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Periurban Water Security

Conflict and cooperation in water resource management in peri-urban Khulna, Bangladesh: Present status of water security and agenda for future exploration

Periurban water security

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Conflict and cooperation in water resource management in peri-urban Khulna, Bangladesh: Present status of water security and agenda for future exploration

Abstract

Khulna, one of the most vulnerable cities in the world, is confronted by flooding, salinity intrusion and storm surges. Such climatic hazards are aggravating the existing urbanization impacts while environmental migration is shaping and re-shaping the peri-urban characteristics and dynamics in Khulna. As a large number of migrants settle in the peri-urban areas, contestation for the limited resource base and livelihood opportunities create conflicts over control on the natural resource capitals. This scoping study report is based on a preliminary study to define the scope of the project in terms of the extent, range and nature of research activities to be carried out in the coming years. This project is intended to analyze how climate change and interventions at different scales are altering societal relations – whether the division between the urban and peri-urban is increasing and whether the societal relations and changes are affecting the policy choices. The initial findings of the study indicate that freshwater is scarce in the area due to high levels of salinity in the groundwater and surface water, and pollution of the Mayur river – an important freshwater body that can be saved to serve both the urban and peri-urban areas. The existing water insecurity would further aggravate with the continuing trends in urbanization and climate change.

Key words: *water security, Khulna, climate change, conflict, cooperation.*

1. Introduction

1.1. Background and rational of the study

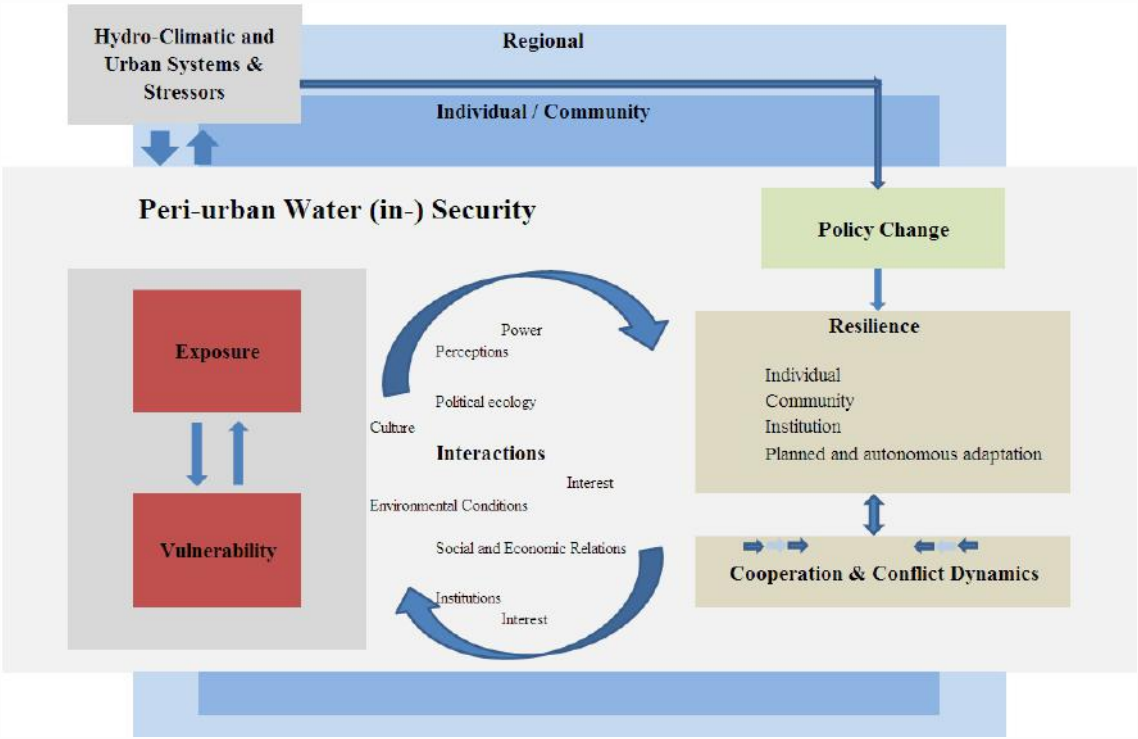
The urban and peri-urban areas in Khulna are relatively flat, on an average only 2.5 metres above the mean sea level, making these vulnerable to poor storm water drainage and cyclonic storm surges. In future, the poor and vulnerable people in Khulna will face climate change effects in three major ways: (i) sudden onset events, e.g., floods and cyclones, (ii) slow onset processes, e.g., coastal erosion and salinity intrusion, and (iii) cascade effects, e.g., aggravation of existing problems by straining overstretched public services (Roy *et al.* 2013). Huq *et al.* (1994) examined the effects of a one-metre rise scenario and identify Khulna district as one of the three most vulnerable districts in Bangladesh, with about 80 percent of the area prone to inundation affecting 3 million people. Aggravated flooding, salinity intrusion and storm surges are identified as other consequences of the sea level rise. Hanson *et al.* (2011) rank Khulna 13th among the 20 most vulnerable port cities on the basis of a combined consideration of climatic and socio-economic changes. This ranking also projects the risk of population exposed to coastal flooding due to sea level rise and storm surge in 2070, and finds Khulna at the 6th place, seeing more than 700 percent increase in exposure. In terms of damage as a percentage of overall gross domestic products (GDP), Hallegatte *et al.* (2013) rank Khulna 8th among the 10 most vulnerable coastal cities. Such climatic hazards are aggravating the existing urbanization impacts while environmental migration is shaping and re-shaping the peri-urban characteristics and dynamics in Khulna. As a large number of migrants settle in the peri-urban areas, contestation for the limited resource base and livelihood opportunities create conflicts over control on the capitals.

