the source of water remains the same. This also creates pressure on availability of water. Water is not for human use only.

Adverse Impacts of water scarcity on Bangladesh

Bangladesh is a river-reign country. Her huge population is largely dependent of water. The Ganges has been flowing through Bangladesh from time immemorial. The lives and livelihoods of people, together with flora and fauna, are conjoined. The rivers provide drinking water, sustains agriculture, forestry, fisheries and inland navigation, helps to operate a quarter of the county's industrial activities, prevents salinity intrusion from the Bay of Bengal and plays the most significant role to maintain the ecology and bio-diversity of the country. There impact of water scarcity has a major impact on individual life and on the country as well. The climate change threat for Bangladesh is related to development, which causes the most threatening impacts on the natural, social, and economic systems of the country. The impact of climate change on Bangladesh economy would be extremely adverse: an annual loss of \$ 1 billion of GDP by 2010, \$ 5 billion by 2070 is estimated.

The UNESCO report indicated that by the middle of this century (2050), almost 2 million children die each year for want of a glass of clean water and adequate sanitation. Millions of women and young girls are forced to spend hours collecting and carrying water, restricting their opportunities and their choices. And water-borne infectious diseases are holding back poverty reduction and economic growth in some of the world's poorest countries.

According to a UN climate report, the Himalayan glaciers that are the sources of Asia's biggest rivers - Ganges, Indus, Brahmaputra, Yangtze, Mekong, Salween and Yellow - could disappear by 2035 as temperatures rise. Approximately 2.4 billion people live in the drainage basin of the Himalayan rivers. India, China, Pakistan, Bangladesh, Nepal and Myanmar could experience floods followed by droughts in coming decades. In India alone, the Ganges provides water for drinking and farming for more than 500 million people.

If the situation goes on this way, millions more will go to bed hungry and thirsty each night than do so already. An extra 272 million school attendance days a year, an added 1.5 billion healthy days for children under five years of age, together worth productivity gains of US \$9.9 billion a year. Deaths, based on discounted future earnings, worth US \$3.6 billion a year. ⁽²³⁾

Impact on Domestic, municipal water demand:

Fresh water is a fundamental requirement of all living organisms, crops, livestock and humanity. According to World Health Organization (WTO), each human being requires 20 liters of fresh water per day, though this figure varies from

country to country. ⁽²⁴⁾ 1 billion people live without clean drinking water. ⁽²⁵⁾ In Bangladesh population with access to water supply is: Urban 99%, Rural 97%. ⁽²⁶⁾ Daily per capita use of water in residential areas is: 350 liters in North America and Japan, 200 liters in Europe, 10-20 liters in sub-Saharan Africa. ⁽²⁷⁾

One billion people lack of access to safe water. An estimated 2.6 billion people representing half the developing world lack toilets and other forms of improved sanitation ⁽²⁸⁾ An estimated 140 million children are out of school and among them 80% live in Africa ⁽²⁹⁾ Girls and women spend an average of three hours per day collecting water from distant sources. ⁽³⁰⁾ In the past 20 years, over 2.4 billion people have gained access to safe water supplies and 600 million to improved sanitation though this number is very low. ⁽³¹⁾

The Gorai river is the main tributary, carrying water to the southwest region is becoming dry because of not getting proper water flow for India's water withdrawal from Ganges. Gorai plays a vital role as it passes through the industrial belt of Khulna, linking Rupsa-Passur and Sibsa river system and eventually emptying into the Bay of Bengal. The sweet water supply through the Gorai is vital for pushing back the salinity and keeping an overall environmental balance. This shrinks the supply of fresh water to the region. ⁽³²⁾

In Dhaka city the daily need for water is 2billion litres where the supply is 1600-1700 liters only. Access to fresh water is decreasing day by day for shortage of fresh water, for population growth and for contaminated water. So people have to use contaminated water, for which diseases among people is also increasing.

Sanitation problems have obvious implications for public health. Diarrheal diseases, arising largely from drinking unsafe water are a leading cause of death in the rural areas. Population with access to sanitation in Bangladesh: Urban 82%, Rural 44%. 2.6 billion people lack adequate sanitation. ⁽³³⁾

Impact on Agriculture:

Food production depends on availability of water. The interdependency of these two areas is evident. Crops in hot countries need 70% of all the water use in the world. ⁽³⁴⁾ It is alleged that to produce 1kg of wheat needs 1000 liters, rice 1400 liters, and beef 13,000 liters. ⁽³⁵⁾ Thus we see that there is a huge demand of sweet water to grow crops.

