Review of impacts of climate changes on the urban water security of Islamabad, Pakistan

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Abstract: The global warming and subsequent climate change has seriously threatened the glaciers of the Hindukush Karakoram Himalaya (HKH) region. These glaciers provide water to more than 60% people of the 11 countries, including Pakistan. The capital city of Pakistan has witnessed unprecedented urbanisation, population increase, development of new townships and associated economic activities. These challenges, together with climate change, have created severe pressure on the water resources of the city. In this mixed mode research, including questionnaire survey of 20 questions was distributed among the residents of the city online through Google Form. The questions were related to the expected impact of climate change on the availability of water, measures for conservation of water etc. About 205 residents from various parts of the city with different demographic backgrounds responded. This was followed by Focus Group Discussions (FDGs) of the experts and the major challenges to the urban water security of Islamabad with special reference to climate change have been assessed. The research has revealed that the water resources of the city are highly unsustainable. The residents have high concerns about the availability and quality of water. The results have shown that there is a number of governance issues in water distribution systems of the city. There are no organized water conservation strategies employed by City Government. The lack of institutional and policy framework has further complicated the situation. Residents seem willing for metering of water for its conservation. Recommendations have been made to municipal authorities for rational water resource management of the city.

Keywords: climate change, global warming, Islamabad, urban water

INTRODUCTION

It is a well-established fact that water is an essential necessity for the life and livelihood of all living things. Ensuring access to clean water and sanitation for everyone is one of the 17 Sustainable Development Goals set by the UN for the period 2015–2030 [Ona et al. 2017]. The latest World Water Development Report of the UN warns about the impacts of climate change on the quality, quantity and availability of drinking water for billions of people [UN 2020]. The water demand at global level is increasing at 1% per year, while about 2.2 bln people don’t have access to clean water at present. Meanwhile, 4.2 bln people (55% of the global population) lack properly managed sanitation systems.

The water resources of Pakistan are mainly fed from Upper Indus Basin (UIB), which provide 44% of water needs to country through a vast network of canals, barrages, weirs and dams [Khan et al. 2015; Tahir et al. 2011]. At the same time 50% or more of the water in UIB is supplied from the melting glaciers in the Hindukush-Karakoram-Himalaya (HKH) region and the sustainability of UIB water system is directly linked with the regular supply of water from these glaciers [Archer 2003]. Spatial and temporal variations in glaciers of HKH region have been experienced in the last few decades, showing advance, stable
and retreat status at various locations [SCHERLER et al. 2011]. The increase in global temperature and subsequent climate change in the region has also contributed to the retreat of glaciers and formation of new glacial lakes in the Karakoram range [SENSE et al. 2018; SHAIQUE et al. 2018]. Similarly, glacial retreat and increase in number and areas of glacial lakes has been observed in Himalayan region [JHA et al. 2016; KHADKA et al. 2018; PRAKASH, NAGARJAN 2018].

The relationship between glacial retreat and ground water resources has not been researched extensively. Rigorous research and coordinated efforts are required to develop various climate models and quantify the variability of water resources due to glacial dynamics [PRAKASH, MOLDEN 2020]. There is a need to analyse the hydroclimatic variables for future planning of the water availability to the millions of people in the basin [KHAN, ADAMS 2019]. The large spread of precipitation during 21st century is expected to provide water availability in the range of −15% to +60% of the baseline during 1971–2000, which will require appropriate adaptation measures [LUTZ et al. 2016]. The increase in precipitation trends to increase the areas of glacial lakes in the UIB, which will change the patterns of surface water flows and ground water [ASHRAF, HANIF-UR-REHMAN 2019]. On the basis of use of variety of climate prediction techniques under various scenarios, a flood with return period of 10 year or even lower has been projected in future in UIB [KHAN et al. 2020a].

In some parts of the KHK regions, like Himalaya basins, the decrease in water to the extent of 40% has been predicted during 2010–2050. These basins are already facing severe water shortages in many parts and the future uncertainty about the water availability can lead to serious droughts in these basins [LI et al. 2016]. The spatio-temporal variations of the hydro-meteorological data of the Kankai River Basin in East Nepal Himalaya showed declining trends in the surface water and ground water due to expected increase in the temperature 0.14–0.64°C per decade. The water availability in the basin will be highly variable at the downstream end [SILWAL et al. 2020].

