

TIPAIMUKH DAM What we need to know

The expected uninterrupted flow released from turbines of the dam is supposed to be halted for diversion at the Fulertal barrage, situated about 100 km downstream of the dam and 100km from Bangladesh border. In that case there is an immediate and urgent need to negotiate and settle our equitable and fair share of Barak waters.

PROF MUSTAFIZUR RAHMAN TARAFDAR

ACCORDING to UN convention, for any intervention on an international river, the upper riparian should supply all information about survey and data collection, design and report, activities in pre- during- and post-construction stages before starting the construction of a dam/barrage. Any disagreement or dispute should be resolved bi-laterally. Any gross disagreement with or violation by the upper riparian such as unilateral construction and withdrawal of waters may lead to reference with the UN. But all attempts must be made to resolve the issue between the parties sharing the common river basin.

A dispute on an international river may stretch for a long time. Farakka issue started in the sixties and an agreement was reached after about 40 years, in 1996. One can say that the problem is not over yet. It may take many more years to get fair share of water of the Ganges as agreed upon. As the agreed share of water is not reaching Bangladesh, we have been facing catastrophic situation in the SW region, severely affected by drought and desertification, environmental degradation and saline water intrusion from the sea as a result of very low or nearly absence of upland flow.

Similar situation may occur in Brahmaputra basin as a result of diversion of Brahmaputra water for river-

linking project in India.

For the reported Chinese gargantuan plan of diversion of Brahmaputra waters for blooming the dry and barren Gobi desert, thousands of miles away, there may arise need for water conservation during the dry season. China is imposing a third dimension in the already volatile and critical water crisis.

We expect that similar deplorable situation may not arise in the Surma-Kushyara-Meghna basin in the near future due to Tipaimukh Dam. We must have assurance that water sharing agreement of Tipaimukh will not follow the one that obtains for Farakka which made SW region a dry land. Government may request India to stop the construction for better. However, the following data should be sought.

Tipaimukh Dam is a rockfilled dam. For any dam design, types and requirements of data are enormous. Only the relatively important ones are highlighted here:

Climatological data: Rainfall-Daily rainfall at damsite. Hourly rainfall data from automatic recorder. Data from an old station -- either a nearby city or airport -- on daily rainfall, hourly rainfall from auto recorder, evaporation, humidity, temperature, wind.

Hydrological data: Discharge from a long duration nearby station and from dam and barrage site stations, types of currentmeters (Price Ott or other), type of bed load samplers, method used in

discharge measurement, launch and extant and hydrometric markers on weekly, fortnightly or monthly intervals.

In hourly discharge, particularly observed at dam site or from a nearby station, we may have to resort to use unit hydrographs and calculate probable maximum flow using rainfall data.

Water level -- From staff gauge daily mean water level, hourly WL from auto recorder.

Sediment data -- Bed load and suspended load.

Cross-sections -- Some cross sections at and up and down of dam site.

Water quality -- Important parameters to be made available.

Geology: Necessary geological information for areas around the dam and the reservoir in report, drawings and maps. Maps of Geological Survey is also required.

Topographic surveys, drawings and maps: Cross-sections of dam site, up and down at designed intervals. Maps of regular topographic surveys with contours, made by Survey of India are required for delineating reservoir area, height of dam, reservoir capacity, volume vs area and area vs height relationships etc.

Geotechnical investigations: Tests are conducted on collected samples, shear strength, compaction, compression and consolidation settlement, tri-axial tests for shear strength, load bearing capacity, stability analysis of slopes,

permeability and seepage analysis etc.

Studies should also be made for sites used for materials for the dam, area and quantity of suitable materials. Seepage analysis will show seepage flow through the foundation so as to ascertain the stability of the dam against erosion and subsidence.

Geophysical investigations, electrical resistivity surveys: Geophysical surveys should be conducted on dam site, u/s and d/s in designed intervals. Survey should be conducted in the reservoir area. Longitudinal surveys of the dam site upto end of reservoir and d/s for the designed distance, location of faults, spots of leakage and any weakness of dam site itself. Major earthquakes magnitude (Richter scale), records of earthquakes etc since the area is frequented by earthquakes, situated in one of the most seismically active zones in India.

Some suggestions

Design of dam -- shape of the dam, drawings -- Reports of different analysis/studies, stress analysis, factor of safety etc, u/s and d/s slopes, impervious membrane, dry rubble below u/s slope and loose rockfill below d/s slope etc, seepage analysis through the dam and foundation to show its stability against subsidence, soil erosion at the d/s slope, seepage through the foundation -- all investigations and studies should be collated, and synchronised for design.

Dam, reservoir and storage: We must have copy or design of the dam and reservoir, particularly in respect of supply and demand of water like inflow of river and runoff from rainfall over the reservoir and loss, evaporation and seepage. Demand side would include requirements of water for hydropower, drinking water supply, ecological release, flood control storage and storage to compensate evaporation and seepage.

