Book of abstract
and convention brief

rainwater harvesting

4th Bangladesh Convention 2019

Book of abstracts
and convention brief

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Thursday, 19 September 2019 | 09:00 to 17:00

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Keynote speech
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Mr Md Zahirul Islam, Additional Secretary, Local Government Division, Ministry of Local Government, Rural Development & Co-operatives, Government of Bangladesh

Dr. Sultan Ahmed, Chairman, RAJUK

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Ms Ismat Ara Pervin, Senior Specialist at the Institute of Water Modelling (IWM)
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Mr Md. Zahid Hossain, Programme Specialist - Engineer, WaterAid Bangladesh
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Professor, Department of Geology, University of Dhaka

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Paper: Reliability, economic benefit, water and energy savings of rainwater harvesting in commercial building in Dhaka city.

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Dr. Md. Tauhid Ur Rahman, Professor of the Department of Civil Engineering, Military Institute of Science and Technology (MIST)
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15.15 **Tea break**

15.30 **Panel discussion**

Moderator
Mr Shyamal Dutta, Editor, The Bhorer Kagoj

List of Discussants

1. **Mr Md Shahadat Hossain**, Chief Engineer, Public Works Department, Government of Bangladesh
2. **Brig. General Mohammad Osman Sarwar**, Chief Engineer, Health Engineering Department, Government of Bangladesh
3. **Mr A.S.M. Raihanul Ferdous**, Chief Engineer, Rajdhani Unnayyan Kartripakkha (RAJUK)
4. **Engr. Mohammad Shamim Akhter**, Director General, House & Building Research Institute
5. **Prof. Dr. M. R. Kabir**, Pro Vice-Chancellor, University of Asia Pacific
6. **Ms Goska Grabek**, Chief Operating Officer, HSBC Bangladesh
7. **Dr Md Akter Mahmud**, Vice President-1, Bangladesh Institute of Planners
8. **Dr Iqbal Habib**, Architect, General Secretary, Bangladesh Paribesh Andolon
9. **Mr Abdullah Al Maher**, Chief Executive Officer, Fakir Fashion Limited

16.45 **Closing remarks and vote of thanks**

Foreword

In Bangladesh, the significance of water resources in sustaining social and economic growth is unparalleled. Increasingly attenuating surface water sources, depleting groundwater levels and an ever-proliferating population have pushed this country to the brink of a major crisis. The adverse impact of climate change has accelerated the already rapidly deteriorating situation. The challenges associated with remediating Bangladesh's water predicament are unique; alternating flooding and water dearth in monsoon and dry seasons. Amidst all this, attaining the status of middle-income country is still possible for Bangladesh through sustainable economic growth with the help of industrialisation. However, the nature of use of water resources by these industries is ultimately resulting to depletion of groundwater sources, and lessened attention to use surface water sources and alternate water sources like rainwater.

In Bangladesh, there is a distinct lack of water smart buildings, although there have been some individual initiatives. This is unfortunate, as well as not quite expected from the part of the private sector. Corporate social responsibility can be a way of alleviating this precarious issue. Private sectors, especially the real estate companies and industries, have till now not been enforced for implementing rainwater harvesting systems in their projects. Government incentives to encourage the private sector is virtually still non-existent, despite a firm acknowledgement in the water policy recognising the importance of public and private investments acting together. Although public agencies have been instructed to provide private bodies with resources for implementation of rainwater harvesting projects, the reality is far-fetched. Often these two sectors find themselves in conflict due to the absence of coordination. The Government's investment in rainwater harvesting and groundwater recharge infrastructure can be seen negligible which is contradictory to its policies regarding the matter.

Recognising the importance of rainwater harvesting and subsequent groundwater recharge in Bangladesh, WaterAid has been working in different geographical locations incorporating rural, urban, climate resilience, hard-to-reach areas through different projects and programmes. As part of its advocacy initiatives, WaterAid also works with the national and local governments in order to develop policy formulations/revisions like inclusion of rainwater harvesting in the Bangladesh National Building Code, organises international conventions on rainwater harvesting in a notion to promote researches in academia, actively works with universities to include rainwater harvesting in the course curricula and action research, celebrates rain day to promote mass awareness prevailing significance of rainwater, and contributes in sector capacity development as part of its 360 knowledge based approach.

Sustaining our socio-economic structure means ensuring a constant supply of fresh water sources. Rainwater harvesting, of course, is the most effective feasible way of doing exactly that. This book of abstract of the 4th Rainwater Convention summarises the researches triggering to address such challenges and way forward resulted through efforts of renowned academicians and sector professionals in a notion to prevail water justice towards the road of reaching SDG6.

On behalf of organizers

Md Anwar Hossain Shikder
Acting Country Director
WaterAid Bangladesh

Keynote speech

Rainwater Harvesting Systems: Prospects, Opportunities and Challenges in the context of Bangladesh

Dr. Tanvir Ahmed
Professor, Department of Civil Engineering, BUET
tanvirahmed@ce.buet.ac.bd

