

Health Risks through Flooding and Coping Strategies for Citizens of Dhaka

Nikola Medimorec*

Master's Course Student, Graduate School of Geography, Seoul National University, Korea

Abstract

This article is a literature review about the challenges and countermeasures for Dhaka's citizens, who are most vulnerable to flooding and climate change. Dhaka, the capital of Bangladesh, is a fast growing city and it has a large proportion of poor citizens. Cyclones or terrestrial rainfall hits Bangladesh regularly. Concerning climate change, weather events will intensify and cause more casualties. Millions of people get displaced or die in floods and their health is under great risk of epidemics. Traditional countermeasures are changes in the built environment but this alone is not enough to secure the livelihood. Especially for the urban poor more soft measures are needed. Measures like education, warning systems and micro-insurances will play a dominant role in the future against the challenge of climate change.

Keywords: Cyclone; Dhaka; Vulnerable; Climate Change; Micro insurance

Introduction

As the cyclone moves closer to the coast, the government warns its citizen about the storm and millions of inhabitants are advised to evacuate their homes. This natural event becomes a natural hazard and as soon as it hits the land, it threatens life of citizens through flooding, land-slides and epidemics. Such a scenario is harsh reality in Bangladesh and it happens multiple times per year. It can be assumed that there is a trend towards a higher frequency of more extreme weather events. This is clearly connected to human-induced changes in climate and it threatens the well-being of the world population.

Historically, cities flourished in areas where the nature is not too harsh or extreme. Nowadays, through over population and other reasons some cities grew larger than there development is able to cope with. The newly arrived migrants settle into outer city areas. Bangladesh is a country already regularly hit by hazards and through climate change disasters will intensify. Climate Change adds a new and very dangerous dimension to natural hazards and health risks of individuals. Evidently, climate change will have negative influence on the health of urban population [1]. IPCC identified climate change as a "substantial risk to human health". Diarrhea and malnutrition are going to be the largest relative risks for mortality in Southeastern Asia in 2030 [2]. Studying this case can help to prevent epidemical outbreaks and high mortality in other cases as well. Roy sees cities as an important battlefield in terms of climate change because they have the chance to produce new and universally usable solutions [3].

This article is not about technical aspects to prevent the consequences of flooding. Instead it is more about measures of resilience and adaptation for the population. That's also why a humanistic approach, where the vulnerable groups are in the focus, is going to be used. According to Del Casino this approach interprets space as a result of human's activities. An analysis of a certain area also investigates the actions of its residents and their subjective experiences. This research was written from the viewpoint of a social geographer to show how the poor are excluded from the safe areas of a town and exposed to climate change.

Curtis & Oven described the issue of climate change and health as one of the most pressing and urgent issues for our society. Human health is under a high risk of hazards caused by global climate change [4]. From an international view there is an underlying complexity

which connects climate change and socio-political processes with each other. On the left you can see their conceptual framework for research on climate change. The content of this paper reflects the structure of this framework, whereby the focus lies on the local context and social determinants of health. Among the issues, which are the main focus of research in this area, according to Curtis & Oven, the key dimension of this research is the issue of adaption and resilience [4].

The method of this research is a secondary analysis of literature about health and climate change, floods in Bangladesh and measures for the urban poor to cope with flooding. Under the viewpoint of the concept by Curtis & Oven, this article sheds new light on what climate change means for slum dwellers in megacities. The aim of this paper is to propose a collection of measures to reduce the vulnerability of people in flood periods and to emphasize at least one method how in long-term adaption for slum dwellers could be possible [4].

What Makes Dhaka Vulnerable to Climate Change?

Bangladesh lies on the eastern end of the Indian subcontinent. It shares almost the whole border with India and just a small part with Burma in the East. The population consists of 163 million people and in relation to its size and economic power, the country is clearly overpopulated. The GDP per capita is one of the lowest in the world. 28.4 % of the population lives in urban areas. The central-lying capital of Bangladesh is Dhaka has 15.391 million inhabitants (data from 2011). This prime city is three times as big as Bangladesh's second largest city Chitttagong [5] (Figures 1,2)

Dhaka is one of the fastest growing cities worldwide with a growth rate of around 2.5% and hence, the population is expected to reach 16 million by 2015 [3]. Each year, between 300 and 400,000 new

*Corresponding authors: Nikola Medimorec, Master's Course Student, Graduate School of Geography, Seoul National University, Korea, Tel: 8228806971; E-mail: nikola.medimorec@gmail.com

