Feasibility of Rainwater Harvesting at Dhaka Export Processing Zone Area: A Potential Approach to Reducing Dependency on Groundwater

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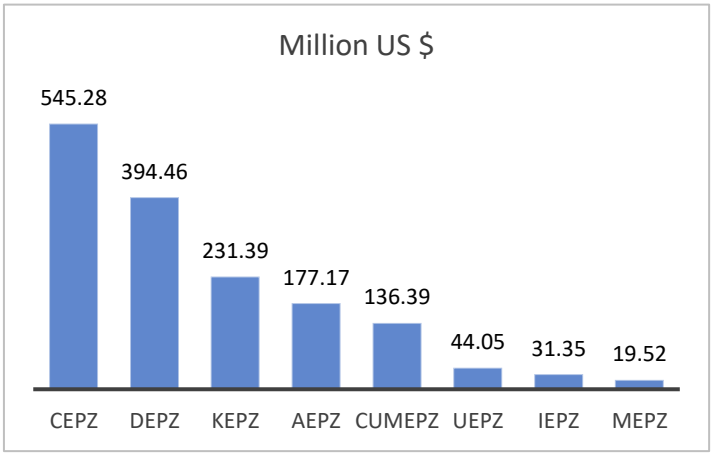
ABSTRACT

Bangladesh's economy has currently been growing fast than others previous decades. Government of Bangladesh recently formulated the 8th Five Year Plan (FYP) and now all developments have been taken under this FYP where economic zone and export processing zone are being considered as vital, need to scale up keeping green environment in place for sustainable development. Dhaka Export Processing Zone (DEPZ), situated at Savar is one among others EPZs which has been contributing to ours economic significantly where groundwater has been extracted and distributed to all factories and its offices by BEPZA. The hydrogeology of Savar is complex because of its geological formation being Pleistocene Terraces, generally called it Madhupur tract. It is seen that northern part of Dhaka, Gazipur and Savar are in Pleistocene Terraces. In these areas the upper soil is up to 30 ft and in some place even up to 150 ft of stiff clay with very low permeability, and eventually natural groundwater recharge is almost negligible. From the groundwater zone map 1998, 2002, 2008 and 2012 developed by Bangladesh Agricultural Development Corporation, it has been seen that the groundwater table depletion rate in this area is too high and being alarming. A study is conducted at DEPZ and took learning from 4 factories in Narayagoonj. From study it is found that there is an opportunity to introduce rainwater harvesting system in DEPZ and by which 1.7 million cubic meters rainwater per year would be captured which is equivalent to 65 million BDT (0.76 million USD). Rainwater could be used for different purposes including production sector such that cloth dyeing and washing at RMG.

Keywords: Export Processing Zone, Groundwater depletion, Rainwater harvesting

Introduction:

Dhaka Export Processing Zone (DEPZ) is situated at Savar, which contributing a great deal to our economy, and in this regard following table is being the best to discuss how much potentiality DEPZ has been possessing. The enterprise of EPZs have earned worth US$ 1579.61 million during the 1st quarter of the fiscal year 2020-21. Export earnings from Chattogram EZP (CEPZ) stand at US$ 545.28 million while that of Dhaka EPZ (DEPZ) US$ 394.46 million, Mongla EPZ (MEPZ) US$ 19.52 million Cumilla EPZ (CumEPZ) US$ 136.39 million, Uttara EPZ (UEPZ) US$ 44.05 million, Ishwardi EPZ (IEPZ) US$ 31.35 million, Adamjee EPZ (AEPZ) US$ 177.17 million and Karnaphuli EPZ (KEPZ) US$ 231.39 million. So, DEPZ is important EPZ in terms of country's economic development. Therefore, our study's aim is to know how much water security there is



Graph-: Income earning of different EPZs fo

because of keeping a balance between water and economic growth for sustainable development. Groundwater depletion rate in this area is too high, that's why need to see how much feasibility for rainwater harvesting as an alternative source of water having there.