Rainwater harvesting (RWH) is an ancient technology; it has been practiced in different cultures and societies in different parts of the world for drinking and other purposes from time immemorial. In the face of global freshwater scarcity, RWH has gained popularity in modern times particularly in the urban context where it is largely recognized as a useful water conservation strategy. With proper design and management, an RWH system can provide acceptable water quality for drinking. In an urban setting, RWH can replace potable water for several less quality-demanding water uses such as house toilet-flushing, terrace cleaning or private garden watering and can reduce the burden on the municipal water supply and wastewater treatment facilities.
In Bangladesh, arsenic contamination of groundwater, salinity in the coastal area, lowering groundwater level and non-availability of reliable water sources in hilly areas have brought RWH in the forefront as a source of alternate water supply option in challenging environments. Bangladesh receives on an average 2000 mm rainfall every year and it is considered adequate to meet most domestic needs though quality and quantity of harvested water will depend on the availability of adequate catchment area, properly sized storage tanks and the presence of necessary water quality control measures. The reliability of some urban RWH systems have been found to be poor as water demand was not properly accounted for. On the other hand, cleanliness of catchment and storage tank is critical in maintaining good quality of rainwater. RWH systems which were installed for arsenic mitigation in rural areas faced microbial contamination issues making them relatively less popular compared to other alternate water supply options. RWH will continue to have value in areas having acute salinity problems (coastal regions) and hilly areas where access to safe water is considerably challenging. Since these areas receive more rainfall compared to other parts in the country, RWH systems can be more reliable but the cost of installing such system at the individual household level can be prohibitive. Climate change, which can potentially modulate the intensity and duration of rainfall in the long run, also needs to be accounted for in reliability estimations. It is encouraging to see the incorporation of RWH in the Bangladesh National Building Code (BNBC) which currently provides guidelines for harvesting rainwater for non-potable use and artificial recharge in an urban context. However, designing of such systems must consider the complex nature of water demand in densely populated areas negotiating space in built-up areas for the placement of storage reservoirs and integrating with the existing plumbing features which can be very challenging. The solutions to these problems are often not unique and may be dealt on a case by case basis. A sound knowledge of various technical aspects related to design, operation, monitoring and surveillance of RWH systems is necessary for the engineers and planners.

Profile of chief guest

Md Shahid Ullah Khandaker
Secretary
Ministry of Housing and Public Works,
Government of Bangladesh

Mr Md Shahid Ullah Khandaker is the Secretary of Ministry of Housing and Public Works of the Government of Bangladesh. He worked as Assistant Commissioner, Upazila Magistrate, Cognizance Magistrate, Revenue Deputy Collector and Thana Executive Officer in the early stages of his career. As Deputy Secretary, Mr Khandaker has worked in the Finance Division for 3 years. He was a member of the National Housing Authority, and later was appointed as Chairman of the same. Mr Khandaker was promoted as the Acting Secretary of the Implementation, Monitoring and Evaluation Development of the Planning Ministry in January 2016 and later on was promoted to the position of Secretary. Soon, he joined the Ministry of Housing and Public Works in March 2016 as Secretary.

Apart from his Government service, Mr Khandaker is engaged with many social organisations. He has consecutively been elected President of the Lion's Club of Dhaka Down Town Club for the past three years. He is also involved with the Gopalganj Zilla Shamity as Treasurer, and as the member of the Executive Committee of Faridpur Service-Holder Society. Through these organisations, he has been engaged in many development work in the education and social sectors of his district Gopalganj, Faridpur and Dhaka.

Profile of keynote speaker

Dr. Tanvir Ahmed
Professor
Department of Civil Engineering, BUET

Dr. Tanvir Ahmed received his Bachelor and Master's degree in Civil Engineering from BUET in 2003 and 2005 respectively; completing his PhD from Massachusetts Institute of Technology (MIT), USA in 2011. He has been a faculty of BUET since 2003 and is currently working as a Professor in the Department of Civil Engineering. His research interest broadly encompasses environmental modelling, waste management and health risk assessment of environmental contaminants; he has also authored several papers in distinguished journals and conferences. Dr. Ahmed is also involved in numerous national and international projects as an EIA Specialist.

Dr. Ahmed received a number of awards in recognition for his excellence in academic achievements and teaching. These include The Prime Minister's Gold Medal in 1994, Malik Akram Hossain Gold Medal in 2003 and the Dean's award for academic excellence. He received the Schoettler Fellowship and Martin Fellowship for Sustainability while pursuing his PhD at MIT and was awarded the Maseeh Award for excellence in teaching from MIT in 2009. He is the author of the textbook "Environmental Sanitation, Wastewater Treatment and Disposal" published by the University Grants Commission. Dr. Ahmed has also been involved with the Department of Environment for drafting the National Action Plan for Short-lived Climate Pollutants and Minamata Initial Assessment Report, as well as in developing the National Mercury Profile. He has been part of a World Bank expert team for conducting the Bangladesh Country Environmental Analysis in 2018. In association with WaterAid, Dr. Ahmed developed a guidebook on Prospects, Principles and Practice of Urban Rainwater Harvesting in Bangladesh.

Profile of special guests

Shitangshu Kumar Sur Chowdhury
Banking Reforms Adviser
Bangladesh Bank

Mr Shitangshu Kumar Sur Chowdhury worked as Deputy Governor of Bangladesh Bank, the Central Bank of Bangladesh, from January 2012 to January 2018. During his tenure, he looked after the core functions of the organization. Currently, he is serving as Banking Reforms Advisor of the central bank of the country.

He secured MA in English with Honours and MBA in Finance and Accounting. He is a Diplomaed Associate of Institute of Bankers Bangladesh (DAIBB), and was awarded the Bangladesh Bank Gold Medal for achieving the first position in the Banking Diploma examination in 1982.

Mr. Chowdhury joined Bangladesh Bank in May 1981 as Assistant Director, and has served the bank with zeal and expertise since then. In the long journey of more than 36 years as a central bank professional, his career has been enriched with in-depth knowledge of financial sector supervision and regulation of financial services. He supervised work on financial sector policy, regulation, financial inclusion, crisis management in the light of global financial crises, IT systems of Bangladesh Bank, and overall financial sector stability of the country. In addition to these, his expertise in foreign exchange reserve management is worth mentioning. He is knowledgeable on the global financial system.