Bangladesh will need to increase its agricultural yield about 2% per year to meet the needs of the population that will increase to 200 million by 2020. To cope with the situation, Bangladesh must rely on surface water from rivers instead of withdrawal of ground water presently being practiced. The glacier melt-downs, carried by rivers, helps Bangladesh to grow 30 million of crops.

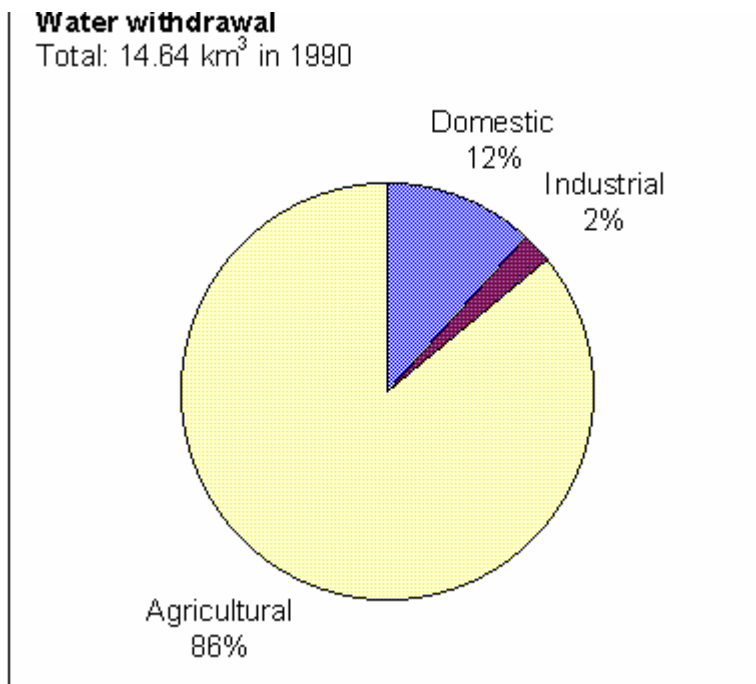


Figure:11 The pie chart shows the withdrawal of water for various purpose

Total annual water withdrawals as share of Annual Water Resource (1990), 12% for Domestic use, 2% for Industrial use and 86% for Agricultural use.⁽³⁶⁾ In 2000 the data is as such: 96% for agricultural use, 3% for domestic use, 1% for industrial use.⁽³⁷⁾ Sources of Irrigation water in Bangladesh are: Surface water 30.8% and Ground water: 69.2%. 63% water is used in Agriculture which provides 19% of GDP.

Bangladesh Agriculture at a Glance

Total family	: 17,600,804
Total farm holding	: 15,089,000
Total area	: 14.845million hectare
Forest	: 2.599 million hectare
Cultivable land	: 8.44 million hectare
Cultivable waste	: 0.268 million hectare
Current fellow	: 0.469 million hectare
Cropping intensity	: 175.97%
Single cropped area	: 2.851 million hectare
Double cropped area	: 3.984 million hectare
Triple cropped area	: 0.974 million hectare
Net cropped area	: 7.809 million hectare

Total cropped area	: 13.742 million hectare
Contribution of agriculture sector to GDP	: 23.50%
Contribution of crop sector to GDP	: 13.44%
Manpower in agriculture	: 62%
Total food crop demand	: 23.029 million metric ton
Total food crop production	: 27.787 million metric ton
Net production	: 24.569 million metric ton

Source: BBS, 2006 and Handbook Agricultural Statistics, MoA

Agriculture contributes about 30% of the GDP in Bangladesh. However, the agricultural production is heavily dependent on irrigation, which in turn depends on the availability of water. The availability of water has been affected by the global environmental changes in the region since water flows are controlled by tri state, Bangladesh, India and Nepal. Out of total water available, agriculture alone withdraws 86% in which 73% comes from ground water and the rest 27% from surface water sources in Bangladesh. In case of total irrigated area, surface water covers 31% and ground water covers 69% of irrigated area. ⁽³⁸⁾

As the salinity is increasing more lands are becoming barren. Most of the agricultural work uses water from rivers, wells, tube-wells. For the presence of arsenic and using that water in agriculture the vegetables that Bangladesh grows is losing actually food value.

Impact on Fisheries and Wildlife:

Fisheries sector takes 9% water of the country that contributes 4% in the GDP. Total number of species available in the water bodies estimated in 1990s is of 260 kinds. From fresh water every year 510,509 metric tons of fish was caught in 1990 and 810,832 metric tons in 2000. Freshwater aquaculture production was 135,442 metric tons in 1987 and 387,223 metric tons in 1997. ⁽³⁹⁾

Fisheries and wildlife are integral aspects of economic development in Bangladesh and strongly linked to the advancement of the country. Fish supplies 75% protein to Bangladesh people.