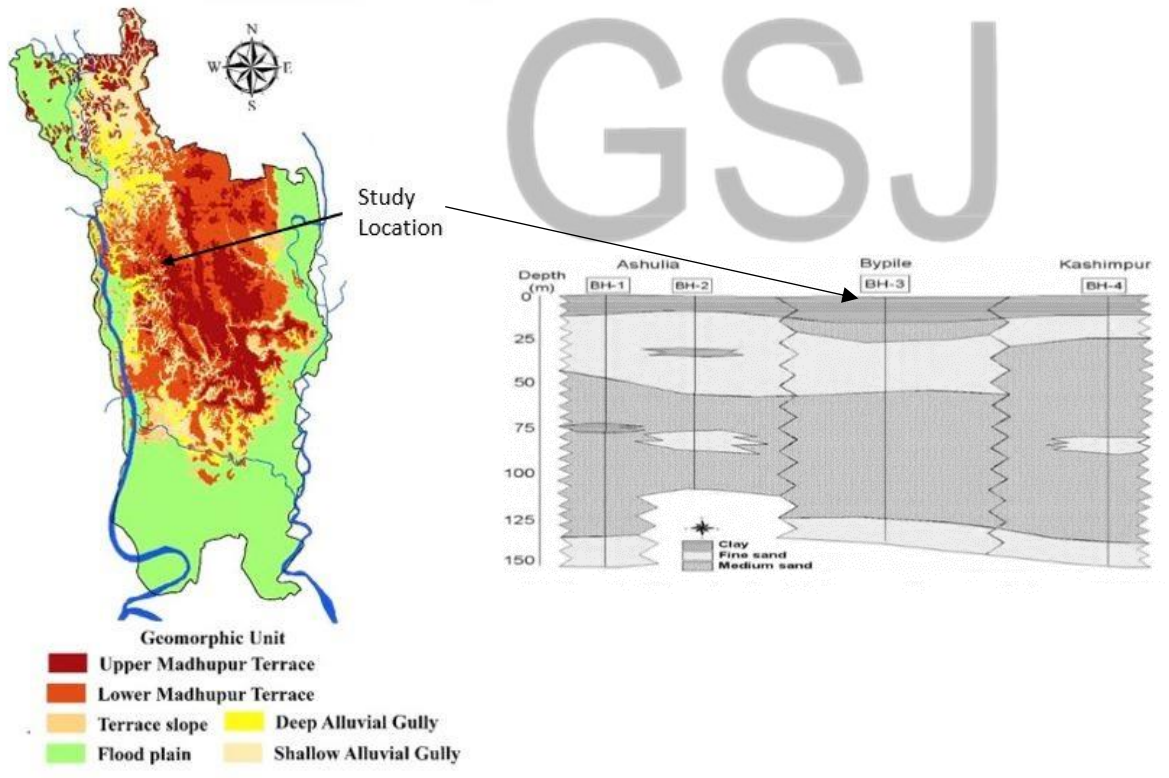
Methodology

Study was conducted through analysing the secondary and primary data. Secondary data and information were collected from various organizations, documents and published journals for getting the analysis of rainfall intensity and annual rainfall with monthly pattern, groundwater extraction by BEPZA, and hydrogeology of the DEPZ. Primary data is generated by survey and Key Informant Interview through structural questionnaires for getting the information how many factories are in DEPZ with feasibility of catchment area for harvesting rain. Calculating the rainwater through software that would be harvest annually from DEPZ. Then analysis the Return on Investment (RoI) of rainwater harvesting system for ensuring sustainable environment.

Analysis and discuss:

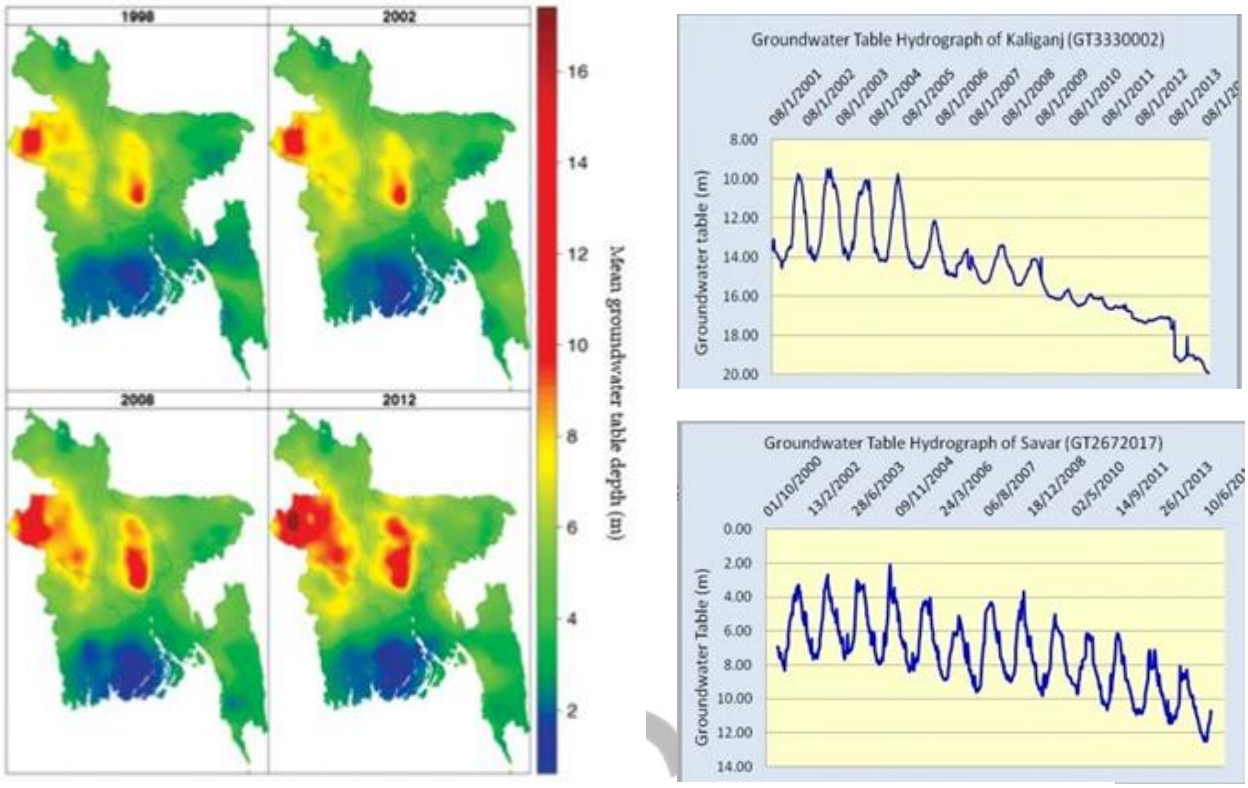
Groundwater:

Groundwater is the only source of DEPZ, and they have been extracted the groundwater from 17 pumps with 85 HP each for 88 factories (establishments). Yearly, DEPZ have been extracted in average 16041792 cubic meters water that worth 61.34 core Tk. Besides DEPZ, many factories are situated at Savar and Gazipur, so a huge amount of water has been withdrawing from there. But groundwater recharge is negligible in these area because of upper soil 20 to 30 meters is stiff clay which is formed Pleistocene terraces generally called Madhupur tract. As a result, groundwater table is decreasing every year, now being concerned. Following map and graph show that DEPZ's soil is Pleistocene soil and Madhupur trace.



Map and graph: Hydrogeology of study area

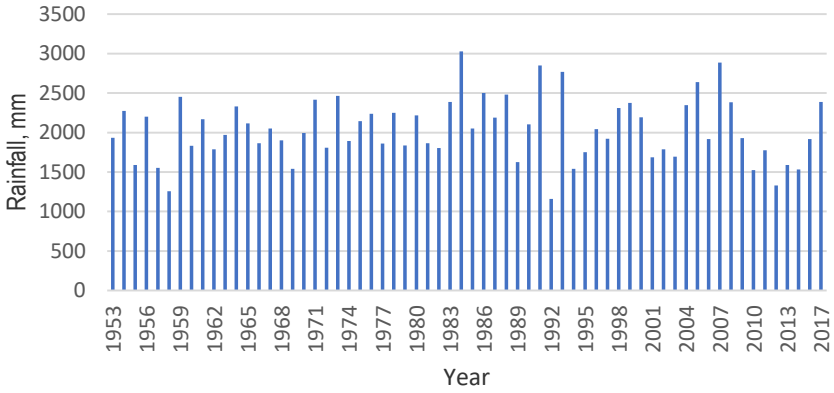
Groundwater table depletion has been analysis from groundwater zone maps and groundwater monitoring station of Khaligonj and Savar as the study area is the middle of these two areas.