He served as the Chairman of Asia Pacific Rural and Agricultural Credit Association (APRACA), Chairman of South East Asia, New Zealand & Australia (SEANZA) Supervisory Forum, Alternate Director of Asian Clearing Union (ACU) and Member of the Board of Director Child Youth Finance International (CYFI) etc. He also served as the Chairman of the Sovereign Bond Transaction Execution Committee, Ministry of Finance, Govt. of Bangladesh, the Trustee of Bangladesh Krishi Gobeshona Endowment Trust, Ministry of Agriculture, Govt. of Bangladesh, Member of Governing Council, Institute of Public Finance (IPF) Bangladesh, Ministry of Finance, Govt. of Bangladesh, Member of Governing Council of Institute of Banker Management (IBB), Governing Board, Institute of Bank Management (BIBM) and Founder Member of Governing Body of Dhaka School of Bank Management. He is a member of the Executive Committee of the Bureau of Business Research, University of Dhaka.

Mr. Chowdhury was awarded the Gandhi Peace Award in 2014, the President Award for contribution to the Scout movement in 2014, the Atish Dipankar Gold Medal in 2015, the Mother Teresa Memorial Awardin 2015, the ICM Award in 2016, Begum Rokeya Padak in 2016, the Meritorious Banker Award in 2017 and the International Mother Language Award in 2018 as appreciation for his contribution to the financial sector.

He represented Bangladesh Bank in numerous international conferences, workshops and seminars in countries including UK, USA, Canada, Sweden, Japan, China, Taiwan, Switzerland, New Zealand, Germany, Indonesia, Iran, India, and Nepal.

Dr. Sultan Ahmed
Chairman
Rajdhani Unnayan Kartripakkha (RAJUK)

Dr. Sultan Ahmed, Chairman of RAJUK, is a career bureaucrat having more than 30 years of working experience with the Government of Bangladesh in various capacities such as Assistant Engineer, Assistant Secretary, Senior Assistant Commissioner and Magistrate, Senior Assistant Secretary, Deputy Secretary, Joint Secretary, Additional Secretary, etc. in different ministries and public offices. He served CEGIS, a scientifically independent centre of excellence in providing intellectual and professional services in water, land, RS, GIS, database and environment development and management that functions under the aegis of the Ministry of Water Resources, as a Director of Business, HRD and Administration, and a senior professional on policy and institution, for a period of over eight years. Dr. Sultan has been serving at the Department of Environment as its Director General since January 2018, and worked previously as Director (Natural Resources Management and Research) at the department from January 2012. He has enormous experience in global level negotiation and participated in the Conference of the Parties (COP) of the UNFCCC, including in COP21 in Paris, COP22 in Marrakech, and COP24 in Katowice. He played an important role in most of the Working Group meetings of Climate and Clean Air Coalition (CCAC) for reduction of short-lived climate pollutants (SLCPs) since its establishment in 2012 as Bangladesh's focal point.

Dr. Sultan studied civil and transportation engineering at Bangladesh University of Engineering and Technology (BUET), He graduated in water resources development engineering at Indian Institute of Technology, Roorkee (IIT-Roorkee). He pursued Doctor of Philosophy in water resources development at BUET. Dr. Sultan also studied engineering and technology in water resources development and management at Asian Institute of Technology, Thailand, IHE-Delft, The Netherlands, Lund University, Sweden, Tsukuba Science University, Japan, and Gothenburg University, Sweden. He received extensive training in systemic instruments on administration, law, policy, institution, development, and management at home and abroad. He has been a policy and institution expert on land, water, environment, and climate change, and an Environmental Impact Assessment (EIA) reviewer. Dr. Sultan is a member of Bangladesh Administrative Services of the 8th Batch. He is a South Asian Water (SAWA) fellow, and a fellow of Institute of Engineers, Bangladesh.

Md. Zahirul Islam

Additional Secretary
Local Government Division,
Ministry of Local Government,
Rural Development & Co-operatives

Mr Md. Zahirul Islam is the Additional Secretary of Local Government Division, Ministry of Local Government, Rural Development and Cooperatives (MoLGRDC), Bangladesh. He started his career as Scientific Officer at Bangladesh Rice Research Institute (1986-1989). In 1989, he joined as Assistant Commissioner and served as AC (Land) and UNO in the early stages of his career. As Senior Assistant Secretary, he worked in the Ministry of Public Administration and Ministry of Finance. Since 2006, as Deputy Secretary he worked in the Ministry of Land and in the post of General Manager in Bangladesh Overseas Employment and Services Limited. In April 2015, he served BCS Administration academy as Director (Training) and Director (Admin) with promotion to Joint Secretary. Before his present position, he served as Additional Secretary, Security Services Division, Ministry of Home Affairs, since November 2017. His areas of interest are Public Policy, Land Management, and Office Management. He visited New Zealand, South Korea, Thailand, China, Jordan, Egypt, India, Maldives, Mauritius, Malaysia, Australia, Singapore and Sweden during his service to the government. He participated in many training courses such as BMA, Survey and Settlement, Advance Administration, ACAD, SSC and MATT.

Profile of guest of honour

Rajindra De Silva Ariyabandu
Chairman
Lanka Rain Water Harvesting Forum,
Sri Lanka

Mr Ariyabandu is a development professional with extensive experience in national and regional water related research, policy and practice. His professional career spans over 30 years and includes working with government and international research institutions, regional water partnerships, multilateral donor agencies, global think tanks, international NGOs and the United Nations. Much of his focus has been on water governance, policy, legislation and promoting regional corporation in disaster risk reduction in the Asia Pacific region. He has knowledge and experience in national water policy formulation, drafting legislations, coordination of programme work in the South Asian region, livelihood research and analysis, and implementing cost effective rural water supply systems in developing countries. He has led many field research programmes at county level and functioned as the team leader in sub-regional water and livelihood projects. He has wide experience in training and consulting work in the Asia-Pacific region. He has many research papers and publications on water management and governance. His core expertise remains in the South Asia Region.

