

Effect of Climate Change on The Coastal Area in Bangladesh

S.M. Abdullah Al Faruq¹, Md. Zohrul Islam² and Hasan Mahmood³
^{1,2,3}Khulna University of Engineering and Technology
E-mail: faruq.kuetian@gmail.com

Abstract

Bangladesh is likely to be one of the most vulnerable countries in the world to climate change. Climate change is an important issue now a days. Various human activities are making the world hot to hotter. The ultimate result is global warming, i.e. climate change. Rising temperature in the atmosphere causes sea level rise and affects low lying coastal areas and deltas of the world. Possible loss of land through beach erosion due to sea level rise on the eastern coast of Bangladesh is examined. Some discussions are also made on the impacts of back water effect due to sea level rise on flood situations in the country. Finally, a few remarks are made on the adaptation options for Bangladesh in the event of climate change. It is very essential to have sufficient water supply and sanitation in all over the world. This study includes an outlook of remedial measurements that can be considered for sustaining the water supply and sanitation due to climate change in coastal belt of Bangladesh. The coastal area affected by severe weather condition which hampers the existing water supply and sanitation facilities. The aims to contribute the trend of environmental changes in the coastal areas of Bangladesh and to identify the major forces responsible for causing these changes, to investigate the coverage of safe water supply services and sanitation facilities in southern zone and to recommend or suggest alternatives adaptation strategies for promoting community-led water supply and sanitation. The country is already beset with many problems like high population density (120 million people living in an area of 144000 km²), shortage of land to accommodate the people, food security, human health, illiteracy, and so forth. The above mentioned types of disasters make the problems all them

Keywords: Climate change · Impacts · Erosion · Back water effect ·

1. Introduction

Climate change is global phenomenon and caused by the accumulation of greenhouse gases in the lower atmosphere. The main sources of greenhouse gases are due to human activities. Rising temperature in the atmosphere causes sea level rise and affects low lying coastal areas and deltas of the world. In 1990, Intergovernmental panel on Climate Change estimates that with a business-as-usual scenario of greenhouse emission, the world would be 3.3⁰ C warmer by the end of next century, with a range of uncertainty of 2.2 to 4.9⁰ C (Warrick et al., 1993). With the rise of temperature, sea level will rise because of thermal expansion and ice melt. Sea level rise has various impacts on Bangladesh, a coastal country facing 710 km long coast to the Bay of Bengal. It already has affected Bangladesh by land erosion, salinity intrusion and loss in biodiversity. Its potential threats are coming even strongly in the future. Sea level rise will cause river bank erosion, salinity intrusion, flood, damage to infrastructures, crop failure, fisheries destruction, loss of biodiversity, etc. along this coast. But, there is still a lack of awareness among the public about climate change and also, little consensus among the concerned bodies about the existence and the types of environmental effects of climate change and the numbers of environmental displacements. Lack of coordination among the organizations makes the situation even more difficult to tackle. It is very essential to have sufficient water supply and sanitation in all over the world. In Bangladesh most of the people live in coastal area are affected with salinity problem and scarce pure drinking water. In every year many people die due to various types of water borne diseases like diarrhea, cholera etc. which is certainly related with the insufficient sanitation system. In coastal areas of Bangladesh which are frequently affected by various natural calamities, there is no sufficient water supply or sanitation system. Thus they are always in want of pure water for drinking, cooking, washing etc. Though Public Health Department and different NGOs install deep and shallow tube-wells, shallow shrouded tube-wells (SST), very shallow shrouded

tube-wells (VSST), pond sand filter (PSF) and rainwater harvesting equipments, it seems inadequate to meet their need. Climate includes patterns of temperature, precipitation, humidity, wind and seasons. "Climate change" affects more than just a change in the weather; it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them.

Because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks.