Received September 07, 2013; Accepted November 28, 2013; Published November 30, 2013

Citation: Medimorec N (2013) Health Risks through Flooding and Coping Strategies for Citizens of Dhaka. J Geogr Nat Disast 3: 114. doi:10.4172/2167-0587.1000114

Copyright: © 2013 Medimorec N. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

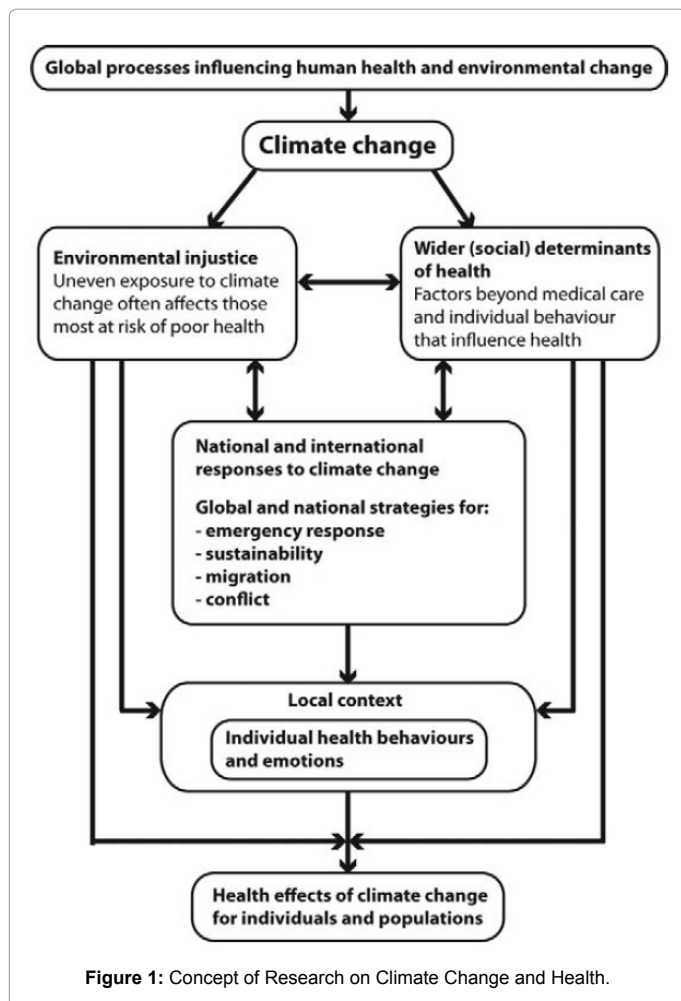


Figure 1: Concept of Research on Climate Change and Health.

migrants move to Dhaka [6]. There are over 3 million people of a lower socioeconomic class who have limited access to basic services and live in unstable areas [7].

In prospect, Dhaka is going to receive 8 million more new inhabitants over the next decades, up to 20 million people will live in Dhaka by 2025. This development makes the urban development not easily controllable and more people will be exposed to natural hazards [8].

The rate of urbanization growth exceeds the national population growth rate and hence the rural population is decreasing (Figure 3). It usually comes along with a growth of urban poor. The most vulnerable point is when the poor population dominates quantitatively the city, which is going to happen within this generation [6]. It can be assumed that a large number of migrants are fleeing from harsh weather conditions, which makes farming difficult. This climate-induced migration will grow in the future and even extend beyond national borders.

In general, Bangladesh is very vulnerable to natural hazards due to its geographical position. There's almost no year without extreme disasters [9]. Ros identifies three causes for natural hazards: (1) tropical cyclones with an increasing intensity, (2) high amounts of rainfall, leads easily to flooding through high rates of deforestation in upper areas and (3) drainage is not well developed and so areas cannot be fast cleared from flood water [3].

Flooding and Its Interaction with Climate Change

Issue of flooding

Flooding is the most often occurring natural hazard in Dhaka [10]. The four rivers Buriganga, Lakhya, Turag and TongiKhal are around Dhaka and nowadays if a flood occurs, major parts of the city are drowned [11]. Dhaka is surrounded by rivers, the Buriganga River in the south, the Balu River and Shitalakhya River in the east, Tongi canal in the north and the Turag River in the west. The main causes for flooding in Dhaka are drowning of the rivers around the city and the rainfall. Throughout the history Dhaka got hit by severe floods. In the last sixty years there have been around nine major floods. Among them the most damaging were in 1988, 1998 and 2004. During floods some areas are inaccessible. People are not able to go back to their homes for several days. From an economic view point, the infrastructure gets destroyed, economic activities halt during this time and property gets damaged [10].