Recognizing such coupled impacts urbanization and climate change on water security and community resilience, the project is aimed at a better understanding of the institutional and other dynamics

1.2. Conceptual Framework

The conceptual framework based on which the project will investigate the implications of climate change and urbanization stressors on peri-urban water security, probable conflicts, scopes of cooperation, and their combined effects on resilience at different scales (e.g. community, regional, etc.) is presented in Figure 2. The concept of 'Peri-urban Water (in-) Security' is shaped by the interaction between exposure and vulnerability to water insecurity on one hand, and resilience directly influenced by policy changes on the other. Exposure and vulnerability will be assessed qualitatively and/or quantitatively depending on the context. Conflict and cooperation are considered as the main mediators shaping the resilience. The spatial and temporal scales will also be considered.

Figure 2: Conceptual framework of the study [adapted from Kloos et al. (2013)]



Review of literature on the state of knowledge on the links among climate change, urbanization and water security, substantiated by field sites assessment, will help identify the stressors and their implications for conflicts and cooperation. Review of relevant urbanization and climate change policies at national, regional and sector level will help identify the implications for peri-urban areas. The approach suggested for 'Conflict Prevention and Cooperation' by Mostert (2003) will be followed in understanding the processes of conflict reduction and promotion of cooperation. The site-specific and regional contexts and situations will be analyzed to identify the main issues and players, and the potential for conflict and cooperation. Starting from a specific 'conflict issue' and recognizing the probable coexistence of conflictive and cooperative actions at various scales (Zeitoun and Mirumachi 2008), conflict will be considered as both an opportunity and a threat. The multidimensional concept of vulnerability (and exposure) will necessitate applying various methods that need to be adapted to the specific context and scales considered. A value-based approach to vulnerability (O'Brien and Wolf 2010) examining different perception of climate change by individuals, groups or communities, which in turn affects vulnerability, will also be followed.

around peri-urban water issues, especially with regard to water insecurity and vulnerability, conflict and cooperation, through the analysis of current vulnerabilities in peri-urban communities and the identification of policies, actions and institutional changes that are needed to build resilience against water insecurities emerging from urbanization and climate change. In this context, the following research questions have been framed:

1. How urbanization and climate change interact in inducing water insecurity in peri–urban settings, creating potential for conflict and/or cooperation?
2. How current water, climate change and other relevant policies influence peri–urban areas and to what extent they (might) create potential for water–related cooperation/conflict?
3. In what ways these social–environmental transformations around water, land and other resources in peri–urban areas produce, reproduce or bring about changes in conditions of poverty, inequality, social differentiation, resilience and vulnerability?
4. What are the options that can be identified on the basis of this analysis for conflict solution and stimulation of cooperation in ways that strengthen the position of the most vulnerable and marginalized groups that are affected by water insecurities?