2. Experimental Details

Location of the Study Area

The field study is related with the present situation of water supply and sanitation in coastal area. For this purpose, Shyamnagar Upazila of Satkhira District in the Division of Khulna was selected. Shyamnagar Upazila is bounded by Kaliganj (Satkhira) and Assasuni upazilas on the north, Sundarbans and Bay of Bengal on the south, Koyra and Assasuni upazilas on the east, West Bengal of India on the west. The main rivers here are: Raymangal, Kalindi, Kobadak, Mother Kholpetua, Arpangachia, Malancha Hariabhanga and Chuna. South Talpatti Island at the estuary of the Hariabhanga is notable places. Shyamnagar has 12 Unions/Wards, 127 Mauzas/Mahallas, and 216 villages. The unions are 1. Vurulia. 2. Shyamnagar Sadar. 3. Munsigong. 4. Horinagor. 5. Koikhali. 6. Ramjan nagor. 7. Nurnagar. 8. Chondipur. 9. Isharipur. 10. Atulia. 11. Podmopukur. 12. Kshimari.

Shyamnagar has a population of 1949899. Males constitute are 1004415 of the population, and females 8945024. This Upazila's eighteen up population is 132516. Shyamnagar has an average literacy rate of 53.32% (7+ years).

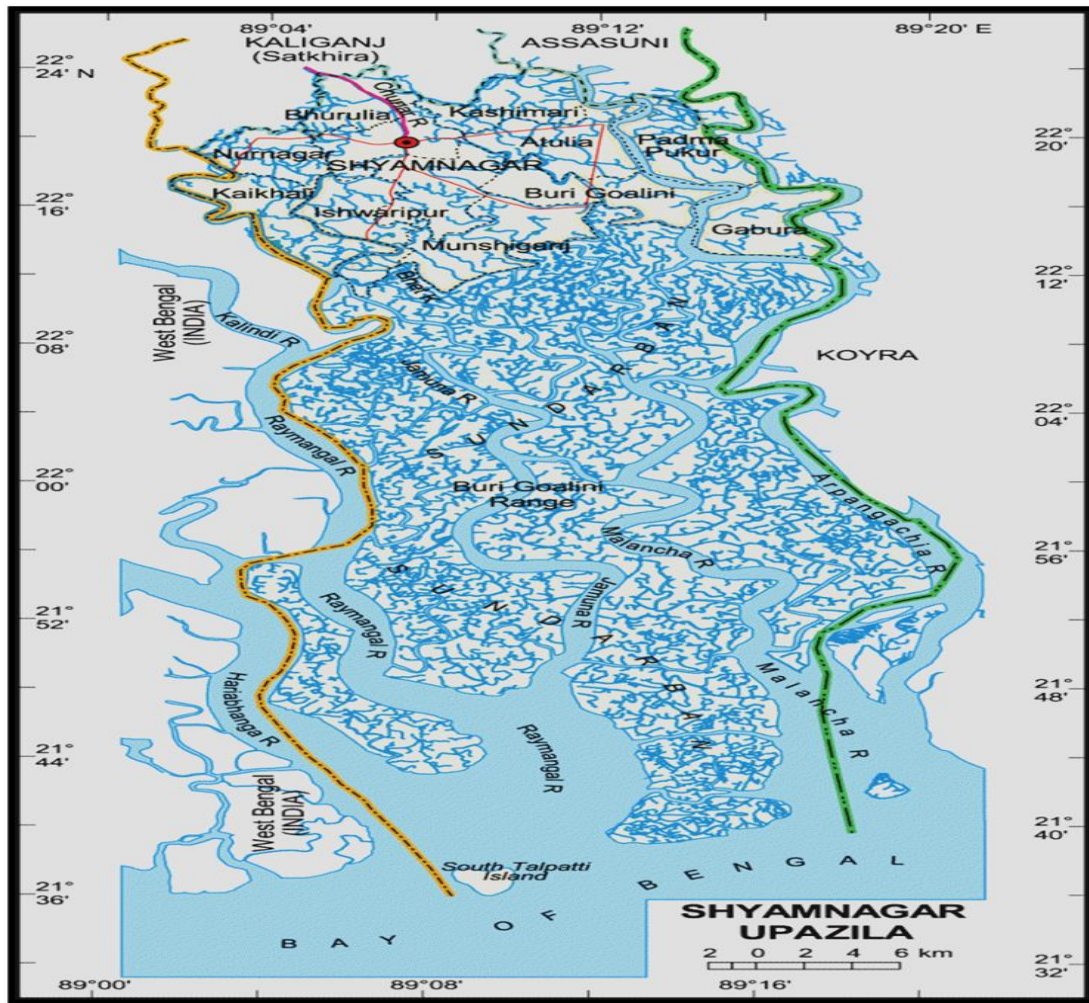


Figure 1: Map of Shyamnagar Upazila

3. Methodology

An elaborated literature study on the related topic was carried out for the better understanding and representation of the problem. To identify the technical and social problems of existing water supply and sanitation situation a questioner survey was conducted among the inhabitants the selected area. Pictorial references of the existing water supply and sanitation facilities were also taken. Raw water and filtered water samples were collected from selected PSFs that were tested in the laboratory for water quality investigation. Important parameters like total coliform (TC), faecal coliform (FC), turbidity, salinity and color were tested for raw water and treated water. After that, suitable adoptive measurements are suggested considering the available facts like available source of water, production cost, accessibility etc.

Present State of the Problem

According to the recent field report (DPHE, Shyamnagar upazila, Shatkhira District, Year 2010) various types of water supply mechanisms are installed in the affected zone which include deep and shallow tube-wells, shallow shrouded tube-wells (SST), very shallow shrouded tube-wells (VSST), pond sand filter (PSF) and rainwater harvesting equipments etc.

4. Data Collection

Collection of Primary Data

While performing site visits, water samples were collected from the rivers, and channels/canals of nearby the crop fields. Soil samples from the crop fields have also been following standard techniques. The land-use patterns, managements and socio-economic aspects of the coastal people have been collected from local administrative unit like Thana Agriculture Office and directly from the local people through questionnaire. In doing so data were collected from Ramjan nagor, Shyamnagar Sadar, Nurnagar, Kshimari. The local people in some selected areas of the coastal zones were also interviewed about their socio-economic aspects and livelihoods. In each location, some 10-20 farmers were randomly selected for the purposes.