Dhaka has a very flat land with an elevation of between 1 to 14 m. A study by Dewan et al. about hazard areas categorized Dhaka into five zones, from least hazard zones to very high hazard zones. The least hazard zone has an elevation of above 13 m and they make only around 8.04 % of Greater Dhaka. Less hazard zones were 21.65%, moderate hazard zones with 15.05%, high hazard zones constitute for 26.56% and very high hazard zones are the biggest portion with 28.7% [12].

The low-lying flood plains are often the place for slum dwellers,

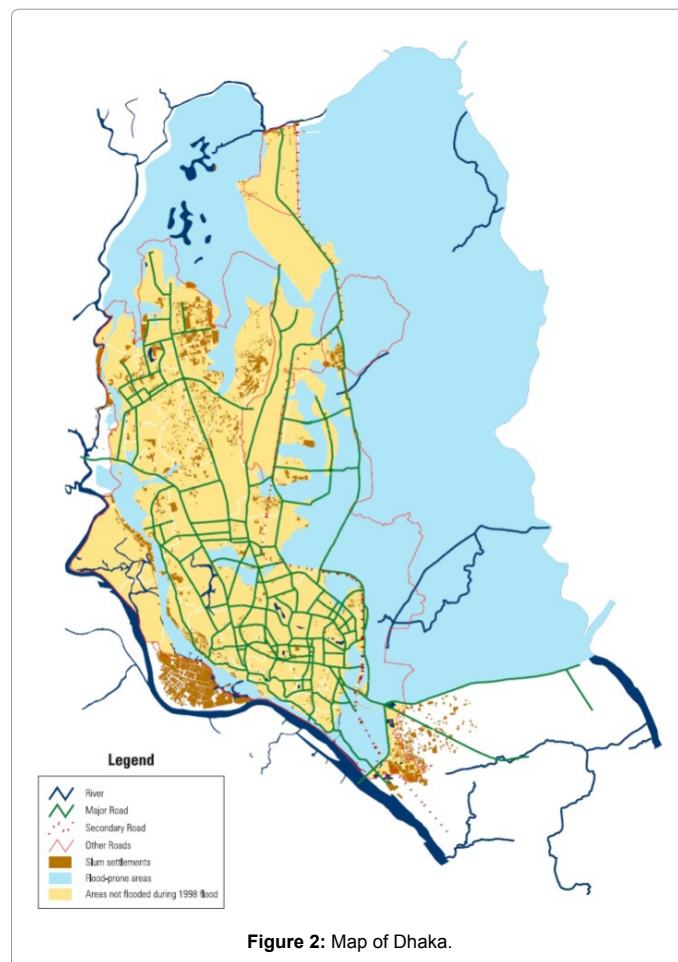


Figure 2: Map of Dhaka.

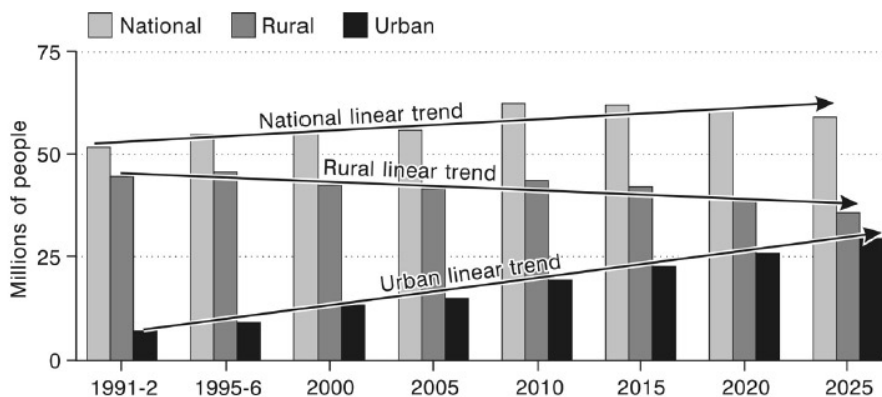


Figure 3: Development of Migration.