Extended abstracts

Reliability, economic benefit, water and energy wavings of rainwater harvesting in commercial building in Dhaka city

Md. Rezaul Karim, Sk. Sadman Sakib and BM Sadman Sakib

Introduction

Dhaka, the capital city of Bangladesh, is considered as one of the megacities of the world with populations more than 15 million and is stumbling with its increased water needs day by day. Population projection shows that the population of the city will be 32 million in 2035. Dhaka Water Supply and Sewerage Authority (DWASA) is responsible for delivering consumable water to city dwellers. According to Rahman et al. (2014), DWASA meets only up to 75% of the total water demand, of which 87% of the water is collected from groundwater and the rest comes from two surface water treatment plants. At present, DWASA can supply about 2149 million liters per day (MLD) against a daily demand of 2250 MLD. The gap between the supply and demand will be further aggravated in the near future due to rapid increase in urban population in Dhaka city. DWASA is seeking alternative sources in satisfying the growing water demand of the city including adaptation of RWH in Dhaka city.

Rainwater harvesting in both residential and commercial buildings may be an alternative water supply option to reduce the burden on DWASA water supply. According to the new proposed Bangladesh National Building Code (BNBC) every building proposed for constructing on plots having area of 300 m^2 or above should have the facilities for conserving and harvesting rainwater. The annual average rainfall in Dhaka is about 2200 mm, 75% of which occurs during the monsoon (June-October). This huge rainfall can be used as a potential alternative water supply source of Dhaka city, if harvested properly. Study by Rahman et al. (2014) found that about 262 m^3 of water can be harvested annually in a residential building having a roof area of 170 m^2 and this volume of rainwater can serve a building with 60 people for about 1.5 months in a year without traditional water supply and can save 11% water annually. Study by Karim et.al. (2015) revealed that about 250-550 kL of rainwater can be harvested per year from catchment area of 140 to 200 m^2 of residential buildings.

Although, there are some studies about the feasibility and reliability of rainwater harvesting in the residential buildings in Dhaka city, there is no study on reliability, water saving and economic benefits of adopting RWH in the commercial buildings in Dhaka city. This present study was undertaken to investigate the potential of RWH in multi-storied in commercial buildings in Dhaka city as well as energy saving and economic benefits.

Methodology

A water balance model was developed in MATLAB considering daily rainfall, contributing catchment area (roof), losses due to leakage and evaporation, storage tank volume (existing) and water uses as outlined by Imteaz et al. (2012). Benefit-cost ratio, annual water and energy savings were also calculated based on model output. The analysis was conducted for commercial buildings having roof areas of 120 to 1242 m^2, having water demand of 30-45 lpcd (BNBC 2017) and the storage tanks ranging from 15 to 60 m^3. The unit water price was considered as 35.28 Tk. per kL of water (DWASA, 2018) and energy price is assumed 4.12 Tk. per kWh. Daily precipitation data of 28 years (1988-2015) in Dhaka was used in this model.

Result and discussion

The results of the analysis reveal that the time-based reliability of RWH in commercial building varies from 3 to 15% and the volumetric reliability varies from 8 to 27%, depending on catchment size and storage tank

Table: Monetary savings and benefit-cost ratio of RWH in commercial buildings.

Catchment area (m^2)	Climatic conditions	Total demand (m^3)	Monetary savings, Tk			Benefit-cost ratio		
			Water	Energy	Water + Energy	Water savings only	Energy savings only	Water + energy savings
120	Wet	4.5	10878	381.09	11259	2.86	0.1001	2.9580
	Average		7788.1	272.85	8061.0	2.05	0.0717	2.1178
	Dry		4454.2	156.05	4610.2	1.17	0.0410	1.2112
600	Wet	18	48087	1684.70	49772	7.27	0.2548	7.5270
	Average		37088	1299.40	38388	5.61	0.1965	5.8054
	Dry		22250	779.50	23029	3.36	0.1179	3.4827
1242	Wet	33	96403	3377.40	99781	9.25	0.3242	9.5771
	Average		76129	2667.10	78796	7.31	0.2560	7.5630
	Dry		45832	1605.70	47438	4.4	0.1541	4.5532

volume. The monetary saving and benefit-cost ratio of RWH system in commercial buildings under three climate conditions are shown in Table 1 assuming 12.5% rate of return considering project life of 10 years. Considering both water and energy savings, it reveals that RWH in commercial buildings is beneficial under each climate condition. If the project life is extended, the economic benefit will also be increased. Since DWASA is increasing the water price in a regular basis, the monetary saving will also be increased by adopting RWH in commercial buildings.

Conclusion

It was also revealed from the analysis that yearly 200-2900 KL of water can be harvested and around 7000-100000 Tk. can be saved roughly per year in different climatic conditions by adopting RWH in commercial buildings. Due to the high price of water supply by DWASA in commercial buildings, RWH is beneficial under each climate condition and about 35 to 630 KWh energy can be saved per year.

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Rainwater adaptation in salinity affected southern coastal community

M. Tauhid Ur Rahman

Introduction

Southern coastal region of Bangladesh faces severe fresh water scarcity due to increasing salinity intrusion. The objective of this study is to examine the existing salinity in water, and to illustrate the adaptation practices of rain water as the safe water source in that coastal community. This study is based on the analysis of collected water samples and a field survey using a semi structured questionnaire.

Methodology

Salinity affected coastal community from two different coastal districts including Satkhira and Patuakhali are considered as the study area. Water samples were collected from Shyamnagar and Tala of Satkhira and Patuakhali sadar of Patuakhali district.

A total of fifty Water samples from various sources such as Tube wells, rainwater harvesting systems, reserved ponds, pond sand filtrations systems, and rivers were collected and tested for determining the existing salinity in terms of EC, TDS and concentration of Cl^- (Chloride). Chloride concentration of water samples was tested by Mohr's Method. Field survey followed by questionnaire were conducted to learn about scarcity of fresh water and also to know how rain water could be their adaptation option to combat increasing salinity.