Collection of Secondary Data

Relevant information have been accumulated by journals, periodicals, browsing internets, personal communications and visiting various Non Government Organization (NGO)s offices like Sushilon, OXFAM, Brati, Muslim Aid, Christian Aid, Action Aid, Pragati etc.

Summary of the questionnaire survey

Table 1: Results of the questionnaire survey

Total No of family	170
Total population	850
Type of family	
(a) Nuclear	110
(b) Extended	60
No of families using tube well as drinking source	52
No of families using PSF as drinking source	90
No of families using rain water harvesting & other units	28
Average drinking water required in each family (l/c/d)	25
Average water required for cooking in each family (l/c/d)	8
No of families using pit latrines or sanitary latrines	45
Open defecation or others	55

5. Results and discussions from the questionnaire survey

PSF is the main drinking water sources in the study area. Another largest drinking water source is tube-well. But most of the tube-wells are salinity affected. The salinity level is not acceptable level. This drinking water sources do not satisfy the drinking water standards. Therefore, increased unavailability of fresh water the people are forced to drink contaminated water. As a result people are affected by different water borne diseases diarrhea, cholera etc. On the other hand people in general have a very poor knowledge about sanitation. Sanitation coverage is not satisfactory one in these areas. Sanitation coverage is only 45%. People are not aware about their health. People in the area often defecated on the drains, in open fields, near the road sides, or on the riverbanks. There are no specific actions on strategies regarding safe water supply and sanitation facilities in the study areas. Thus, strong policy advocacy is required to ensure safe water supply and hygienic sanitation facilities in the study area.



Figure 2: Existing water supply facilities in Shamnagar Upazila

Table 2: Sanitation Facilities in Shamnagar Upazila

SI no	Name of union	Total Family no	No of family who use sanitary latrine	No of family who are not use sanitary latrine	Eligible but there is no latrine	No of Ineligible family	ineligible and there is no land	In (%)
01	Vhurulia	2674	721	1322	02	426	203	26.96
02	Khashimari	4857	2339	1528	160	744	86	48.15
03	Shyamnagar	5650	3193	1074	287	1096	-	56.51
04	Nurnagar	3895	1536	1217	167	852	123	39.44
05	Koikhali	3602	1277	1873	75	361	16	35.45
06	Romjannagar	4455	1783	2209	27	303	136	39.95
07	Munshigonja	5304	1545	2396	42	910	411	29.12
08	Eswaripur	3896	1414	1004	419	1004	55	36.29
09	Burigoalini	5167	2029	1340	562	956	280	39.26
10	Atulia	4560	1532	1792	112	1034	90	33.60
11	Padmapukur	3221	596	2160	129	297	39	18.50
12	Gabura	5017	534	2675	142	1510	156	10.64
	Total	52298	18496	20590	2124	9493	1595	34.48 (average)