Pic: Groundwater zone map and groundwater table for 2001 to 2013 for study area

Rainfall intensity in study area:

Availability of rainfall data, rain curve in hydrological map of country and distance between factories to rain gauge station, Dhaka is the best for choosing as rainfall station. Monthly and yearly rainfall from 1953 to 2017 has been collected from Bangladesh Agricultural Research Council (BARC). Table for yearly rainfall in Dhaka from 1953 to 2017 showed not continuously degradation or upgradation for 6 years but showed a fluctuation which did not follow a time interval. After analysed, it was seen, yearly rainfall was unpredictable from 1953 to 2017. As example, in 1958 annual rainfall was 1258 mm, and next year in 1959 it was 2453 mm, in addition after 45 years it was 1919 mm in 2006 and 2885 mm in 2007, means that there was a huge gap in consecutive two years. On the other hand, another observation was founded, in 1994 annual rainfall was 1540 mm, and since then it was gradually increased up to 1999 with 2374 mm, then it was decreased with fluctuation until reaching 2885 mm at 2007. Rainfall intensity lowest to highest was 1258 mm to 2885 mm respectively, but we can assume an average rainfall in Dhaka is 2000 mm based on analysed and correlation with literature review.



Graph: Yearly rainfall for 1953 2017 at Dhaka station

Learning from 4 textile and RMG factories in Narayangonj:

Next Accessories Ltd (NAL):

Under present RHS, 7,200 m3 rainwater has been harvested annually at NAL. Among 7200 m3, 3,000 m3 is used for toilet flushing purposes and rest 4,200 m3 is used for underground water recharge. Still having the opportunity to incorporate additional 2,000 m2 catchment, and during that time 10,400 m3 rainwater would be harvested.

Next Accessories Ltd

Fakir Fashion Ltd

Metro Knitting & Dyeing Mills Ltd

Epic Garments Manufacturing Company Ltd

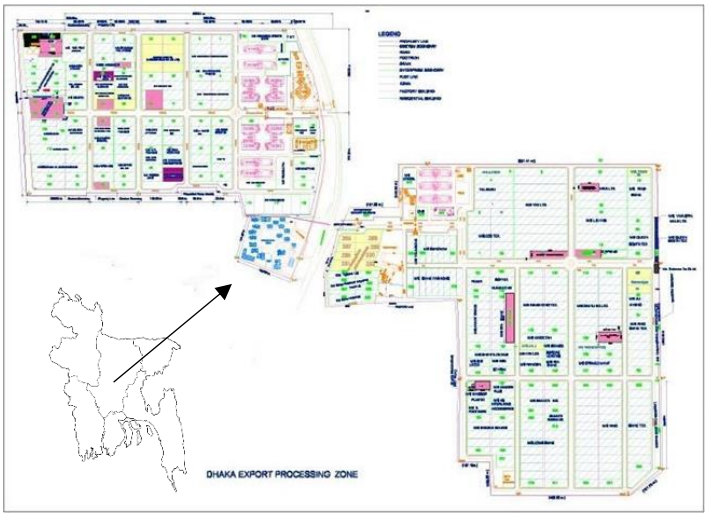
Fakir Fashion Ltd (FFL)
Under present RHS, 14,995 m3 rainwater has been harvested annually at FFL. Total rainwater is used for cloth washing and dyeing purposes. Still having the opportunity to incorporate additional 13,568 m2 catchment, and during that time 36704 m3 rainwater would be harvested.

Metro Knitting & Dyeing Mills Ltd (MKML)
Under present RHS, 12320 m3 rainwater has been harvested annually at KKML. Total rainwater is to be used for cloth washing and dyeing purposes. Still having the opportunity to incorporate additional 10,690 m2 catchment, and during that time 29924 m3 rainwater would be harvested.