Result and discussion

Salinity problem and Fresh water Crisis: Salinity of drinking water sources (surface and groundwater) in most of the Upazila lies between 600 and 1,500 ppm. After testing the water samples, the EC value in Shyamnagar, Tala and Patuakhali sadar was found ranging from 100 µS/cm to 30,000 µS/cm with an average of 5,000 µS/cm. Presence of high EC in the drinking water sources indicates that the water of the study areas is highly salinity affected. TDS of the water samples was also investigated in order to determine the salinity in the drinking water sources. The TDS of the Shyamnager, Tala and patuakhali was found at ranges from 50 mg/L to 20,000 mg/L with an average of 3000 mg/L. The average value of chloride was found 1,000 mg/L (Fig. 1).

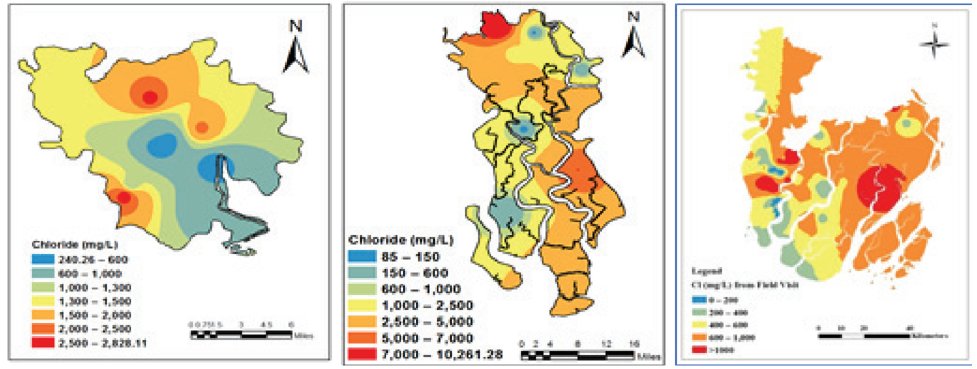

Figure 1: Chloride concentration of (a) Shyamnagar, (b) Tala and (c) Patuakhali

The threshold value of chloride is 150-1,000 mg/L for drinking water in the coastal regions of Bangladesh. Most of the drinking water sources of Shyamnagar and Tala exceeded this limit. In patuakhali salinity, TDS, EC and Chloride concentrations were found as high as those were for Tala and Shyamnagar.

Adaptation of Rain Water: Coastal Community are practicing different adaptation measures to mitigate the impacts of increased salinity. To meet the scarcity of safe drinking water, household practice measures such as rainwater harvesting, conservation of pond waters, and harvesting drinking water through ring wells. Preserving rainwater in the clay made containers was observed frequently in coastal community (Fig. 2a). Besides conservation of ponds and pond water is more popular among local people. At community level, digging of artificial ponds and using pond sand filters (PSF) are additional techniques above the individual level. Rainwater harvesting gets preferred at the community level. Annual average rainfall (i.e. 2000 mm) was found as enough to adopt rainwater as the source of drinking water for several months (Fig. 2b).

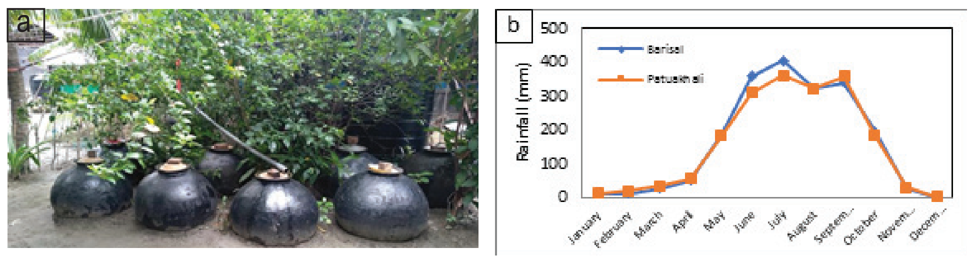

Figure 2: (a) RWH practice in a coastal community, (b) monthly rainfall in coastal districts

Conclusion

Water salinity of selected coastal community exceeded the safe water limit. Field survey confirmed the severity of fresh water crisis. Harvesting rain water in the clay made container has become one of the commonly practiced adaptation options. Annual average rainfall was sufficient enough to preserve and utilize as the drinking water source.

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Need of appropriate policy promotions to make city level rainwater harvesting in Kathmandu valley

Prakash C. Amatya, Manashree Newa and Shreesha Nankhwa

Introduction

Rainwater harvesting is an ancient technology and has been practiced since time immemorial by different civilizations (The Renewable Energy Hub UK, 2018). The people in the hills and mountains of Nepal practiced digging ponds to store rainwater for feeding the cattle. The cultural city of Kathmandu also practiced rainwater harvesting to recharge aquifers, which were the source of water for stone spouts (Thanju & Shrestha, 2010). At present, the change in lifestyle, advancement in technologies, and piped water supply, has resulted in significant increase in water demand. However, even though people value rainwater, the rainwater harvesting knowledge has remained traditional, and not updated according to time.

With the development of easier options for water availability like piped supply or tank system, the practices of rainwater harvesting can also be observed being ignored. Considering the high levels of air pollution in Kathmandu, people have a perception that rainwater is not pure. Although this is a valid and justifiable opinion, it also signifies the lack of awareness in people about correct measures of rainwater harvesting, water storage, and water purification. There is also a lack of technical knowledge in the municipal and ward level, affecting the policy, and enforcement of rainwater harvesting system. Thus, with an objective to study the interaction of residents of Kathmandu with rainwater, this paper has been prepared. This paper aims to point out the urgency of appropriate policy for a city-level rainwater harvesting at Kathmandu in order to fulfill the water demands, balanced water ecosystem, and prevention rainwater related disasters

Methodology

This social and policy based study was accomplished through three major processes.