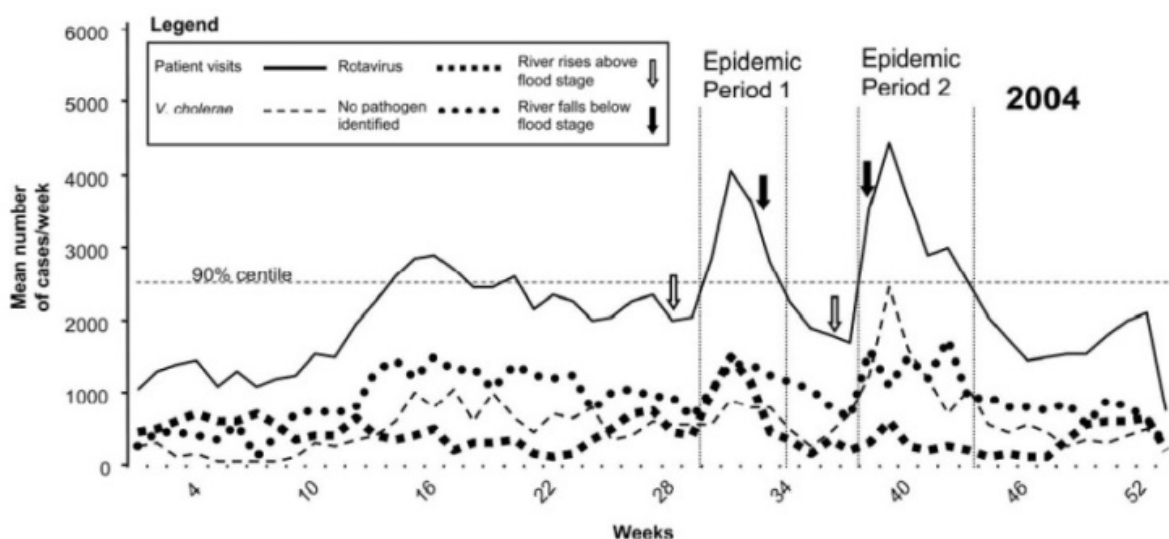


Figure 4: Connection between Flooding and Epidemics.

because it is the only available space for expansion of the city. Air pollution is severe and half of the city doesn't have sewage [3].

The situation is severe because 60 % of the slums are prone to floods and they have insufficient or no drainage. 30 % of housing in Dhaka is of poor quality and the houses wouldn't withstand extreme environmental hazards [8] (Figure 4)

Interaction with climate change

This following section looks how these environmental issues may change through climate change. Hereby, even though that UN-HABITAT (2008) sees heat stress as important as floods regarding climate change but the focus of this section lies on flooding to keep. There are going to be more floods in Dhaka due climate change [1]. More climate extremes are coming along with a higher risk of infectious diseases. Indirect health problems out of socioeconomic reasons are substantial [13].

The issue of climate change is urgent and urban poor are going to become more vulnerable out of three reasons, according to Banks et al. (1) poverty is going to spread and concentrate in certain areas, (2) environmental hazards are going to become extremer and they are

accompanied by a higher risks for health problems and disturbance of daily lives more often, (3) constrained urban resources demanded by more people [4].

For the future there seems to be an increase in the annual mean rainfall in Bangladesh and other areas of South-Eastern Asia [2] and as the Himalaya glaciers are melting the rivers are going to carry more water into the delta of Brahmaputra and Ganga Climate change changes the pattern of rainfall in Bangladesh. The amount of annual rainfall does not change but while the numbers of days without rain are showing an increasing trend, seasonal rainfall tends to become more irregular and erratic. In other words, days with rain are going to be more seldom but if rain falls, it is going to be more extreme. Even though the death toll might be not so high, the number of people who are affected through floods is in general multiple times higher [10].

Partially, the rural-urban migration is also related to climate change. The menace of climate change in coastal or other rural areas of Bangladesh displaces them and in search for protection they go to the cities [4]

Climate change leads to fewer resources which constrain possible

measures of Bangladesh and Dhaka. In terms of the ongoing high growth of the urban population through rural-urban migration, the city is going to have a hard time to challenge the problems [10].

Health risks

So what does it mean for the health? Urban poor will suffer under infectious diseases after floods. Cholera, cryptosporidiosis and typhoid fever can be observed. Diarrheal diseases occur as well. The flood water is contaminated with chemicals like pesticides or heavy metals and other harmful substances. After floods the water stays for a long period of time due to the insufficient drainage system. Thus, in such areas there is a higher chance of malaria and dengue. An increase of average temperature due to climate change may intensify outbreaks and transmissions of the mentioned diseases [1].