The globalisation, urbanisation and increase in global population have created severe pressure on the global water resources. The Global Water Partner (GWP) has defined water security as “Water security, at any level from the household to governmental level will be required. These may include mapping water sources, assessment of water demand and supply with future projections, developing deeper understanding of recharge zones and their protection, documentation of climate induced

Table 1. National Water Security Index (NWSI) of Pakistan as compared to the neighbouring countries

<table>
<thead>
<tr>
<th>Country</th>
<th>KD1</th>
<th>KD2</th>
<th>KD3</th>
<th>KD4</th>
<th>KD5</th>
<th>Total rating</th>
<th>NWSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Cambodia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Nepal</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>China</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>1</td>
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</tr>
</tbody>
</table>

Explanations: KD = key dimension; KD1 = household security; KD2 = economic water security; KD3 = urban water security; KD4 = environmental water security; KD5 = resilience; 1 = hazardous, 2 = engaged, 3 = capable, 4 = effective, 5 = model.

Source: ZHANG et al. [2021].
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STUDY AREAS OF CAPITAL CITY OF ISLAMABAD, PAKISTAN

The capital city of Pakistan was established in 1960’s when it was decided to shift the federal capital from Karachi to Islamabad. The area is Potohar Plateau, which remained uninhabited previously with scattered nomadic population of few thousands before the decision of making it capital of the country. The area of the city is 906 km² with a population of about 2 mln, according to 2017 census. Most of the residents of the city are working in public and private offices with sizeable business community and small industrial sector. The city contributes 1% of the national GDP and 24% income tax revenue of the country [PBS 2017]. The population of the city is expected to raise to 4.4 mln in next 25 years, with an average growth rate of 5.7%, one of the highest in the region [RASHID et al. 2018]. The location map of the city is shown in Figure 1.

QUESTIONNAIRE SURVEY AND FOCUS GROUP DISCUSSIONS

A questionnaire survey was conducted amongst the residents of Islamabad using Google Form. The survey was comprised of demographic details, the age, sex, location etc. of the respondents. The questionnaire was comprised of 20 questions about the perceptions of the residents of the city about the quality of water, expected impacts of climate changes on the water availability, and their willingness for various conservation strategies. For Focal Group Discussion (FGD), the platform of Institution of Engineers Pakistan Islamabad chapter was used and the standard procedure of structured questions and pre-planned probes was administered in line with KRAUSGER and CASEY [2000]. The two-way focus group discussion method was used, in which two groups were used. One group actively discussed the issues and the other groups observed and raised questions. The typical parts of the FGD, included introduction by the moderator, welcoming the participants and requesting them to introduce themselves. This is followed by the opening question, which is normally simple, so that the participants can feel comfortable. The following major questions were asked from panel of 6 experts, from the water resource management, municipal authorities and consumers.

1. Introduction of the delegates by moderator (10 min).
2. Water sustainability and security issues due to climate changes (15 min).
3. The major quality issues of water (15 min).
4. What are the major threats to water security of Islamabad? (15 min).

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5. What are current water conservation strategies and way forward? (15 min).
6. What are the expected climate change impacts on urban water security? (15 min).
7. What are some of the solutions for sustainable urban water security of the city? (15 min).
8. Questions and answers session (20 min).

The FGD was administered online and besides the panel experts, about 50 observers/listeners also participated, which lasted for about 2 h. The secretary of the Institution of Engineers played a moderator role.

RESULTS AND DISCUSSION

RESPONSES OF SURVEY

46 people responded to the survey, which included 7% female and 93% male. Majority of the respondents were in the age of 55 or more (52%) followed by the age group of 37–54 year (35%). About 50% of the respondents were living in the city for 6 years or more, showing their good familiarity with the water issues of the city. Majority (91%) were located in the urban areas. The major responses are shown in Figure 2.

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Fig. 1. Location map of Islamabad; source: JAVED et al. [2017], modified

Fig. 2. Major responses of the questionnaire survey (n = 46); source: own study
The major findings of the survey are given as follows.

1. The main reasons for the water quantity and quality deterioration as responded by the majority included urbanisation, discharge of septic tanks, urban waste water and deforestation. This was also endorsed by the experts in the FGD.

2. Majority of the people (80%) report that unregulated development schemes and slums have deteriorated the quality of water.

3. 78% of the people think that the climate change will limit the amount of water and they show high degree of concerns over it.

4. No organised water conservation strategies have been reported at individual or institutions level.

5. About 54% people recommend that water metering be undertaken for water conservation of the city.

6. People have shown their willingness to reduce consumption of non-drinking water by shortening shower time, washing car less frequently than once a month, reducing watering the lawns etc. Majority of the people (85%) are also willing to reuse the waste water for irrigation and car washing, etc.

7. The people in general believe that increased in population and urbanisation will ultimately lead to severe water shortages, if the existing water resources are not augmented.

RESULTS OF FOCUS GROUP DISCUSSIONS

The major responses to various questions in the FGD are given as follows:

Q.1 Sustainability of urban water security of Islamabad

The former member of Engineering of the Municipal Corporation Islamabad (MCI) responded: “There are many structural and administrative issues relating to water supply. MCI has no funding for maintenance since last four years. Replacement and repairs of damaged pipes is a major issue as large amount of water is wasted”.