Firstly, social media campaign #monsoonwisdom was used to study the one-to-one cases of rainwater harvesting across Kathmandu Valley. A total of 52 case stories were collected, where people shared their rainwater harvesting techniques, allowing us to study the level of awareness in people. The participants of the campaign were contacted through telephone interview, site visits, and direct conversations. Secondly, several consultative workshops on rainwater harvesting were organised and attended with an objective to gather knowledge and experiences of experts in this field. The events allowed us to identify the works of various organizations, understand the perspective of many experts, and be aware of the current situation and gaps.

Thirdly, all the authors, providing the bases for analysis of rainwater harvesting behaviour, also did a vigilant observation of people's interaction with rainwater.

Result and discussion

Through this study, we have found out that most of the residents of Kathmandu Valley practiced rainwater harvesting. Water crisis and increasing water demand have made monsoon a boon to the urban residents, curbing the water gap at least for a short term. But, the rainwater harvesting practiced in Kathmandu is mostly seasonal. People still practice traditional harvesting techniques, which do not match the current environmental conditions and demand. The level of awareness regarding rainwater harvesting is present, but the correct technical knowledge is lacking in most of the residents. People are not aware that rainwater harvesting, if done properly, can be used for drinking and can last throughout the year. This is resulting in waste of the valuable resource, which could otherwise curb all the water problems of Kathmandu.

The adequate knowledge about systematic groundwater recharge mechanism was found absent in most of the residents. This can have severe consequences in the far future. It is important that the public is given complete knowledge about rainwater harvesting and ground water recharge mechanisms. Thus, there is an urgency of setting a national target for rainwater harvesting awareness and implementation, which can be achieved with the combined efforts of governmental and non-governmental organizations. If framed properly, the issues of water crisis in Kathmandu can be solved permanently through rainwater harvesting.

Above all, strong policies need to be drafted that address the need to utilize rainwater and recharge ground water. The sectors such as building permit, storm and sewer management, water supply, geology, etc. should come together in order to develop an integrated policy to implement household level and a city level rainwater harvesting. The government should also designate large open areas as a recharge ground, implementing the concepts of sponge city. Every municipality and ward should develop building bylaws, the process being facilitated by proper training, discussions, and consultation. A robust rainwater national guidelines and directive is a nick of time to give a proper policy and regulatory directions to harness the potential of rainwater city in the Kathmandu Valley.

Conclusion

Thus, it is evident that the residents of Kathmandu Valley have been practicing rainwater harvesting. However, the measures of rainwater harvesting are rather traditional, seasonal and not systematic. Even though people have understood its benefits, there are barriers in financial investments for a proper rainwater system. The technical manpower involved in construction has also limited knowledge on rainwater harvesting system. Thus, it is very important to initiate awareness and enforcement activities on a national level. Appropriate policies in line with the demands and situation of the community and the country should be drafted and implemented as soon as possible. This can not only curb the water crisis, but also maintain the ecological balance.

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Feasibility analysis of rainwater harvesting system in industrial buildings: findings and learning from practical experience

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Introduction

This study represents the feasibility and acceptability of harvested rainwater in industrial buildings of Bangladesh using simple, modern and cost-effective technology. As a part of this study, a field survey was conducted in five different industries of Dhaka, Gazipur, Mymensingh, Narayanganj and Habiganj.

Methodology

Physical site inspection

Physical site inspection was carried out to know technical details specification of the of the industries. As part of the process, the available secondary documents as like design, drawing of existing building were reviewed.

Questionnaire Survey

In the questionnaire survey, the workers were asked about their problems related to water and also the problems they encounter on consumption of water from the available sources. Apart from their hurdles, their opinion was gathered regarding the rain water harvesting system.

Focus Group Discussion (FGD)

The FGD was the then conducted with the key stakeholders including respective authority, service providers, operators, general manager, project manager, project engineer and labor leader of the industries. They were also asked about their opinion and experiences regarding the available water sources and also from them got to know about their preferences regarding the rain water harvesting system.

Result and discussion

Table 1 shows the rainfall available for each industries according to BNBC 2006. Rainfall available depends on the catchment size.

Table 1: Available Rain Water

Industry No.	Total Employee	Total Catchment Area (sqm)	Yearly Available RW (cum)	Max. Available RW for 1-month (cum)	Max. Available RW for 1-month (cum)
Industry 1	14000	20500	34153	6761	1560
Industry 2	1430	6810	11345	2246	550
Industry 3	9570	15490	24784	5192	1053
Industry 4	4904	1860	2976	623	126
Industry 5	610	10770	18611	4032	862

Figures 1 and 2 show water demand for flushing, car washing and gardening for the five industries. The demand depends on number of employee, area of garden and industry.

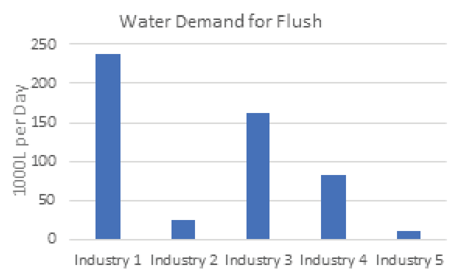

Figure 1: Daily water demand for flush

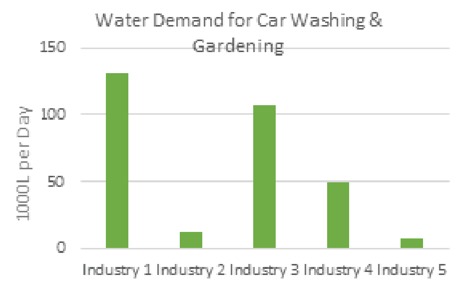

Figure 2: Daily water demand for car washing and gardening

Figure 3 indicate that the existing condition of Down and Drainage Pipe are very poor. Only one among five industries has fulfilled the all requirement of Down and Drainage Pipe for rain water harvesting.