They contribute around 8% to national income, which is 32% of the total agricultural income. About 90% of animal protein in our diet comes from fish and livestock. ⁽⁴⁰⁾

Lesser flow of water in rivers makes lives of the species difficult. Pollution decrease oxygen presence in the water below 4 mg which is impossible for the survival of aquifers. Chemical and industrial wastes are killing this resource of Bangladesh on which a huge community is dependent to earn their livelihood.

The people who are dependent on water for their livelihood and living would try to find an alternate for survival. They would start resettling into the cities which are already over populated. This huge number of people would remain jobless, thousands of mouths without food, and a place to live. It would completely destabilize the country gradually.

Impact on Navigation:

Inland navigation holds one of the most important economic assets of Bangladesh. The water ways provides the cheapest mean of transportation. But the growing sedimentation and siltation from the upper riparian rives, disrupted communications in many water channels. It would again create joblessness and resettlements and would result in the high prices of goods in the market.

Impact on Hydropower:

Water is a great resource for producing hydroelectric power. There is so far only one hydroelectric dam in Bangladesh at Kaptai. There are two other rivers having potential to produce electricity. But there has been a decline in water quality in the Chittagong Hill Tracts due to seasoning of timber in the water and leakage of fuel from motorized engine transports. There is a huge potential to use tidal wave for producing electricity.

Impact on Energy Production:

Energy production depends on the availability of water, the production of electricity at hydropower sites in which the kinetic energy of falling water is converted to electricity. Thermal power plants, in which fossil, nuclear and biomass fuels are used to heat water to steam to drive turbine-generators, require large quantities of water to cool their exhaust stream.

Impact on Environment:

It is very important to preserve and protect the natural environment to have a sustainable development. All the environmental resources are linked to water. Water is essential for the protection, restoration, and preservation of the environment and its bio-diversity including wetlands, mangrove and other national forests, endangered species, and the water quality. Water is life and is necessary for all ecosystems to survive. Sound ecosystems ensure balanced communities of species and rich livelihoods. Rich and diverse livelihoods are fundamental for our well-being and for the survival of the poorest. Currently,

around 1,9 million species are described in the world and millions of others are still to discover ⁽⁴¹⁾

Our meals, health and livelihoods depend on biodiversity. Food resources from agriculture or fisheries, the diversity of medicinal herbs, water-consuming industries, or tourist activities developed next to lakes and rivers demonstrate that water resources are of vital importance for mankind.

Poor water quality affects the availability of fresh water that is used for various purposes. Contamination of surface water bodies and groundwater aquifers by agricultural pollutants, industrial discharge, domestic pollution, all these endangers both natural ecosystem integrity and public health. Environmental problems that causes water shortage includes: excessive soil erosion and sedimentation, water logging and salinity of agricultural land, groundwater depletion, watershed degradation and deforestation, reduction of biodiversity, wetland loss, saltwater intrusion and coastal zone habitat loss.

A book was published in 1963 by David Pren named “Bengal Plants” stressed is a list of 2,864 plants in Bangladesh, among them 10% been uprooted by now. IUCN in their “Red Book Data” included 106 kinds of plants in Bangladesh, those whose existence are in danger.

There used to be 8000 categories of rice paddy and 3000 categories of other crops which are very rare to see now-a-days. Fisheries Research Institution gave the data that there were 266 kinds of sweet water fish and 442 kinds of sea fishes available in Bangladesh. There were 126 categories of reptiles in Bangladesh. ⁽⁴²⁾

Climate change is expected to become increasingly important. A wide range of mammals, birds, amphibians, reptiles, crustaceans, and above all the Royal Bengal Tiger will face extinction in Bangladesh due to climate change.

Coral reefs are threatened by the bleaching that occurs with changes in ocean temperature and chemistry and forests and agricultural systems are vulnerable to increase incidents of disease and pest out-breaks as a result of changing climatic conditions. ⁽⁴³⁾

The devastating hurricane attack (Sidr) on the south and south-west of Bangladesh killed about five thousand people, millions of trees, thousands of wild animals and millions of cultured chickens and prawns.