Dam break study: The total massive

stored volume of water should be considered in dam break study to anticipate, predict the inevitable deluge which will lead to flooding in Surma, Kushiara and Meghna basins, causing untold miseries, death and destruction. The reported designed volume of 15 billion m³ water will submerge the greater Sylhet district to a depth of 15 feet or more! This deluge occurs during catastrophic hydrological upheavals or devastating earthquakes. Invariably, dams and reservoirs with huge dead weight tend to accentuate the occurrence, frequency, intensity, magnitude and severity of earthquakes more so in the seismically active earthquake-prone zone.

Methods and instruments for data collection: Methods of observations and instruments used in climatologically, hydrological and other investigations and observations, should be asked for ascertaining the accuracy, appropriateness and veracity of data collected and used for design.

Environmental impact assessment study: It is to be ascertained whether the study apart from other impacts, included adverse effects on economy and environment in the lower riparian Bangladesh. Whether the damages were expressed in monetary figures and suggested mitigation measures. As upper riparian, is expected to bear the cost of mitigation activities involved, all studies, data used, assumptions made etc. should be made available to Bangladesh.

Shared water for Bangladesh: Ascertain whether the water released by turbine after generating hydroelectricity, will be allowed to flow downstream for Bangladesh, along with rate set aside for ecological flow and the balance of flow that is required to total the agreed equitable and fair rate of flow for Bangladesh.

Sedimentation and life of reservoir: Details of calculation of reservoir sedi-

mentation should be supplied to Bangladesh to ascertain the life of the project.

Design of spillway: All calculations and drawings are needed to ascertain how the spillway bed level was fixed, how the maximum flow rate and its depth above the bed was determined.

Turbine flow: Turbines, type, size, capacity its rate of flow etc number and size (KVA) of generators and its generating capacity; information regarding discharge of turbine water after its use, whether it is discharged in river downstream to flow to Bangladesh or intercepted by a barrage -- details of all technical data should be provided.

Fulertal Barrage: Bangladesh delegate will ask for data and design of Fulertal barrage. If there is irrigation, ask for area under irrigation, crop type, total water used per season/yearly in million/billion m³ and other data.

Concluding remarks

The expected uninterrupted flow released from turbines of the dam is supposed to be halted for diversion at the Fulertal barrage, situated about 100 km downstream of the dam and 100km from Bangladesh border. In that case there is an immediate and urgent need to negotiate and settle our equitable and fair share of Barak waters. Our government may request India to stop the construction of both the dam and barrage as none of them, in any way, is helpful for Bangladesh. There is strong apprehension that near desertification conditions of SW region as a result of Ganges water withdrawal at Farakka will be replicated in NE region, in more than 50% of land area of the country which will be fearfully affected.

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Century's longest solar eclipse The new moon black and full in daytime

The longest total solar eclipse during the 8,000 year period from 3000 BC to 5000 AD will occur on July 16, 2186, when totality will last 7 min 29 s. For comparison, the longest eclipse of the 21st century will occur on July 22, 2009 and last 6 min 39sec.

DR. ANWAR-UL KARIM

THE moon has a powerful allure -- it is full of beauty, legend, myth and romance. However the phases of the moon are caused by the relative positions of the earth, sun and moon. The moon goes round the earth in 27.3 days, or 27 days 7 hours 43 minutes, on average.

In astronomical terminology, the new moon is the lunar phase that occurs when the moon, in its orbital motion around the earth, lies between the earth and the sun and is in conjunction with the sun as seen from the earth. The moon then lies in the same direction (longitude) as the sun. At this time, the illuminated half of the moon faces directly towards the sun, and the dark or unilluminated portion faces directly towards the earth, so the moon is invisible as seen

from the earth. Full moon occurs as the moon comes into conjunction with the sun when it passes behind the earth.

The first time that the thin waxing crescent is visible after new moon, low in the evening sky just after sunset, marks the beginning of a month in the Islamic calendar. This usually happens with moon's age more than 24 hrs. (i.e., from the time of conjunction to the time of evening of observation) and moonset taking place at least about 48 minutes after sunset. When the new moon is in conjunction with the sun as seen from the earth and other conditions satisfy for a solar eclipse to occur in daytime in your city or if there is a solar eclipse anywhere in the world after sunset in your city, then next day is not the first day of lunar month for your city.

A solar eclipse occurs when the Moon passes between the

Sun and the Earth so that the Sun is wholly or partially obscured. This can only happen during a new moon, when the Sun and Moon are in conjunction as seen from the Earth. At least two and up to five solar eclipses occur each year on Earth. Total solar eclipses are nevertheless rare at any location because during each eclipse totality exists only along a narrow corridor in the relatively tiny area of the Moon's umbra. A total eclipse occurs when the sun is completely obscured by the Moon. The intensely bright disk of the Sun is replaced by the dark silhouette of the Moon, and the much fainter sun's corona or outer atmosphere is visible. Fig-1

The match between the apparent sizes of the Sun and Moon during a total eclipse is a coincidence. The Sun's distance from the Earth is about

400 times of Moon's distance, and the Sun's diameter is about 400 times the Moon's diameter. Because these ratios are approximately the same, the sizes of the Sun and the Moon as seen from Earth appear to be approximately the same: about 0.5 degree of arc in angular measure.