Waterborne diseases can be found in surface water and ground water has often a high level of arsenic. And these are just some among many issues in Bangladesh [5].

Schwartz et al. have done detailed studies about viral epidemics during flood and in comparison with non-flood periods and he even included, as far as possible, socioeconomic factors of a patient. Very dangerous are waterborne and vector-borne epidemics which break out after floods due to contaminated water. They cause increases in morbidity and mortality [11].

Further, the research showed that cholera infections appear more often along with dehydration during flood periods and a lot of patients came from a lower socioeconomic class. Infections of vibrio cholera were almost double as high during all flood-periods than in non-flood periods. Rotavirus was the primary cause of diarrhea during the 1998 floods and the second biggest in 2004 [11].

The problem of flooding is not only limited to epidemics and outbreaks, floods can directly lead to loss of life and psychological distress due to damage to one's property and displacement [9].

Shahid analyzed a couple of indirect impacts which may be stronger and diverse than the direct impacts. Indirect impacts like water logging, lack of fresh water and contaminated water causes cholera, diarrhea, malnutrition, skin diseases. High river levels seem to have a connection with diarrheal diseases. During the monsoon season, there seems to be more cholera outbreaks in Bangladesh. Through climate change, cholera might become regular issues in the future. Another impact may be that the breeding period of mosquitoes changes. Diseases like Japanese encephalitis, which have been seldom, are increasing. Dengue virus, a major infectious disease of Bangladesh, may spread faster and patterns of malaria are about to change. Near river embankments, the cases of visceral leishmaniasis increase [9].

Diarrheal diseases are most extreme during rainy season and parasites who lead to outbreaks of waterborne and diarrheal diseases have a direct relation to heavy rainfall. So they will increase, too. Bangladesh's public health will be under great risk due to climate change. Already now public health infrastructure is in a bad condition and climate change will make this problem even more extreme. In combination with social inequity, low literacy rate, poverty and insufficient institutional capacity this leads to a dangerous situation [9].

Counter Measures

Dhaka is actively trying to anticipate next hazards but this section won't discuss typical solutions like water embankment, drainage system and other features in the built environment. The experience

in Dhaka proved that constructions had the effect that uncontrolled settlement in low-lying areas of Dhaka grew very fast and so this is not a final solution [10]. Besides, constructional measures have been researched well. For example, Alam & Golam-Rabani summarize all possible measures for air quality, flood protection and improvement of drainage system [10] or Jabeen et al. show coping strategies through built environment before and after floods. Instead of fortifying it is important to change the lives of the people in Bangladesh. Hereby, as it was said before, it has to be taken care of the urban poor [7].

Information and education

Most of the problems in Dhaka actually seem to have their origins in human perception. There is a lack of accepting measures from the government and so a lot of measures are not able to be implemented successfully [10]. A research by Saroar & Routray investigated this issue in the coastal regions of Bangladesh. It can be transferred to the urban population as well because most of the citizens have a rural background. They found out that people mainly understood the things that they experienced. This relates to cyclones, tidal changes etc. but they were unaware of issues like global warming and climate change. Further, they had three results: First, the general adaptive capacity correlates with the amount of income and possession of land. In other words, the poor showed a low general adaptive capacity. Second, demographic features and the socio-economic status plays an essential role in adaptation against disasters. With higher education the adaptive capacity is also higher. Third, access to information helps to improve adaptation. Weather information through radio is able to save lives [14].

Huq & Alam introduce a number of nonstructural measures: flood zoning, flood forecasting and warning, flood proofing, flood insurance, and evacuation measures. Dhaka has to expect to be hit by strong floods like in 1988 and 1998 more frequently. So it's essential to develop a long-term plan for flood-mitigation and adaptation to climate change [15].

In their subjective experience individuals are well aware of floods, as it seems. Nevertheless realizing that global changes are happening and that locally the impacts of that are able to feel. So the first step is going to be about education and through this way people's awareness of the risks through climate change will be raised. Therefore, the World Bank recommended actions like establishment of a warning system, evacuation plans, better crisis management, better health education, acknowledgment of certain informal settlements as legal properties of their tenants so that their housing situation is secured and that they build more high-quality housing [1]. A case study about Korail, the biggest slum of Dhaka, was conducted by Jabeen et al. [7]. Korail lies in a very flood-prone area in East Dhaka. 100,000 people live there on 90 acres. Every year, Korail's citizens suffer from weather extremes. However, due to their insecure tenant situation, they don't intend to improve their houses and most of them can't afford to invest into better living conditions.