The water scarcity issue is mainly due to lack of funding for repairs and maintenance of the supply pipes, which have been worn out as these were laid in 1970s. The water needs are presently met from Simly dam, Khanpur dam and extraction from ground through 100 tube wells. Shortage is mainly faced in summer due to increase in demand, power outages and extensive leakages. The shortage is also met from supply of water through water tankers. The situation in new residential areas in some cases is worse as the water supply in summer fails and people rely on transported water through water tankers.

Regarding the water management, one of the experts replied: "The water supply authorities having four directorates that are facing funding issues and also they don’t have institutional support for enforcement of the relevant laws against abuse of water. The issue is more of management than availability”.

The existing storage capacity of the water is not sufficient and a large amount of water is wasted as runoff.

Q.2 Major quality issues of drinking water supplied by municipal authorities

The water quality issue has been attributed to leaking pipes and poor maintenance. The lack of appropriate treatment facilities also leads to poor quality. The existing water treatment plants installed across the city are also not properly maintained.

Q.3 Major water security challenges

One of the major issue as pointed out by the expert: "Eight new housing sectors being developed by Capital Development Authority will face severe water shortage if new water resources are not explored. About 100 illegal housing schemes have no water availability plans and they are functioning without legal approval”.

The major threats to urban water security include urbanisation, increase in population and unregulated developments. The new housing schemes both legal and illegal pose severe challenges for water security of the city. There seems no short term solution with the city administration. The burden on ground water is increasing as large volume of water is extracted from ground through 100 tube wells, which is leading to continuous lowering of water table. In the absence of appropriate water recharge mechanism, the ground water is lowering at 5–6 feet per year.

Q.4 Water conservation strategies

One of the experts responded: "Though Islamabad has high level of precipitation, in the country with average rain fall 1142 mm per year, yet there is no organised water recharge and rain water harvesting system at individual and institutional levels”.

The policy of establishing Rain Water Harvesting System (RWHS) by large plots was approved, but could not be implemented due to poor institutional and administrative framework. The litigations by various large consumers, illegal connections by services stations, water wastage in general are some of the major sources of water abuse. The experts stressed over the need to bring stringent water conservation regime through legislation and institutional strengthening, installation of water meters and imposing heavy fines on the individuals and organisations abusing the water.

Q.5 Impacts of climate changes on the urban water security of Islamabad

One of the experts recalled that "Water crisis was experienced in 1994, due to severe drought and emergency was enforced. This led the Municipal authorities to enforce water rationing”.

Majority of the water supply of Islamabad comes from stored water of various dams, hence the climate change will have severe impact on the availability of surface water for storage. The change in the climatic patterns will also disturb the supply patterns of the water. Currently the Simly dam has capacity for supply to 120 days, but in severe drought it goes down to 60–50 days, thereby leading to severe water crisis. The experts opine that the climate change will have severe repercussions for the water supply of the city.

Q.6 Major recommendations by the FGD for urban water security of Islamabad

1. Three prong strategy (3Es) of education, engineering and enforcement was advocated by the experts. Awareness about the current status of water challenges needs to be created through social media and other media resources. To repair and replace the damaged pipes, funding is required from the Federal Government and diligent enforcement of existing bylaws is required.

1 1 foot = 0.3048 m.
2. For ground water recharge, proper check dams, diversion dams, drainage galleries and other appropriate structures may be constructed.

3. Short term, medium term and long term strategies and feasibility for water security of the city may be undertaken.

4. For water conservation, water metering for large consumers was recommended. Similarly, for large plots the policy of rain water harvesting (RWH) may be implemented as an integral part of design and construction. The completion certificate for such facilities may not be issued unless the RWH system is deployed.

5. Policy dialogue involving the ministry of water and power, representatives from business community, industries and chamber of commerce etc. may be undertaken to highlight the issue and formulate appropriate policy tools for water governance.

CONCLUSIONS

This research was undertaken to assess the urban water security challenges of Islamabad, Pakistan due to climate change on the basis of questionnaire survey and Focus Group Discussions. The following major conclusions are drawn:

- Majority of the respondents of the questionnaire survey have shown their concerns about the quality and quantity of water due to urbanisation, increased in population and unregulated development schemes. People have also serious concerns about the impacts of climate change on the availability of water. There are no organised water conservation strategies for rain water harvesting and ground water recharge. The respondents have shown their willingness for reduction in water use and reuse of waste water.
- The Focus Group Discussions have revealed serious administrative and state issues in the water supply system of the city. The existing pipelines have exhausted their service life and the lack of funds for repair of maintenance of the pipelines have led to wastage of water.
- For improvement of urban water security of Islamabad Pakistan, three prongs strategy including education (awareness), engineering (repair and maintenance) and enforcement (implementation of rules and related laws) is recommended.

REFERENCES


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