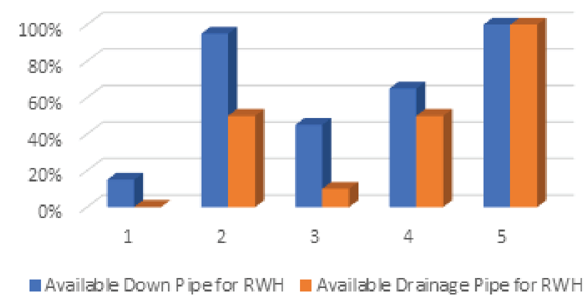

Figure 3: Available Down and Drainage Pipe for RWH

Table 2 shows that the available RW can fulfill the demand of each industry from 7.5% to 347.6%. This percentage depends on number of employee, area of garden and industry. The amount of tariff saved (calculated as per rate charged by DWASA) is also noticeable.

Table 2: Yearly Non-Potable Water Demand Fulfilled by Rain Water and water bill saved

Industry No.	Yearly Non-Potable Water Demand	Yearly Available RW (cum)	Demand Fulfil by RW (%)	Yearly Water Bill Saved (BDT in Thousand)
Industry 1	108826	34153	31.38	2530
Industry 2	10757	11345	105.5	840
Industry 3	79669	24784	31.11	1836
Industry 4	39350	2976	7.56	220
Industry 5	5354	18611	347.61	1378

Conclusion

readiness of industrial authorities for using the technology is still far from execution. Though the Promotion of RWH among industrial sector is going on rapidly, policy support and encouragement is required from Govt agencies as well from the buyers end. Based on the practical experience of promoting and providing design support and technical assistance to the factories, the following recommendations have been derived from the study:

1. Government legislation should be stronger, specially providing and renewing the environmental clearance certificate
2. Findings from research and case studies of utilizing the rainwater in production and other uses should be disseminated in the form of training and workshops among the factory engineers.
3. Considering the ground water level depletion, the RWH system in the design of the factory buildings need to be ensured.
4. As the RWH systems cost is not high, if it is planned before construction, the assurance of implementing RWH will be easier.
5. Financial support in the form of low interest rate loan or long-term loan facilities would be encouraging the factory owners for implementing the RWH. Considering the saving and the environmental impact of implementing RWH, the financial aid/ support will be beneficial in the long term.
6. Scientific knowledge of sustainable water management should be mandatory to all professional disciplines who deal with building technology.

Rainwater harvesting potential for Bangabandhu Sheikh Mujib Shilpa Nagar at Mirsarai

Ismat Ara Pervin and Doyananda Debnath

Introduction

Mrisarai, Sitakundu and Sonagazi are adjoining upazilas of Chittagong and Feni. Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) is being developed on a contiguous land of 30,000 acres of these three Upazilas, which is located on the mouth of Feni river, covering 25 KMs of coast lines of Sandweep channel of the Bay of Bengal. Bangladesh Economic Zone Authority (BEZA) is in the process of developing a comprehensive master plan including incorporation of sea port, rail connectivity, marine drive, residential area, power plant, hospital, school and university for developing this self-sustained industrial city. Feni and Little Feni are the two major rivers which flow down to the Bay of Bengal on the north west of proposed BSMSN area. Both the rivers have closures at their estuaries with gated regulations. The water resources projects on Feni River is Muhuri Irrigation Project and that on Little Feni River is Dakatia Little Feni Drainage Project. Upstream of their closures serve as fresh water reservoirs and recreation places. There is an irrigation demand at Feni reservoir while storage at Little Feni reservoir is not defined for uses but facilitate public purposes. Mohamaya lake is a large valley reservoir in the eastern hills which mainly serves the irrigation demand. The allocation of these water resources will be a key issue for BSMSN, which will have to look into the industrial demand growth and growth in municipal demand. However, sustaining and meeting future growth aspirations in industrial sector of BSMSN will require a befitting approach (combination of surface, ground and sea water) to manage the emerging water demand, quality and availability risks. As the total area of project is very large and average rainfall in this area is more than average rainfall of Bangladesh, rainwater harvesting may be one of the most important options for this area.

Water demand assessment

Assessment of industrial rate of utility demand is expressed in practicing unit of demand per day per unit of area. Total water demand as estimated for BSMSN is divided into two major portions: 1. Industrial

Water Demand, and 2. Domestic and non-domestic water demand. Total projected water demand for industrial part is about 721 million liters per day, Domestic and non-domestic water demand is about 207 million liters per day. Considering some losses in the treatment plant and along transmission and distribution system, gross water demand is about 1125 million liters per day. The water requirement will be 610 million liters in phase 1 (2019-2025), 190 million liters in phase 2 (2020-2030) and 325 million liter in phase 3 (2031-2040).

Water uses and potentiality assessment

The annual rainfall of the BSMSN area is 3300mm. About 90% of the total rainfall occur from May to October (BMD, 2018). The Master plan has been conducted for an area of 30,094 acre. It is found that the areas used for transportation and communication, conservation and water body cannot be used for rainwater harvesting but those can be used for natural reservoir and recharge. The remaining area is about 18,756 acre which can be used for rainwater harvesting. If 50% of the area considered to be used for industrial and other purpose and 60% of rainfall from May to October can be utilized, then annually about 67,278 million liters volume rain water will be available for harvesting which is equivalent to about 184 MLD (16.35% of total demand).. To ensure natural harvesting proper storm drainage, natural reservoir, wetlands and separate drainage for storm water and wastewater should be constructed. Such huge amount of harvested rainwater can be utilized not only for industrial use but also can be used for ground water recharge. The other possible use of harvested rainwater for non-potable domestic use.