Major districts affected by Cyclone 'SIRD'

Figure:12 Sidr affected areas

Because of the population density and the reasons that the coastal people have been driven away from their parental/ self-made homes by river erosion, constructions of dams or embankments, or industrialization and urbanization in certain areas of the country, they live in coastal zones. These people are termed as “environmental refugees” a term popularized by Andrew Simms since 2003. Floods, salinity intrusion and droughts, all drastically affect crop productivity and food security. We will also face riverbank erosion, sea water level rise and lack of fresh water in the coastal zones. Half of the children of Bangladesh already don't have enough to eat, get less clean water which causes waterborne diseases. 24% deaths are caused by the waterborne diseases.

Only a 50cm rise shows in the map that entire Barisal Division, half of Khulna Division and the districts of Lakkhipur, Noakhali, Feni, Cox's Bazar, and parts of Chittagong would then be under water. ⁽⁴⁴⁾



Figure 13: The map shows the areas affected by sea level rise

Bangladesh is one of the world's deltas formed by a dense network of 230 unstable rivers; most of the country is less than 10 meters above sea level. If the world gets warm by just one degree Celsius, 11% of Bangladesh would be submerged, putting the lives of 55 million people in danger. The Earth's average surface temperature has increased by 0.76^o C since 1850. Over the last 16,000 years, the rate of increase in global temperatures has been about 1^o C for every 4,000 years. Some predictions now suggest that we may see another 1^oC increase over the next one hundred years. In the fourth Assessment Report (AR4), published on 2 February 2007, the Intergovernmental Panel on Climate Change (IPCC) projects that, without further action to reduce greenhouse gas emissions, the global average surface temperature is likely to rise by a further 1.8^o-4^o C this century.

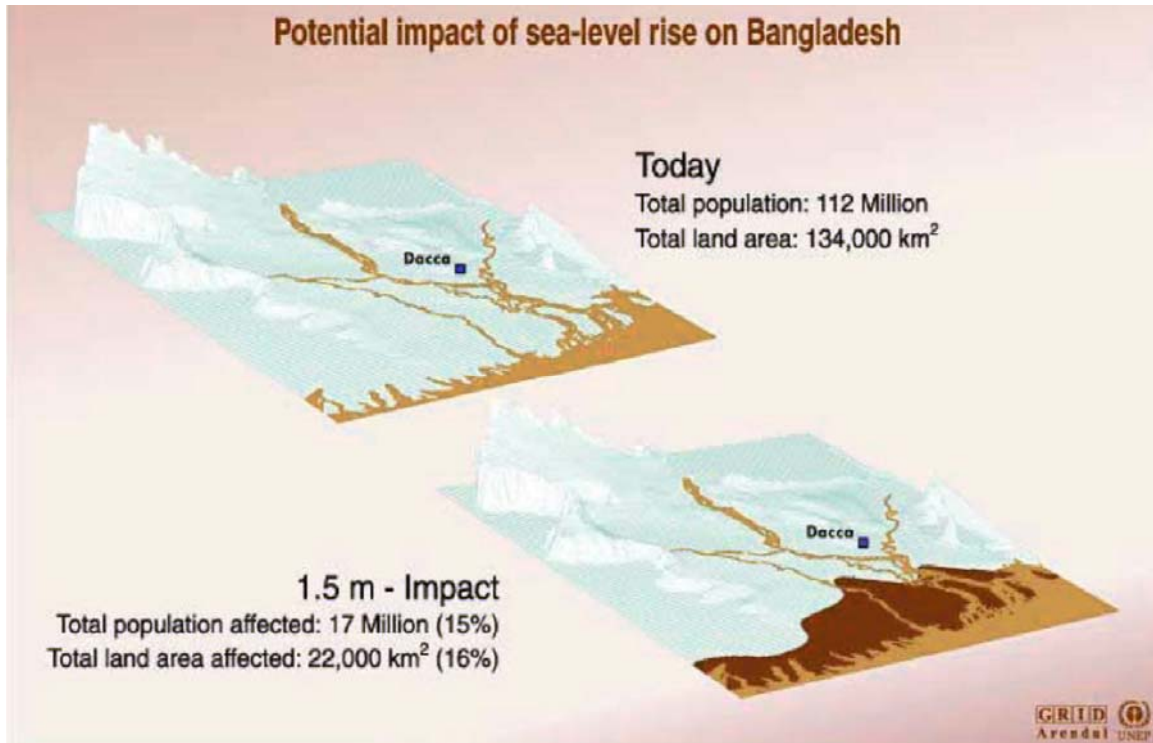


Figure:14 Impact of sea level rise on Bangladesh

Global warming and the inadequate river water flow, creating dams in the upper riparian countries causes flood in Bangladesh. The alluvial lands goes under water, the crops cultivation gets affected, a lot of people becomes homeless, epidemic breaks out that kills thousands of people, the ground-water level gets affected which cause arsenic problem in the water.