This scoping study report is based on a preliminary study to define the scope of the project in terms of the extent, range and nature of research activities to be carried out in the coming years. The study, a rapid review type, does not necessarily describe final research findings in any detail but is intended to identify potential areas and methods of investigation. This scoping study has used a combination of qualitative, stakeholder consultations and engagement, as well as professional experiences of the research team in order to delineate the scope of the project. A range of literature on the relevant terms, concepts, methods, etc. has been reviewed for conceptualizing the research problems and understanding the dynamics of peri-urban water security and community resilience within the broader context of climate change and urbanization. Focus was given in understanding the characteristics and social dynamics of peri-urban area; relevant information on the study area; and implications of climate change and urbanization for water security and community resilience. Parallel to this exploration of secondary information was the feedbacks collected from the stakeholders and local people through focus group discussions (FGD), group consultation, etc. especially for identification of research sites/cases (Figure 1).

Figure 1: FGDs with (a) fishermen, (b) women and (c) farmers in peri-urban Khulna

(*a*)

(*b*)

(*c*)

Source: JJS, 2014

1.3. Methodological approach

Knowing the fact, particularly in Khulna, that conflict is not always explicitly expressed, identification and exploration of conflict or cooperation from different perspectives is very important. The weaker section of the society may lose their dispute though they may have resentment and pain in their mind. Sometimes, they express their discontent when they are alone or away from their powerful counterpart but rarely express it in front of their stronger contenders. Recognizing this situation, different classes (Ti 2001) and mechanisms (Hsiang *et al.* 2013) of conflicts will be investigated. While the class includes the nature of conflicts (e.g. social, economic, etc.), mechanism suggests a plausible explanation of conflict evolution (declined productivity, grievance, climate-induced migration, urbanization, etc.). Such an approach to conflict will help better understand the conflicts as well as the probable space of cooperation to be promoted. Initially, case studies on conflict and cooperation will be conducted to draw a 'life cycle' of different conflicts and potential areas of cooperation. Focus Group Discussion, Key Informant Interview, Expert Interview, etc., will be conducted for this purpose. If deemed necessary, hydrological analysis and other quantitative studies will be conducted to establish the backward and forward linkages of conflict and cooperation with implications for policy intervention and other externalities like climate change. For example, analysis on the availability of water in adequate quantity and acceptable quality for different uses in the Mayur river in different time and places coupled with determination of water requirements by different users can be useful in better understanding the prevailing conflict among the users, and also in identifying the scope of cooperation and policy intervention.

This project will analyze how climate change and interventions (both technology and policy) are altering societal relations – whether the division between the urban and peri-urban is increasing and whether the societal relations and changes (e.g. migrant influx, access control) are affecting the policy choices (i.e. priorities on the urban areas over the peri-urban). Attempts will be taken to categorize conflicts based on underlying causes (e.g. urbanization, climate change). A mixed-method approach comprising qualitative and quantitative methods will be employed in this respect. Necessary hydrological analysis will be carried out to explore the implications for conflicts and cooperation. Interviews, case studies, community meetings and stakeholder workshops will be conducted. Key actors will be engaged in the study through regular meetings and joint site visits for policy advocacy and to ensure inclusive planning. Established contacts and links (e.g. with the Khulna City Corporation (KCC) Mayor) will be useful for this purpose.

Community resilience improves with enhanced knowledge and capacity. Stakeholders' active engagement in the process will be an essential element of this project. A multi-stakeholder platform, established through a previous action research project, will be promoted to enhance capacity of the vulnerable communities. Stakeholder workshops will be organized to discuss the sources of conflicts and the scopes of cooperation. Local-level awareness building activities and national-level policy interventions, through stakeholder consultation, direct engagement in research activities, etc. will be also attempted during the project.