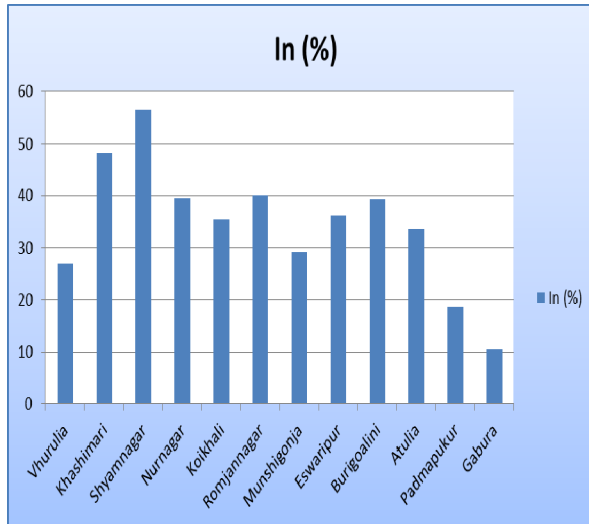


Figure 3: Sanitation Uses in Shamnagar Upazila

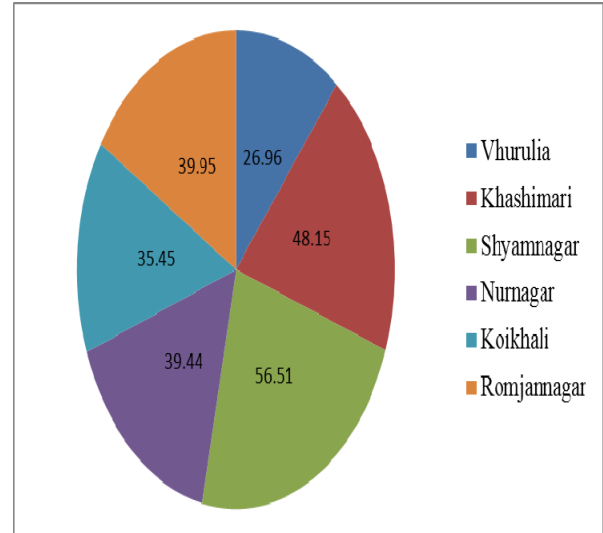


Figure (a)

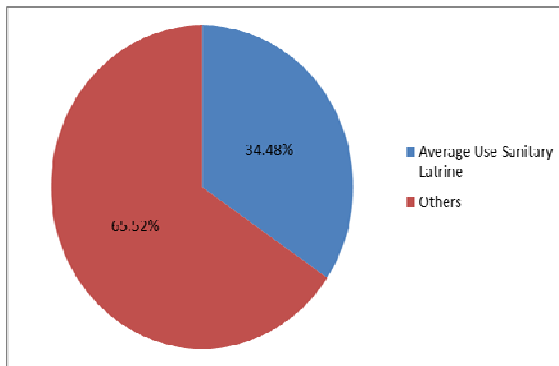


Figure 4: Present practice of sanitation based on questionnaire survey (Shamnagar Upazila)

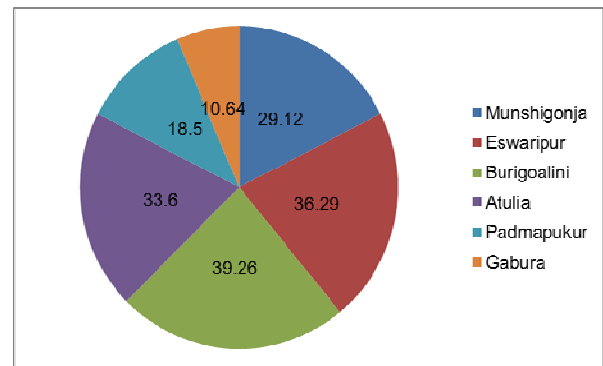


Figure (b)

Figure 5: Present Sanitation practices in Shamnagar Upazila

People in the Shamnagar Upazila, sanitation practice are not good. Sanitation coverage is the maximum at Shamnagar 56%. In other Upazilas sanitation coverage condition is more deplorable. This is due to the occurrences of divesting cyclone Sidr and Aila. Because sanitation sector are the vulnerable due to storm surges. Another cause is people in these areas are not conscious about their health. As a result, they suffer by the different sanitation related diseases.