Impact on Preservation of Haors, Baor, and Beels:

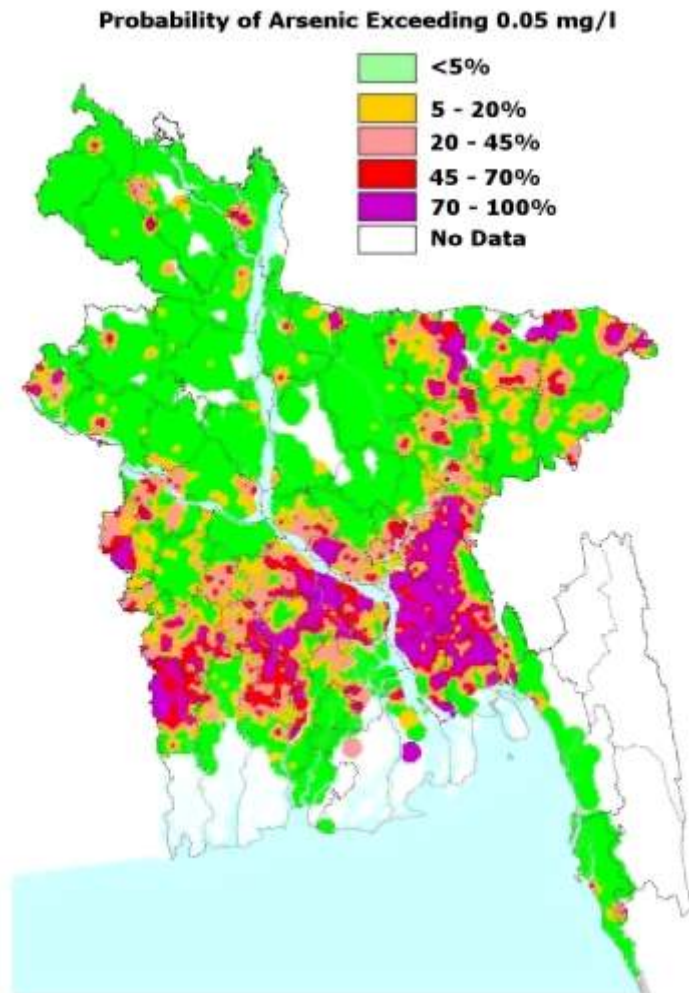
Haor, Baor and Beels are precious assets of Bangladesh holding immense regional characteristics. They have a great economic and environmental value apart from their scenic beauty. During the dry season when the beels turns in to quagmires the haors and baors retain considerable amount of water. These water bodies account for a large share of the natural capture fisheries and provide a habitat for a wide variety of aquatic vegetation and birds. They also provide sanctuary to migratory birds during winter. The haors and beels usually connect to some adjoining river through khals.

Haors and beels is used for irrigation, drained through engineering interventions and turned into croplands. This intervention has deleterious to the environment. This adverse affect have destroyed the fish and aquatic vegetables that thrive in these wetland and are important in the diet of the rural poor. These interventions also blocked the flow of wastes, discharged from the flood plains and domestic

sources, which naturally move out of the beels through the khals into the rivers drainage system.

Impact on Ground-water:

It has been observed that lowered river levels resulted in a reversal of the existing groundwater gradient affecting the availability of groundwater. The fall of groundwater about 10 feet has been observed in most of the wells along both the banks of the rivers the Ganges, the Mohananda and the Gorai-Madhumati The fall of groundwater level is maximum in the districts of Rajshahi and Pabna followed by Kushtia and Jessore. The quality of ground water has also deteriorated ⁽⁴⁵⁾



*Figure 15 Picture: Arsenic presence in drinking water of Bangladesh
Ref: <http://www.unicef.org/bangladesh/Arsenic.pdf>*