An understanding of the conflict-cooperation-policy dynamics involving water security and climate change will largely depend on an understanding of the relevant stakeholders, actors and institutions. Actor and Institutional mapping will be employed to analyze the linkages and relations. Stakeholder analysis will be conducted to identify the key stakeholders and assess their knowledge, interests, positions, alliances and importance related to a particular issue. During this process, their differential access to information, perceptions of the issues at stake, and ability to influence the decision-making process will be taken into consideration.

An important aspect of this research project will be to contribute in policy process by facilitating evidence based policy making at various levels. The following template (Table 1) will be used to undertake review of relevant policies having implications for creating water related conflict/cooperation in peri-urban Khulna.

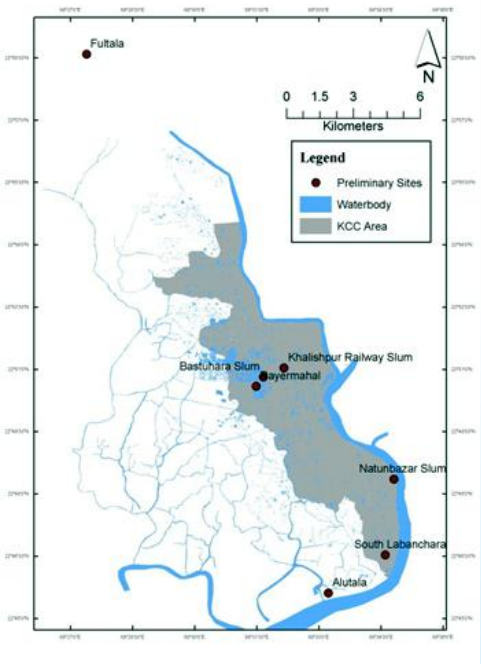
Table 1: Template for policy review

Policy	Coverage in relation to water security			Implication	
	Climate change	Urbanization	Peri-urban	Conflict	Cooperation
National					
Regional					
Sector					

1.4. Site selection

The predominant characteristics of the peri-urban areas of Khulna are heterogeneity in land use, mixed institutional arrangement, diversity in livelihood options including dependence on urban resources, urban–peri-urban hydrological linkages, urban–peri-urban water use nexus, and vulnerability to water stress. These characteristics and the site-specific 'conflict issues' were considered for selecting the preliminary sites (Figure 3). Both physical and socio-economic issues including industrial use, water logging, water/resource use, urban pocket, climate migration, etc., were considered as the selection criteria. Site selection criteria also included the physical (e.g. canal, river) or virtual (e.g. groundwater transfer) 'water linkages' between the urban and peri-urban areas. In the final selection of research locations and cases, priority was given to those that most clearly relate to climate change processes for which there are evidences in the area concerned. The final selection also involves discussion with stakeholders in a sharing meeting. Based on those discussions and suggestions from the stakeholders the list of sites has been narrowed down to 10. Table 2 presents the 10 sites with the issues prevailing in those locations.

Figure 3: Peri-urban sites selected for scoping study



Source: Prepared by Author.