Even though Bangladesh's government implanted policies for adaptation of climate change, the urban poor are greatly neglected [4]. An improvement in health of urban populations is possible but history shows that improvements are not equally distributed. There has to be a focus on the lower socio-economic classes. Traditional approaches are the top-down measures, which happen at the regional or national level. But there is a need for more city-based assessments locally [1].

According to Shahid stakeholders like heads of communities, health experts, local government and private or non-governmental organizations have to be involved on the local level. Community

involvement is the key to adapt to climate change. Such bottom-up approaches would lead to more involvement of locals and hopefully to more trust between the government and citizen [9].

Micro insurance

Bangladesh is the origin of the idea about micro credits which are tailored to the needs of poor. The idea by Muhammed Yunus gives them a chance to improve their situation through the possibility of borrowing small amounts of money. The principles of this idea can be transferred to natural disasters, where instead of credits insurance policies are more important.

It was several times mentioned that the urban poor suffer the most. Akter says that there is no support for them and they are left in a vicious cycle of poverty due to the burden of damages through climate change. That is where the idea of a micro insurance can be a reactive adaptation measure to reconstruct the damaged properties after a flood. Governmental bodies explored the possibility of micro flood insurances which could be another reactive adaptation strategy. Currently, there are no formal insurances related to natural disasters in Bangladesh. Since several years the government does pre-assessments on this measure [16].

The rate of participation of this trial program was very low because most of the people could not afford it and the amount, which people were ready to pay, was much lower than the damage. Another problem was also that there was no financial return if no disaster occurred. Bangladeshis are familiar with the system of life insurances but they give them financial returns like a bond. Insuring property without return does not make sense in the eyes of an individual. This could be a main obstacle in establishing micro insurance in Bangladesh. The micro insurance has to be adjusted better to the situation of Dhaka's citizen because the success of that measure depends on their participation [16].

Low-income households pay between 17 and 22 per cent of their monthly income only for rents. As they live in informal dwellings, costs for water and electricity are also high [4].

Requirements for the success of this measure are functioning framework, adjusting to the needs of the groups in largest need and more responsibility by the government [16]. Even though this measure seems quite promising, it does not help to protect against floods. This measure supports rehabilitation after a natural disaster. There are still adjustments to make: It should be less expensive, benefits towards subscribers should be shown more clearly. In this case, raising awareness and the previously mentioned enhanced education of climate change will contribute largely to more acceptances among the population [17-25].

Conclusion

As this paper shows, currently around 3 million people are affected by natural hazards in Dhaka. The combination of urbanization and climate change may double the number. Climate change is evidently a danger to human health. Even though hazards affect the whole population, the urban poor are hit the strongest. So it is crucial to work on better measures as the high mortality during floods and epidemical outbreaks after flooding shows.

This paper showed a local issue but we should not forget that climate change is a global problem. Instead of rainfall other locations may suffer under drought, extreme heat or extreme cold. This literature review of a case-study can be helpful to show how adaption to severe weather conditions can happen through education, crisis planning and

access to information. For the urban poor, assurance of their tenure situation is important. If their homes would be legal, they would probably invest into these homes and take micro insurances for their property. Still a big problem is that slums are often on vulnerable land. Solutions for this problem are not easy to find. A number of measures would be necessary and micro insurances are just a small part of it.

Further research in the area of adaption towards climate change has to be undertaken. Such research should focus on creative ways and they should include the most vulnerable. The usage of big data (as far as it exists) for analyzes could draw a deeper picture of the situation and people's sense of place. More research has to be done on the effects of climate-induced migration at a national scale for Bangladesh. Climate change destroys the livelihood of rural farmers and they search for refuge in urban areas. However, as they may not be familiar with the city or do not have another choice, they settle on flood-prone land and make themselves vulnerable to floods. Quick adaption to urban life and hazards is essential for ensuring their health.

This research tried to show that it is possible to adapt to a process like climate change, which implies continuous change and increase of extreme events. The measures are neither too costly nor biased towards changes in the built environment. Basic measures can be in favor of lower socio-economic groups and small steps may lead to great effects.

Acknowledgement

This research and publication are supported by Brain Korea 21 (BK21) 4-Zero program.