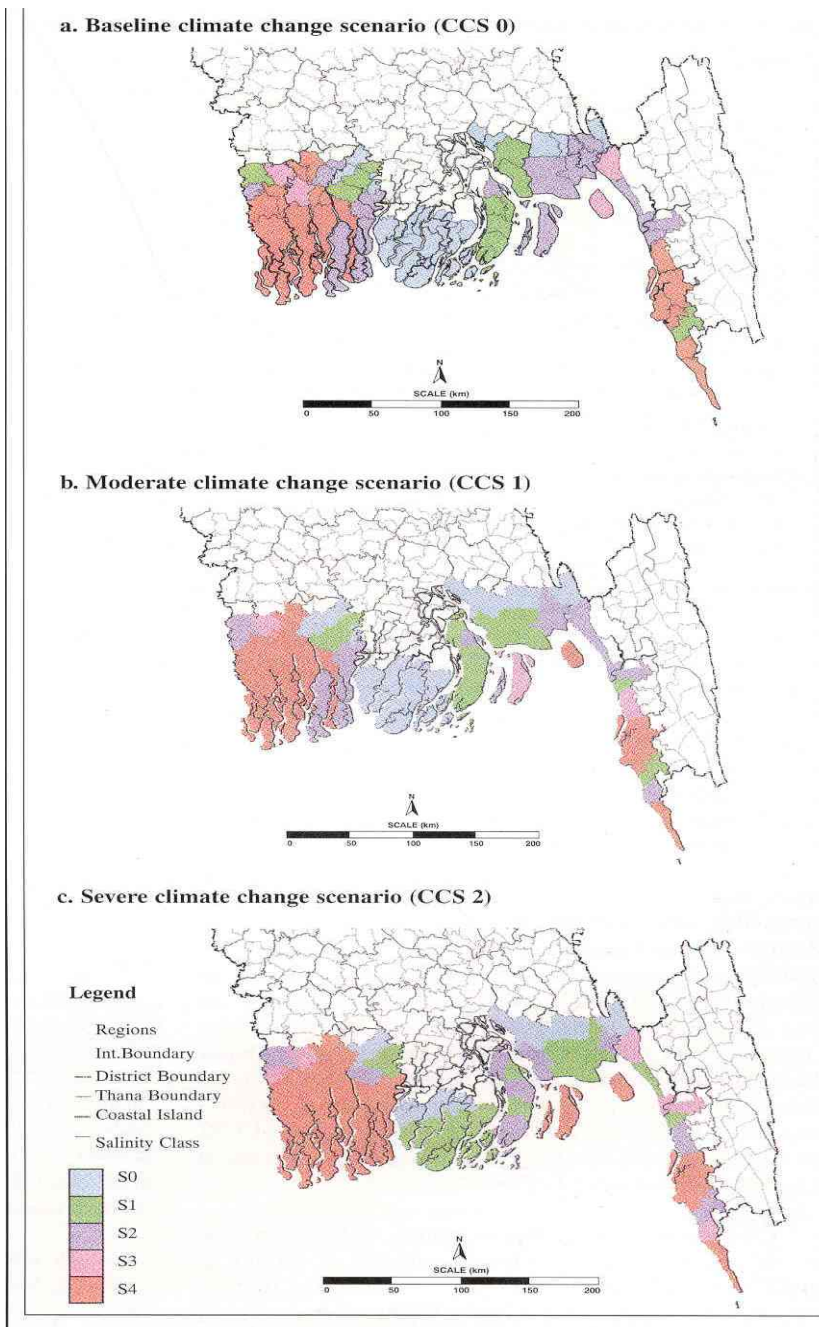
Out of 150 million population of Bangladesh nearly 80 million people are exposed to aquifer contamination caused by a metallic element called arsenic, the white,

tasteless metallic powder which can cause skin cancer, kidney and liver failure and in extreme cases death. In June 2000, the Dhaka-based National Institute of Preventive and Social Medicine (NIPSOM) tested some 1,000 tube wells in 17 districts and found arsenic in at least 180 water pumps while the earlier random studies said the metallic element was detected in 61 out of the 64 districts. ⁽⁴⁶⁾

Furthermore underground water source will be gradually depleted as 69% of Bangladesh's water reportedly comes from below ground. For Dhaka city itself, it relies on underground water reserves. There are 1300 bore-holes tapping water below Dhaka and it is reported that in some areas the water table has fallen more than 40 meters.

Increases in Salinity:

The most devastating effect of the diversion of the Ganges water has been caused by increase in salinity, both in surface and ground water leading to higher soil salinity in the south-west region of Bangladesh. Since the Farakka withdrawals commenced, the salinity ingress pattern in the area has a tendency of cumulative increase due to residual deposits which would further aggravate if the present pattern of Ganges flow continues.



*Figure: 16 Increase in average soil salinity under three climate change scenario
Source: www.bdix.net/./climate_change_salinity.htm*

Water reduction in the dry season results the increased salinity in Khulna area from 380 micro-mhos/cm during the pre-diversion period (1974) to about 29,500 micro-mhos/cm in April, 1992. The salinity front of 500 micro-mhos/cm moved through the Passur Estuary from 90 miles to about 136 miles inland after the diversion. These have resulted in increased soil salinity leading to crop damage and severe yield reduction. The Gorai river plays a dominant role as it passes through the industrial belt of Khulna, linking Rupsa-Passur and Sibsa river

system and eventually ends in to the Bay of Bengal. The sweet water flow of Gorai is very important to push back the salty sea water which keeps the balance in the environment. ⁽⁴⁷⁾ But as the flow of water decreased in this river the sweet water is not being able to push back the salty water, thus the salinity is increasing in these rivers and the whole land, agriculture and fresh water supply in these areas are getting affected.