Table 2: Sites suggested by the stakeholders

SL	Site	Issues
1	Alutala	- Administrative conflicts (sluice gate operation) - Fishermen-farmer water distribution conflicts - Upstream-downstream conflicts - New migrated urban area - Land graber-fisherman conflicts - Sweet water-saline water conflict - Community participation is present
2	Harintana	- Fishermen-farmer water distribution conflicts - Upstream-downstream conflicts - Water logging due to unplanned settlements. - Scarcity of irrigation water and low agricultural production - Decrease of cultivable land due to rapid urbanization - Lowering of water table - Decrease in soil nutrient
3	Labonchara	- Water logging - Drinking water scarcity - Water pollution - Salinity in surface and ground water - KWASA is constructing a reservoir is south Labonchara
4	Bastuhara Slum	- Drinking water problem - Wastewater problems
5	Khalishpur Railway Slum	- Water scarcity - Over-extraction of ground water by water vendor and industries - Lowering of water table in dry season
6	Gollamari	- Drainage Outlet of KCC - Solid waste dumping from slaughter house - Dumping of clinical wastes
7	Rayer Mahal	- Water logging - Scarcity of irrigational water - Salinity in ground water - Poor service of water distribution authority
8	Sachibunia	- River grabbing (Mayur, Kajibacha, Hatia) - River drying - Water logging - Surface water pollution
9	Fultala	- KCC-local people conflict for ground water extraction - Lowering of ground water level - Irrigational water problem
10	Maheswarpasha	- Scarce ground water - KCC is planning to treat surface water in supplying water for communities.

Source: Stakeholder sharing meeting held in Khulna on 30 December, 2014

2. Water security, urbanization and climate change nexus

Khulna is the third largest (46 sq. km.) metropolitan city of Bangladesh and once it is known as an industrial city with a large sea port at Mongla. Geographically Khulna City is located on a natural levee of the Rupsha and Bhairab rivers and characterized by Ganges tidal floodplains with low relief, criss-crossed by rivers and water channels, and surrounded by tidal marshes and swamps. Historically Khulna was a market town and seat of administration. During the early days, tobacco and sugarcane were traded here and it had a shopping link with Calcutta. Khulna declared as a municipality in 1884. It became linked with railway in 1985. Industrialization process has been started in Khulna since 1960s (Murtaza 2001). Demographic characteristic shows that population growth in Khulna is rapid (3.8 percent) due to rural-urban migration. Literacy rate is generally higher compared with other cities. Gross population density is very high, about 18,000 per sq. km. A large proportion of people are engaged in informal sector activities (Murtaza 2001).

Topographically, the slope of Khulna is westward but regionally it is southward. The average height of Khulna is about 3.32 metres from mean sea level. The area comprises of mostly flat land with two natural ground slopes in different direction: one is from northwest to southwest which is parallel to the general flow direction of the Bhairab River (upper reach) and Rupsha River (middle to lower reach); and another is from northeast to southwest which may facilitate the sea water intrusion to the aquifer system of the Khulna. The Khulna City Corporation (KCC) in southwestern Bangladesh lies on the Late Holocene-Recent alluvium of the Ganges deltaic plain in the north and Ganges estuarine plain in the south (Adhikari *et al.* 2006).

The prevailing water insecurity of peri-urban communities in Khulna is aggravating due to their exposure to different stressors of climate change and urbanization, and the lack in their capacity to mitigate the impacts. Urbanization in Khulna is sustained mainly by the acquisition and conversion of agricultural land and water bodies in the peri-urban areas. The present urbanization and growth trends of Khulna indicate that the areas covered by water bodies, low lands and fallow lands are decreasing, whereas the built-up areas are increasing. It is projected that in 2019 the water bodies and low lands in the present city area will reduce to 3 percent and 29 percent, respectively, and the built-up areas will expand to 33 percent (Ahmed 2011). The resulting altered land entitlements, and water access and rights are leading to stresses on the lives and livelihoods of the peri-urban communities.

Current climatic trends and variability are perceived to have multi-dimensional effects on water security in the peri-urban areas. A significant portion of the peri-urban population depends on crop farming, daily labour, private service and small business. These people are relatively poorer, have smaller assets bases, attained lower education level and have less access to political or social leadership. They are likely to be more vulnerable to climate change induced hazards and disasters. The increasing heat stress during the pre-monsoon summer season is likely to bring discomfort to the lives of these people, particularly to the elderly and physical labourers.

Domestic water demand for drinking, bathing and washing-cleaning is most likely to increase due to the rising temperature and humidity, particularly during the pre-monsoon season. The increased demand may add to the stresses for the women, who usually take the burden of household water collection.