Table 3: Drinking water sources in Shyamnagar upazila

Serial no.	Name of union	Tubewell			Shallow tubewell		
		Total	Functioning	Closed	Total	Functioning	Closed
01	Vhurulia	161	138	23	30	19	11
02	Khashimari	472	450	22	40	30	10
03	Shyamnagar	387	350	37	61	44	17
04	Nurnagar	191	166	25	46	33	13
05	Koikhali	94	81	13	12	08	04
06	Romjannagar	91	65	26	08	03	05
07	Munshigonja	153	110	43	05	02	03
08	Eswaripur	174	119	55	37	15	22
09	Burigoalini	129	67	62	24	17	07
10	Atulia	181	142	39	14	08	06
11	Padmapukur	268	250	18	11	09	02
12	Gabura	158	147	11	28	25	03

--	Total	2459	2085	374	316	213	103
----	-------	------	------	-----	-----	-----	-----

Source: DPHE – 2010

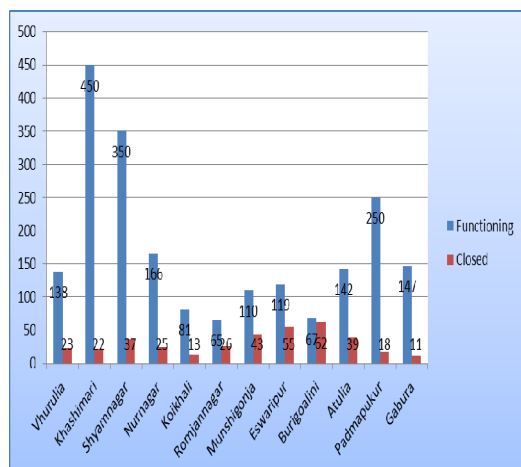


Figure6: Drinking water source in Shamnagar Upazila (Tubewell)

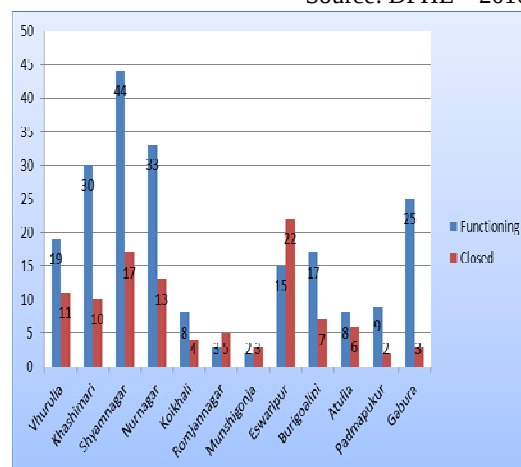


Figure 7: Drinking water source in Shamnagar Upazila (Shallow Tube-well)

Table 4: Drinking water sources in Shyamnagar upazila

Serial no.	Name of union	SST			Rainwater harvesting unit		
		Total	Functioning	Closed	Total	Functioning	Closed
01	Vhurulia	21	19	02	05	05	00
02	Khashimari	45	42	03	00	00	00
03	Shyamnagar	132	127	05	08	08	00
04	Nurnagar	51	49	02	01	01	00
05	Koikhali	05	05	00	05	05	00
06	Romjannagar	02	02	00	03	03	00
07	Munshigonja	00	00	00	00	00	00
08	Eswaripur	26	24	02	05	05	00
09	Burigoalini	10	09	01	04	04	00
10	Atulia	01	01	00	02	02	00
11	Padmapukur	00	00	00	01	01	00
12	Gabura	00	00	00	03	03	00
--	Total	293	278	15	37	37	00