Result and discussion

Every year total more than 400-billion-liter rain water can be harvested considering the full area of 30,094 acre comprising both artificial and natural rainwater harvesting and storage. Groundwater resource is not very worthy here, over extraction can lead to saline intrusion in groundwater or mining which can lead to dramatic change in groundwater availability and consequently sea water dependability will increase. If rainwater harvesting can be enacted from the beginning of the project, about 16.35% of total water can be harvested for recharge and reuse. As most of the rainfall is during the rainy season, harvesting for recharge can be one of the best options as it will replenish the ground water source.

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Promoting rainwater harvesting in RMG and textile area: a case study of Next Accessories Ltd. Bangladesh

Md. Zahid Hossain

Introduction

The export-oriented readymade garments (RMG) sector along with the textile industries in Bangladesh has been playing a pivotal role in facilitating the country's export earnings, contributing more than 83.4% of total export. This sector is one of the potential sectors for the best utilization of demographic dividend by creating huge employment opportunities. Most of the garment and textile factories are situated in Dhaka, Gazipur, Savar and Narayangonj and using more than 201 litres of water for washing and dyeing one kilogram of fabrics while the global best practice is 70 litres (PaCT 2016). Bangladesh's textile industry consumes 1,500 billion litres of groundwater a year for washing and dyeing fabrics (WPN 2014). RMG and textile sectors in Bangladesh exported $30.61 billion in FY 2018, and targeting $50 billion export earnings annually by 2021 (RMG Times 2019); eventually water will be challenged with other issues to meet this target.

To address the water crises in textile industry, some international partners, buyers and owners have been trying to adapt water efficiency in industry. In addition, under the 7th Five Year Plan, the government of Bangladesh aims to attain the environmental sustainability in industry with a view to reducing groundwater dependency through taking some initiatives - one is exploring options for rainwater harvesting in industry. WaterAid, an international NGO, has been working together with a factory to construct a rainwater harvesting system. In this study potential of rainwater harvesting system (RWHS) has been calculated to reduce the dependence on groundwater, helping to attain environmental sustainability and eventually contributing for obtaining LEED certificate.

Brief description of the Next Accessories Ltd.'s Rainwater Harvesting system

The factory we worked in located Vulta, Rupganj under Narayangonj district with a view to serving apparel identification solution, print and packaging which are the most crucial determinants of quality for apparel products. The total building's roof top of NAL is 6500 square meters, and currently 4500 square meters has been using as catchment area for harvesting the rainwater, and rest of the catchment is to be added in later. Currently, rainwater has been using for non-production purposes, and in future this water will be used for wet processing also when catchment area is to be extended. So, both storage and filtering facilities are there for getting clean water. At first, the captured rainwater from the roof is passed through downward pipes which were set up during constructing the building to drain out the roof top's rainwater. These downwards pipes are connected to underground pipes and thereafter collectively passed to a filter (combination of de-siltation and gravel bed). For filtration, downgraded gravel materials with thickness of 2 inch to 4 inch have been used. Size of the underground storage tank and filter are 3 lakh litres and 20 thousand litres respectively. A beautiful flower garden is planted on the top of storage and filter tank which extends the landscape of factory.

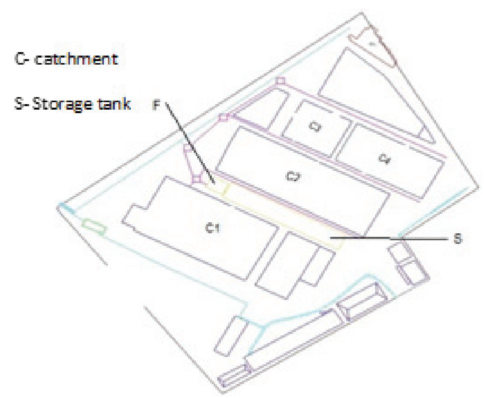

Figure 1: Layout of RWHS

Figure 2: Pipe connection

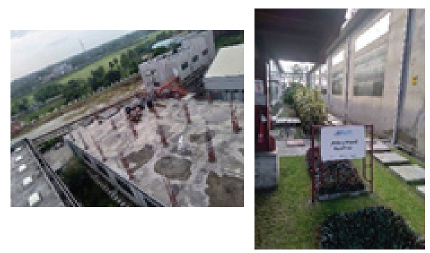

Figure 3: Catchment and Storage tank

Results and discussion

Rainwater is to be harvested according to the following table-

Month	Rainfall, m	Coefficient	Catchment Area, m^2	Harvested Rainwater (litre)
January	0	0.8	4500	0
February	0	0.8	4500	0
March	0	0.8	4500	0
April	0.123	0.8	4500	442800
May	0.235	0.8	4500	846000
June	0.314	0.8	4500	1130400
July	0.356	0.8	4500	1281600
August	0.409	0.8	4500	1472400
September	0.250	0.8	4500	900000
October	0.265	0.8	4500	954000
November	0	0.8	4500	0
December	0	0.8	4500	0
Total harvested rainwater				7027200

According to the reading of Flow meter, the factory has consumed 2100000 litres rainwater for different purposes from April 2019 to July 2019. Finally, it is not possible to cover the demand for all-round the year as storage tank capacity is 3 lakh litres only. So, under this RWHS, 3937000 litres rainwater are to be used. If the factory had to buy water at the rate of BDT 37.35/ m^3 from BEPZA, they would have spent BDT 147000. If the factory can utilize the 6500 sqm catchment, then annually harvested rainwater will be 10140000 litres, which would be used for wet processing also. In this case RWHS will save BDT 378000.

Concluding remarks

The successful demonstration of RWHS in the factory we worked signifies that rainwater harvesting is a profitable proposition for RMG and textile sector. This system is reducing the dependence on groundwater, eventually contributing to environmental sustainability which will help them for achieving LEED certificate and meet the other compliance requirements that are directly or indirectly related to business.

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