Increasing temperature and humidity would create a more favourable condition for the formation of cyclones in the Bay of Bengal. Increase in the frequency of severe cyclones is evident from the occurrence of two recent devastating cyclones – Sidr in May 2007 and Aila in November 2009. These cyclones,

accompanied by high storm surges, caused widespread damage to properties and the loss of human and animal lives. Increase in soil salinity, due to long-standing saline water on farmlands from storm surge inundation, has affected the crop cultivation.

Increasing water levels, accompanied by higher rainfall, may exacerbate the flooding problem in Chhoto Boyra and the water-logging problem in Labonchara. More agricultural lands in Alutala may come under tidal influence, the soil salinity of those lands may increase, the cropping pattern may change, and some of those lands may be converted for shrimp aquaculture. Thus, some of the current cropped lands may become shrimp ghers in future and the share-croppers, small farmers and agricultural labourers may be adversely affected by such change in land use.

The anticipated changes in future climate are likely to have an impact on human health. There is already a prevalence of water-borne diseases, such as diarrhoea, cholera, typhoid, dysentery and jaundice, and skin and eye infections among the peri-urban communities. The summer season is the peak time of occurrences of such diseases. Incidences of such diseases may increase in future due to an increase in flooding and water-logging from increased rainfall and river water levels.

3. Water security, urbanization and climate change policies

The Master Plan for the city projects that the metropolitan area will be more than doubled in its areal extent in future. However, there is no clear indication on how Khulna Water Supply and Sewerage Authority (KWASA) will meet the future water demands in the urban and peri-urban areas given the existing freshwater scarcity. Although adaptation measures are being planned through the construction of climate-resilient urban infrastructures and augmentation of freshwater supplies for the city, none of these measures addresses the water insecurity in the peri-urban areas. Peri-urban communities are adapting to their water insecurity through collective actions, water conservation practices, and changes in livelihoods and agricultural practices. A formal or informal institutional arrangement could strengthen the adaptive capacity of the peri-urban communities.

4. Conflict, cooperation and climate change around peri-urban water resources

In peri-urban Khulna water conflict among different users are very complex. The nature and dynamics of these complexities depends on several bio-physical, social, economic and political factors. Water insecurity induced conflicts in the Khulna area are largely constituted by a number of stressors related to urbanization, climate change, and regional and upstream interventions in the hydrological systems. Some stressors such as wastewater pollution and solid waste disposal originate locally due to urbanization, while others such as salinity intrusion and reduced upstream freshwater flow are the results of climate change and/or interventions in the flow regime.

Contestation for peri-urban resources is creating conflicts and undermining community resilience. This is evident from the consequences of urban land development projects buying peri-urban lands in Chhoto Boyra, or urban elites taking control over peri-urban water resources in Alutala. The peri-urban biophysical systems and processes are also being altered by the urbanization. Urban wastewater and solid wastes have degraded the common water bodies such as the Mayur river and the local environment.

5. Final cases selected for further research and intervention

5.1. Hydro-social system

The Rupsha-Bhairab and the Mayur rivers are hydraulically linked through an intricate network of canals and water bodies in and around Khulna city. Both rivers play important roles in trade, commerce, industries, livelihoods and ecosystem sustenance in the urban and peri-urban areas. The Mayur river is shared by the urban and peri-urban residents for various uses. Although it provides important ecosystem services and functions to the urban and peri-urban residents of Khulna, it has been facing severe threats due to unplanned and unregulated urbanization. Future projections indicate that it would be further affected by salinity intrusion and sea-level rise due to climate change. These compounding effects of climate change and urbanization will reduce water availability in the river and aggravate the water insecurity in the area.