Source:DPHE2010

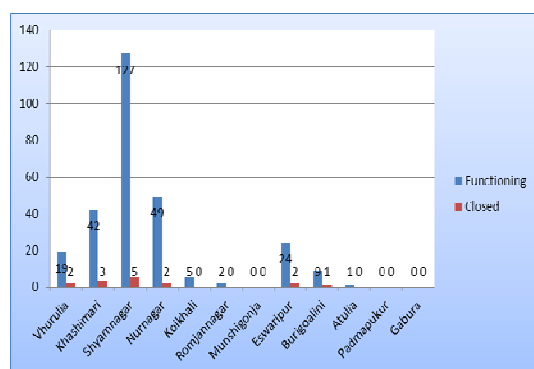
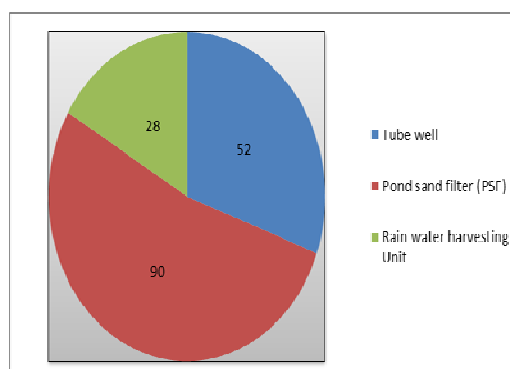


Figure 8: Drinking water sources in Shyamnagar upazila (Shallow Shrouded Tube-well)



9: Different sources of drinking water (Shamnagar Upazila)

At Shamnagar most of the people drink PSF water for drinking purposes. Although some of these PSF water does not satisfy the drinking water standard. But people in these areas are careless.

Table 5: Turbidity, pH. Salinity of raw water and treated water and NO₃, Total solid, dissolved solid and suspended solid.(for PSF water)

SI No.	Location	Turbidity (NTU)		pH		Salinity (mg/L)		NO ₃ (mg/L)	Total solid	Dissolved Solid	Suspended Solid
		Raw Water	Treated Water	Raw Water	Treated Water	Raw Water	Treated Water				
01	Shamnagar	17.6	3.92	7.32	7.31	230	200	Under range	180	100	80
02	Burigoalini	7.79	4.18	8.06	7.88	642	469	0.6	270	130	140
03	Munshigang	8.79	1.32	7.22	6.87	150	80	0.3	630	460	170

. Findings from the Field Investigation

On the basis of the data collection and chemical analysis of the collected sample, the following observations can be drawn-

- The values of alkalinity, salinity, turbidity were found very high. Because Aila was occurred two year ago at the southern region of Bangladesh.
- Salt water intrusion is a major problem in most of the tube-well. The upper aquifers are mostly saline.
- In most of the bank of the pond is not well protected. So the outside impure water could easily enter into the pond during Aila.
- In most areas deep tube-wells (though more expensive) provide fresh water. Other technologies include PSF, SST, VSST & RWH.
- Coverage of safe drinking water is low compared to the rest of the country. This part of the coastal belt is by far the most under-served area.
- People are bound to use this water. This water is not satisfying the drinking water standard.
- The impurities removal efficiency of the existing PSFs is not adequate which does not satisfy the drinking water standard.
- Water and sanitation infrastructures are vulnerable to cyclones and storm surges.

Most of the sanitary latrines were destroyed during Aila. The practicing of open defecation is increased after the divesting cyclone Aila & Sidr.

6. Conclusions

Bangladesh is one of the most victimized countries of the world due to the climate change. Water supply and sanitation is the most vulnerable sector due to climate change. The upper aquifers are mostly saline. people living in the affected areas suffer from deprivation of the water supply and sanitation facilities and become vulnerable to several health risks. At Shamnagar people in general have a very poor understanding of the relationship between the health and sanitation. It is important to understand that the improvement of health is not possible without sanitary disposal of human excreta. However, neither sanitation nor water supply alone is good enough for health improvement. It is now well established that health education or hygiene promotion must accompany sufficient quantities of safe water and sanitary disposal of excreta to ensure the control of water and sanitation related diseases. People in the area often defecate on the drains, in open fields, near the road sides, or on the riverbanks. There are no specific actions on strategies regarding safe water supply and sanitation facilities in the study areas. Water supplied by Government and NGO is insufficient. Extensive research and development for cost effective and socially acceptable solution is required. Improvement of existing water supply facilities is required. Raising awareness to avoid practicing open defecation and use sanitary latrines. Thus, strong policy advocacy is required to ensure safe water supply and hygienic sanitation facilities in the study area. The sanitary collection, transportation, treatment and disposal of human waste promotes health, improves the quality of the environment and thus, the quality of life in a community. In communities occupying coastal areas, human waste is directly disposed of into the surface water such as rivers,