Impact on Forestry:

The Sundarbans is the largest mangrove forest which is situated near the Bay of Bengal comprising an area of about 10,06,000 acres in Bangladesh is situated at the southwest of Khulna district. The forest extend about 50 miles north of the Bay of Bengal and are bounded on the east by the Baleswar river and on the west by the international boundary with India. With the increase of salinity, Sundri, the main species of Sundarbans, started drying and the regeneration of the species also decreased. Sundri may ultimately disappear if the salinity goes above the tolerance limit. ⁽⁴⁸⁾ Again a lot of people are dependent on Sundarbans for their living, which would make this people live a life below the poverty.

Impact on Public Health:

Today, one person in five across the world has no access to safe drinking water, and one in two lacks to safe sanitation, more than 30,000 children die before reaching their fifth birthdays, either by hunger or by easily-preventable diseases. And adequate safe water is key to good health and a proper diet. 1.8 million people die every year from diarrheal diseases. ⁽⁴⁹⁾ 3 900 children die every day from water borne diseases ⁽⁵⁰⁾ 90% of all deaths caused by diarrhea diseases are children under 5 years of age. Each year more than five million people die from water-related disease. For the first time, the number of people without improved drinking water has dropped below one billion.

At any one time, more than half the poor of the developing world are ill from causes related to hygiene, sanitation and water supply. The majority of the illness in the world is caused by fecal matter. 2.5 billion people still lack access to improved sanitation, including 1.2 billion people who still have no facilities at all. Eighty-eight percent of cases of diarrhea worldwide are attributable to unsafe water, inadequate sanitation or insufficient hygiene. ⁽⁵¹⁾

Number of deaths due to flood and drought is 1,919 people (1990-2000), Economic loss due to flood and drought is \$3,204 million. (1990-2000) ⁽⁵²⁾ The 1998 flood in Bangladesh ravaged approximately 60% of the land and affected over 30 million people. The aim of this study is to examine the impact of the flood on the health of the communities affected and to explore factors associated with episodes of diarrhea.

A survey reveals that out of 517 respondents, 98.3% developed health problems or found that existing health problems were exacerbated. Many perceived that their general health condition was 'much worse' (16.9%) or 'worse' (64.3%). The most prevalent condition was fever (63.6%), followed by respiratory problems (46.8%), diarrhea (44.3%), and skin problems (41.0%). Only 1.0% and 6.7% of the respondents treated water before drinking, by boiling and chlorination, respectively, although water collected from tube-wells (93.2%) and rivers (6.0%) was perceived by 75.0% of the respondents to be contaminated.

Mode of Solution

Bangladesh should take fast and foremost steps to develop the existing situation that threatens her existence. Bangladesh should increase her susceptibility and its ability to manage environmental threats. National awareness, national and international cooperation is essential to help the country and its people build the necessary capacity and resilience. There are a few methods that we can take to solve the situation like: collecting rain water. During the monsoon Bangladesh have plenty of water which goes waste and in dry season she lacks to survive. There is no rainwater harvesting process. Reservoirs can be made to preserve this abundant rain water, which is a good source of water.

Both the Ganges and the Brahmaputra have enough flow of water that is sufficient to meet the requirement of the country people and to survive in the future as well. But the flow remains so low in the dry season that the problem arises to meet the demand. Thus both India and Bangladesh should agree to augment the flow into the rivers in dry seasons. If the water can be stored in the upper riparian states by creating a reservoir in India or Nepal, India says 100000 cusec water can be flown in to the Ganges from Brahmaputra through a 200 km. link canal. But this remedy is not accepted by Nepal for various reasons like: it would take a big area to create a reservoir that Nepal lacks, if it is built it would create numbers of internally displaced people whom Nepal might not be able to resettle, it might cause heavy flood that can affect all three countries.

There is abundant water in the monsoon season, but the scarcity of water is in dry seasons. So if the abundant water can be used in productive sectors like: reservation, producing hydroelectricity and navigation routes, irrigation facilities within tri-partite arrangements, all the countries of the region can be benefited. Nepal can get a good number of foreign currency by exporting this resource.