References

1. Kovats S, Akhtar R (2008) Climate, Climate Change and Human Health in Asian Cities, *Environment and Urbanization*, 20: 165-175.
2. IPCC (1) (2007) Chapter 8: Human Health, *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*.
3. Roy M (2009) Planning For Sustainable Urbanization in Fast Growing Cities: Mitigation and Adaptation Issues Addressed in Dhaka, Bangladesh, *Habitat International* 33: 276-286.
4. Curtis SE, Oven KJ (2011) Geographies of Health and Climate Change, *Progress in Human Geography* 35: 654-666.
5. Central Intelligence Agency (2013) Bangladesh.
6. Banks N, Roy M, Hulme D (2011) Neglecting the Urban Poor in Bangladesh: Research, Policy and Action in the Context of Climate Change, *Environment and Urbanization* 23: 487-502.
7. Jabeen H, Johnson C, Allen A (2010) Built-In Resilience: Learning From Grassroots Coping Strategies For Climate Variability, In: *Environment And Urbanization* 22: 415-431.
8. UN-HABITAT (2008) State of The World's Cities 2008/2009 - Harmonious Cities.
9. Shahid S (2010) Probable Impacts of Climate Change on Public Health in Bangladesh. *Asia Pac J Public Health* 22: 310-319.
10. Alam M, Golam-Rabbani MD (2007) Vulnerabilities and Responses to Climate Change for Dhaka, *Environment and Urbanization* 19: 81-97.
11. Schwartz BS, Harris JB, Khanai, Larocquerc, Sack DA et. al. (2006) Diarrhoeal Epidemics in Dhaka, Bangladesh, During Three Consecutive Floods: 1988, 1998 and 2004. *American Journal of Tropical Medicine and Hygiene* 74: 1067-1073.
12. Dewan AM, Islam MM, Kumamoto T, Nishigaki M (2007) Evaluating Flood Hazard For Land-Use Planning in Greater Dhaka of Bangladesh Using Remote Sensing and GIS Techniques, *Water Resources Management* 21: 1601-1612.
13. IPCC (2) (2007) Chapter 10: Asia, *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*.
14. Saroar MM, Routray JK (2012) Impacts of Climatic Disasters in Coastal

-
- Bangladesh: Why Does Private Adaptive Capacity Differ? *Regional Environmental Change* 12:169-190.
15. Huq S, Alamm (2003) Chapter 9: Flood Management and Vulnerability of Dhaka City, *Building Safer Cities: The Future of Disaster Risk*, World Bank. 121-135.
 16. Akter S (2012) The Role of Micro Insurance as A Safety Net Against Environmental Risks in Bangladesh, *The Journal of Environment Development* 21: 263-280.
 17. Alderman K, Turner LR, Tong S (2012) Floods and Human Health: A Systematic Review, *Environmental International* 47: 37-47.
 18. Dewan, AM, Yamaguchi Y (2009) Land Use and Land Cover Change in Greater Dhaka, Bangladesh: Using Remote Sensing To Promote Sustainable Urbanization, *Applied Geography* 29: 390-401.
 19. Burkart K, Schneider A, Breitner S, Khan MB, Kraemer A, Endlicher W (2011) The Effect of Atmospheric Thermal Conditions and Urban Thermal Pollution on All-Cause and Cardiovascular Mortality in Bangladesh, *Environmental Pollution* 159: 2035-2043.
 20. Chowdhury MHI (2010) A Short City Profile on Dhaka City Adaptation Issues for Climate Change, German Technical Cooperation GTZ.
 21. Few R (2003) Flooding, Vulnerability and Coping Strategies: Local Responses to a Global Threat, In: *Progress In Development Studies* 3: 43-58.
 22. Gasper R, Blohm A, Ruth M (2011) Social and Economic Impacts of Climate Change on the Urban Environment, In: *Current Opinion in Environmental Sustainability* 3: 150-157.
 23. Kunii O, Nakamura S, Abdur R, Wakai S (2002) The Impact on Health and Risk Factors of the Diarrhoea Epidemics in the 1998 Bangladesh Floods, In: *Public Health* 116: 68-74.
 24. Mccarney PL (2012) City Indicators on Climate Change, Implications for Governance, Environment and Urbanization Asia 3: 1-39.
 25. Wilby RL, Keenan R (2012) Adapting To Flood Risk Under Climate Change. *Progress in Physical Geography*, 36: 348-378.