canals and sea or in the mudflat to await the tide. These surface waters, however, are often the communities' sources of food, and water for drinking, domestic and personal cleaning. Present condition of sanitation shows that contaminated water and human wastes are major factors in the transmission of serious diseases in coastal regions of Bangladesh.

7. References

- [1] Agrawala, S., Ota, T., Ahmed, A.U., Smoth, J., Aalst, M.V., *Development and Climate Change in Bangladesh Focus on Coastal Flooding and the Sundarbans*, Organization for Economic Co- operation and Development (OECD), Paris, 2003.
- [2] Ahmed, M. F. and Rahman, M.. "Water Supply & Sanitation, Rural and Low Income Urban Communities", 3rd Edition, ITN- Bangladesh, 2007.
- [3] Brammer, H., Asaduzzaman M. & Sultana, P. 'Effects of Climate and Sea-level Changes on the Natural Resources of Bangladesh. Briefing Document No. 3, Bangladesh Unnayan Parishad (BUP), Dhaka, 1993.
- [4] Broadus, J.M.,. *Possible impacts of, and adjustment to, sea level rise: the cases of Bangladesh And Egypt*, In: Warrick, R.A., Barrow, E.M. and Wighley, M.L. (Ed.). *Climate and Sea Level Change: Observation, Projection and Implication*, Cambridge University press, Cambridge, 1993.
- [5] Brzeski, V., Newkirk, G. *Integrated coastal food production systems- a review of current literature*, *Ocean & Coastal Management* 34, pp.55-71, 1997.
- [6] Chanratchakool, P., *Problems in Penaeus monodon culture in low salinity areas*, *Aquaculture Asia* VIII (1), pp.54-56, 2003.
- [7] Chatterjee, R., Huq, S., *A Report on the Inter-regional Conference on Adaptation to Climate Change Mitigation and Adaptation Strategies for Global Change* 7, pp.403-406, 2002.
- [8] Chowdhury, A., *Disasters: Issues and Responses*, In: Gain, P. (Ed.), *Bangladesh Environment: Facing 21st Century*, SEHD, Dhaka, Bangladesh, 1998.
- [9] Department Of Public Health Engineering (DPHE, Shyamnagar Upazila, Shatkhira District, Year 2010.
- [10] Farquharson, F., Fung, C.F., Chowdhury, J.U., Hassan, A. Horsburgh, K. and Lowe, J. *Impact of climate And Sea Level Change in Part of the indian sub- Continent (CLASIC)*, DFID funded KAR Project, Final Report, Centre for Ecology & Hydrology (CEH), UK, 2007.
- [11] Kausher, A., Kay, R.C., Asaduzzaman, M., Paul, S., *Climate Change and Sea-level Rise: the Case of the Coast. Briefing Document No. 6*, Bangladesh Unnayan Parishad (BUP), Dhaka, 1993.
- [12] NAPA, 2002. *Interactive Dialogue on Climate Change, Bangladesh and the LDC Expert Group (LEG), Workshop on National Adaptation Programs of Action (NAPAs)*, Dhaka, Held on 18-21 September 2002.
- [13] Salam, M.A., Ross, L.G., Beveridge, C.M.M., *A comparison of development opportunities for crab and shrimp aquaculture in southwestern Bangladesh using GIS modeling*, *Aquaculture* 220, Pp.477-494, 2003.
- [14] Smit, B., Burton, I., Klein, R.J.T., Street, R., *The Science of Adaptation: A Framework for Assessment, Mitigation and Adaptation Strategies for Global Change* 4, pp.199-213, 1999.
- [15] Warrick, R.A., Bhuiya, A.H., Mirza, M.Q., *Climate Change and Sea-level Rise: the Case of the Coast. Briefing Document No. 6*, Bangladesh Unnayan Parishad (BUP), Dhaka, 1993.