All the states sharing the trans-boundary rivers should co-operate with each-other about this problem. On Bangladesh's claim to India of not getting proper flow of water in Padma for the Farakka barrage, India continuously deny the fact. They claim of providing the flow to Padma according to the Ganges Water Agreement. Years been passed on this topic blaming each-other, but it went in

vein. Bangladesh got massively affected for not getting proper water flow. So instead of this blame game it is time for Bangladesh to get in action, to make the Joint River Committee more active and get the proper data and if there occurs any problem there should be open governmental or non-governmental bi-lateral discussions and rapid actions. Bangladesh, can also solve this years old dispute by taking the issue to the International Court of Justice.

Bangladesh can recycle the waste water that we use for various domestic purposes, to use for irrigation, in the industries or in the house for domestic use. By doing so the pressure on pure fresh water can be cut to a tolerant amount.

As Bangladesh has a huge sea in her south part. The government can adapt technology to desalinize the ocean water. If that can be done successfully Bangladesh can satisfy the thirsty people and can supply adequate water to the agricultural, industrial, domestic purpose.

Conservation of ground water is very much needed. To preserve the environment we have to provide all the elements of the environment, to rescue the natural cycle. Trees are very important to maintain the ground water level and prevention of arsenic.

Dredging of silted rivers is also important to maintain the flow and to maintain the river course. River training is equally important.

Bangladesh should produce crops that need less water and plant trees that are suitable for the land according to the challenging situation.

To control flood and to pass out the excessive water, creating embankments is a good remedy. Embankments were constructed in Bangladesh for taking protection against flood which functioned well.

The rivers of Bangladesh coming from upper riparian bring silt with the flow. As the flow becomes low when it enters into Bangladesh the silt that the rivers brings makes the rivers narrow or decrease the depth of rivers. So sedimentation management plans needs to be taken.

The principle strategy of disaster management is disaster preparedness with the objective of mitigating the losses. Bangladesh should be keen to forecast any disaster that can occur in the country and the magnitude of the attack. There also should be disaster management team to work rapid on such areas to rescue the people and take proper means. There should also be measures to handle and resettle the environmental refugees that would be caused for the environmental degradation. The consequence should also remember the grievances of "environmental refugees" that how to maintain, settle and feed them and most of all bring them back to their regular way of life.

The urbanization should be done in a proper way thus it does not fill up all the water reservoirs. There should be individual water supply for every city or locality. There should be separate waste water reservoir tanks. The sewerage should be dumped in separate places which are away from the possibility to mix with water. Technology needs to be enhanced to make use of the wastes and utilize it in productive sector.

Conclusion

Bangladesh is a developing small nation with a huge population of over 150 million. This country, since her birth has been fighting so many challenges. People of this nation always fight back whenever there is an external, internal or natural threat. Scarcity of water is creating human life miserable. This country is still largely based on nature. Discussing various dimensions of water security it is possible to face the challenges and live in a sound environment. Considering all the consciousness, internal dimensions can be changed. It is the upper riparian countries who needs to understand that de-stabilizing one country in the region would de-stabilize the whole region. People would constantly try to find their way out which would turmoil the tranquil environment. India should understand the impacts of withdrawal of water from the trans-boundary rivers. The water that flows within India is not only India's water. Even India is facing the same consequences when the upper riparian country China also planned to withdraw water from her river, which would make the whole region unstable. Tibet has the world largest river systems. Its river waters are a lifeline to the world's two most populous states China and India as well as to Bangladesh, Myanmar, Bhutan, Nepal, Cambodia, Pakistan, Laos, Thailand and Vietnam. These countries make up 47% of the global population. To reserve the bounteous water reserves that the Tibetan plateau holds, China implemented a plan that has dammed rivers not just to produce hydropower but also to channel water for irrigation and other purpose, and is currently toying with massive inter-basin and inter-river water-transfer projects.



Figure:17 In Yellow shows the flow of Brahmaputra river rising from China and fall into the Bay of Bengal

It's not only the country, it's the country people, the government policies, regional countries and as well the international actors, all have to put some effort to sustain the environment, try not to create any problem that can be a threat to the existence of any country. Cause once a threat to a country would become a threat to the non-affected country of the region.

This region has been the theatre of politics and big games since immemorial time. The region should work in unison, helping each-other in every possible sector rather creating problems. In terms of playing global politics it's again the strength of unity that this region can have to face the world besides being a threat to each other. If the home, the region is not supportive no one nation can play a stronger part in the global politics. So to maintain the peace of the region it is very important that this small land country with huge population remains safe.

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