5.2. Urbanization impacts

The growing land developing businesses in Khulna are responsible for filling up of the open water-bodies in the peri-urban areas. Competition among different user groups in the urban and peri-urban areas for the scarce water resources increases as urbanization increases the domestic and industrial water demands and reduces the surface and groundwater resources. This competition has created complex water-use conflicts among the urban and peri-urban residents. The nature and dynamics of these conflicts are governed by various social, economic and political factors, and are visible in three major ways. First, urban wastewater flow limits freshwater availability in both urban and peri-urban areas, and creates water use conflicts between the urban and peri-urban residents as well as among the urban residents themselves. Wastewater flow from a few industries in the peri-urban areas adds to river pollution. Second, urban water supply is planned to be augmented by transferring groundwater from peri-urban areas. This water transfer plan, presently postponed, was protested against by the peri-urban residents because it would severely deplete their local groundwater. Third, culture fisheries, practiced in the peri-urban stretches of the Mayur River and adjoining areas, require saline water whereas agriculture requires freshwater. Urban elites, who own most of the fish farms, influence the control of saline water flow through the downstream regulator at Alutala, limiting freshwater availability for peri-urban agriculture.

5.3. Drinking water scarcity

Previous study and preliminary assessment of potential sites reveal that peri-urban communities in Khulna are primarily vulnerable to the unavailability of freshwater for drinking and domestic uses. Since most of the surface water and ground water sources are polluted or saline, they have to look for distant sources to collect water. The degree of this burden of water collection varies across economic classes and among men, women and children. In the urban areas, the drinking water supply system is entirely based on a ground water resource. The KWASA serves only 30 percent of the urban population through a piped distribution system; the rest of the population depends on personal or community-based hand tube wells (HTWs).

The situation is particularly bad during the dry season when the water in the Mayur and nearby khals becomes extremely polluted. People with no other choices have to use this water for washing and bathing. In some areas, women and children have to walk long distances to collect drinking water. People are

forced to drink tube well water contaminated with arsenic and iron in the absence of an alternative safe source of water. Sometimes they have to consume the contaminated water to avoid the hard work and uncertainty in collecting water from the distant sources.

5.4 Water pollution

Surface water pollution is another reason behind water insecurity in the Khulna area. Peri-urban communities, particularly those dependent on the Mayur river and other polluted water sources are extremely vulnerable to degrading water quality. Wastewater generated in the city is discharged into the Mayur river through 22 open drains. At present, about 240-60 tons of solid wastes are generated daily within the KCC area, which is disposed off in the unplanned landfills and low-lying areas around the city, causing severe environmental and health problems in the peri-urban areas. The pollution of the river's water limits the livelihood opportunities based on agriculture and aquaculture that previously existed in the peri-urban areas. The aquatic environment is severely degraded in Gollamari, where a major outfall discharges urban waste-water into the Mayur river. Water logging, a major problem in Harintana, Labonchara, Rayer Mahal and Sachibunia in the event of heavy and continuous rainfalls, also causes pollution of local surface water bodies. Other major sources of water pollution include industrial wastes and bathing of cattle. In addition, salinity intrusion and arsenic contamination in ground water are also reducing water access and security in the region.

Assessment of the physico-chemical characteristics (as part of a previous action research project) of the waste-water flowing into the river from the KCC area revealed that the pH values were within the permissible limit for re-use in agriculture. The DO levels were found to be below the permissible level recommended for irrigation. The EC and TDS values exceeded the irrigation water quality limits at a few spots. Some anion and cation concentrations were higher than the irrigation water quality limits. In sum, the wastewater is not totally safe for re-use in agriculture, and may pose threats for health, sanitation and the environment. Analysis of the hydrochemistry of the Mayur river indicates that the river is overwhelmed with pollution, and the localized pollution is increasing rapidly due to stagnation and drainage congestion. DO in the river water ranges from 0.9 to 4.8 mg/L, whereas at least 5 mg/L is essential to maintain healthy aquatic life, and a DO level less than 3 mg/L is indicative of the absence of most fish species. Salinity in the river water shows high variation, from 5 to 14 ppt, with an average of 9 ppt. This variation is well correlated with the tidal variation when the Alutala regulator is open to the Rupsha river.

5.5. Institutional arrangement

In peri-urban area water management institutions are not found in any form. Local people said that neither KCC nor local government authority take the responsibility to ensure the basic community needs at their site. In South Labonchara local peoples said that their locality is situated at the city corporation boundary and they pay all taxes as per the KCC rules and regulation. However, no KCC facilities (electricity, water supply, school, health facilities) are there in place.