Epic Garments Manufacturing Company Ltd (EGMCL)
Under present RHS, 32,000 m3 rainwater is to be harvested annually at Epic GMCL. Total rainwater is to be used for cloth washing purposes. Still having the opportunity to incorporate additional 10,365 m2 catchment area when 48,584 m3 rainwater would be harvested

Result and Discussion:

The study team conducted a survey of all enterprises (factories and offices) in DEPZ to assess how much catchment areas the enterprise belongs that are to be considered for rainwater harvesting. And in parallel, also collected the data how much water they are purchasing from BEPZA.



Pic: Map of DEPZ

These two types information from 88 enterprises were analysed, and has been reflected in the following table

Category based on catchment of RWHS	Number of Factory (establishment)	Yearly consume water, cubic meter	Yearly water bill, @ 38.24 BDT	Catchment for RWHS, square meter	Captured rainwater, cubic meters yearly	Captured rainwater worth @ 38.24 BDT yearly
500 to 2000 m^2	18	270420	10340860	17886	28617	1094337
2001 to 4000 m^2	20	847476	32407482	56061	89697	3430036
4001 to 8000 m^2	16	1378200	52702368	91168	145868	5578023
8001 to 20000 m^2	14	2762040	105620409	182712	292339	11179051
20001 to 40000 m^2	15	6602628	252484494	436772	698835	26723458
40001 to 80000 m^2	5	4181028	159882510	276579	442526	16922210
Total	**88**	**16041792**	**613438123**	**1061178**	**1697882**	**64927115**

Table: Groundwater consume and rainwater to be harvested with worth value

The above table shows that about 57% enterprises (establishment) contain 4000 to 80000 square meters top roof that can easily be used as a catchment for rainwater harvesting by which every enterprise can save 0.4 million BDT to 3.4 million BDT means that Return on Investment (RoI) is positive. For other factories RoI is relatively low but considering others factors like that environmental RoI is too high, so it has been reflecting positive sense also.

So, tangible benefit by rainwater harvesting in DEPZ is significant. Every year 88 enterprises (establishment) have been paying around 615 million BDT for water bill where they could save around 65 million BDT.

Environmental benefit is huge because around 1.7 million cubic meters water will not be withdrawn annually. This amount water could not get the space to penetrate into groundwater as upper soil 20 to 30 meters is stiff clay. So, by this way rainwater harvesting could reducing the pressure on groundwater.

Conclusion:

a) Water quality and treatment cost

For dyeing and washing processing, some standard in water quality parameters need to maintain, like colour less, iron free and hardness should not exceed 5 to 7 mg/l. However, rainwater which was tested in factories in Narayangonj. So, rainwater is being stored through passes a stone bed filter which is enough to make it fit for dyeing and washing purposes. But treatment is needed for groundwater if its hardness is above 7mg/l

Indirect Benefit

a) Environmental benefit:

Though reducing dependency on groundwater is not too much for DEPZ by RHS but significant considering the volume of rainwater that has been using. Waterlogging has been created due to heavy rainfall, poor drainage facilities and uplifting water body's bed, a common picture of the country. Last couple of years, it has been seen that rain day is shorten, but intensity of rainfall is increased which is main cause to make sudden flood or inundation. In April 2017, within 24 hours 48

mm rainfall was happened and 3 factories' premises were inundated for few hours which hampered their productivity. So, RWHS reducing the drainage volume which has financial and environmental benefit also.

b) Social benefit:
RHS has been contribute the factory to be green factory which draws the attention to buyers, government, policy makers, civil societies positively, and eventually contributing to extending their brand. 4 factories getting extra benefit by RHS, one is meeting the demand of H & M, a big buyer in Bangladesh, as they are choosing the RMG factory in where RHS is working. RHS also contributing for getting LEED certificate as it helps to increase the score.

Return on Investment and Environment
For constructing the RHS at 88 factories in DEPZ around 40 core BDT will be spent. But every year RHS will save 6.42 core BDT. So, 6 to 8 years is needed to recover the investment in where structural life span of RHS in average 60 years. Environmental benefit is huge, interms of reducing dependency on groundwater. Besides, drainage management specially during heavily rainfall day.

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