KCC and KWASA have been trying to augment water supply to meet the increasing urban demand. A plan to import groundwater from a peri-urban area through a pipeline was severely resisted by local activists and civil society. It was eventually postponed by a court decision in a case filed by the Bangladesh Environmental Lawyers Association (BELA), although at that time 40 percent of the project funds had already been invested. A plan of KWASA to import river water from a location some 40 kilometers away from the city is facing uncertainty since the salinity level at the source has already exceeded the projected

level. They have also planned to construct a surface water treatment plant and an impounding reservoir to augment water supply in the city. However, these plans and strategies are solely aimed at addressing urban water supply and vulnerabilities.

5.6. Peri-urban agriculture

Agriculture in peri-urban Khulna is almost entirely dependent on surface water and rainwater. Surface water bodies have been diminishing because of the spread of urban built-up area, encroachment by urban users and urban waste-water pollution, resulting in changes in cropping practices of the farmers. They rarely cultivate boro rice and are switching from rice to vegetables which can be irrigated with wastewater. Salinity-tolerant crop varieties are also being introduced as the soil and water salinity are increasing. Some farmers are converting their agricultural lands to practice fish farming. In extreme situations, farmers sell off their agricultural lands to developers and move to non-agriculture based livelihoods.

6. Conclusion

The Master Plan for the city projects that the metropolitan area will be more than doubled in its areal extent in future. However, there is no clear indication on how Khulna Water Supply and Sewerage Authority (KWASA) will meet the future water demands in the urban and peri-urban areas given the existing freshwater scarcity. Although adaptation measures are being planned through the construction of climate-resilient urban infrastructures and augmentation of freshwater supplies for the city, none of these measures addresses the water insecurity in the peri-urban areas. Peri-urban communities are adapting to their water insecurity through collective actions, water conservation practices, and changes in livelihoods and agricultural practices. A formal or informal institutional arrangement could strengthen the adaptive capacity of the peri-urban communities.

Table 4: Cases according to dominant nature of conflict and climate change implication

Cases	Nature/cause of conflict			Climate change implication
	Resource driven	Socioeconomic structure	Institutional	
Sluice gate operation			✓	
Fishermen-farmer conflicts		✓		✓
Upstream-downstream conflicts	✓			✓
New migrated urban area	✓			✓
Land graber-fisherman conflicts		✓		
Salinity intrusion	✓			✓
Water logging due to unplanned settlements			✓	✓
Scarcity of irrigation water and low agricultural production	✓			✓
Decrease of cultivable land due to rapid urbanization			✓	

Cases	Nature/cause of conflict			Climate change implication
	Resource driven	Socioeconomic structure	Institutional	
Decrease in soil nutrient	✓			✓
Drinking water scarcity	✓			
Water pollution		✓		
Salinity in surface and ground water	✓			✓
Construction of reservoir by state agency			✓	
Wastewater problems			✓	
Over-extraction of ground water by water vendor and industries		✓		✓
Lowering of water table in dry season	✓			✓
Drainage Outlet of KCC			✓	
Solid waste dumping from slaughter house			✓	
Dumping of clinical wastes			✓	
Water logging	✓			✓
Poor service of water distribution authority			✓	
River grabbing		✓		
River drying	✓			✓
KCC-local people conflict for ground water extraction			✓	
Scarce ground water	✓			✓

Note: Attribution to nature of conflict and climate change implication is done, mostly subjectively, by the research team in order to have a quick appraisal of the cases.

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Climate policy, conflicts and cooperation in peri-urban south Asia: Towards resilient and water secure communities

The research project aims to improve mutual learning, strengthen institutional & community capacities to optimally manage water insecurity, and bolster resilience in periurban south Asia. It endeavors to support and empower communities to effectively use, manage and govern their water resources against a backdrop of water insecurity caused by climate change and urbanization. A consortium of north-south institutions brings together experience, skills and know-how in research, capacity-building and knowledge generation. This four-year collaborative endeavor will cover four cities:

- Khulna, Bangladesh
- Kathmandu, Nepal
- Gurgaon and Hyderabad, India

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