The Moon's orbit around the Earth is inclined at an angle of just over 5 degrees to the plane of the Earth's orbit around the Sun (the ecliptic). A solar eclipse can occur only when the new moon occurs close to one of the points (known as nodes) where the Moon's orbit crosses the ecliptic. The Moon's orbit intersects with the ecliptic, at the two nodes that are 180 degrees apart. There will always be at least one solar eclipse when the new moon occurs close to the nodes at two periods of the year approximately six months

apart.

Spectacular solar eclipses are an extreme rarity within the universe at large. They are seen on Earth because of a fortuitous combination of circumstances that are statistically very improbable. Even on Earth, spectacular eclipses of the type familiar to people today are a temporary (on a geological time scale) phenomenon. Many millions of years in the past, the Moon was too close to the Earth to precisely occult the Sun as it does during eclipses today; and many millions of years in the future, it will be too far away to do so.

The total eclipse only lasts for a few minutes at a given location, as the Moon's umbra moves eastward at over 1700 km/h. Totality can never last more than 7 min 31s, and is usually much shorter; during each millennium there are typically fewer than 10 total solar eclipses exceeding 7 minutes. The last time this happened was June 30, 1973 (7 min 3 sec). Observers aboard a Concorde aircraft were able to stretch the totality to about 74 minutes by flying along the

path of the Moon's umbra. The next eclipse exceeding seven minutes in duration will not occur until June 25, 2150. The longest total solar eclipse during the 8,000 year period from 3000 BC to 5000 AD will occur on July 16, 2186, when totality will last 7 min 29 s. For comparison, the longest eclipse of the 21st century will occur on July 22, 2009 and last 6 min 39sec.

In the 21st century, 2001 to 2100 AD, there will be 224 solar eclipses of which 77 will be partial, 72 annular, 68 total and 7 hybrids between total and annular eclipses. The predictions given here are by Fred Espenak of NASA's Goddard Space Flight Center.

An annular eclipse occurs when the Sun and Moon are exactly in line, but the apparent size of the Moon is smaller than that of the Sun. Hence the Sun appears as a very bright ring, or annulus, surrounding the outline of the Moon. Fig-2

A hybrid eclipse is intermediate between a total and annular eclipse. At some points on the surface of the Earth it is visible as a total eclipse, whereas at others it is annular. Hybrid eclipses are rather rare.

A partial eclipse occurs when the Sun and Moon are not exactly in line, and the Moon only partially obscures the Sun. This phenomenon can usually be seen from a large part of the Earth outside of the track of an annular or total eclipse. However, some eclipses can only be seen as a partial eclipse, because the umbra never intersects the Earth's surface. Fig-3.

In the 21st century, 2001 to 2100 AD, the longest while the longest solar eclipse will be on July 22, 2009, the longest annular eclipse will be on January

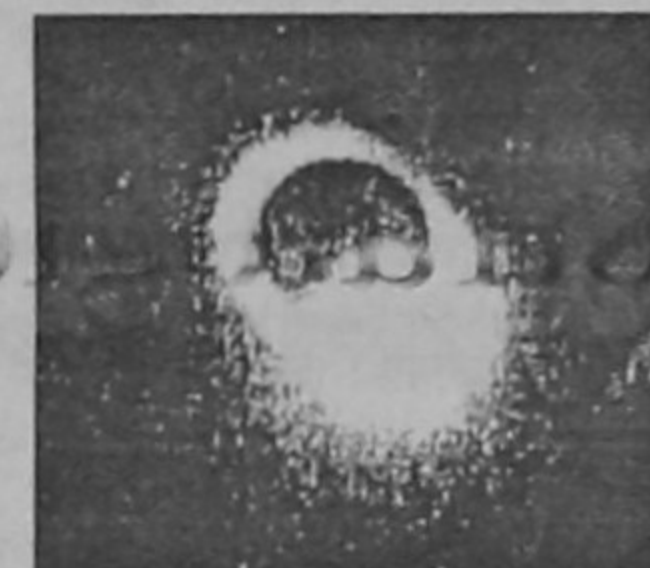


Fig-5: Diamond ring.

15, 2010. The former will be visible from Bangladesh but the latter will be visible from Maldives, South Eastern India, Sri Lanka, Myanmar.

Even when a small part of the Earth's surface does come to fall within the umbra and thus experiences a total eclipse, there will be a much larger area surrounding it which is within the penumbra; once again, some of the Sun's light still reaches the Earth and the eclipse is never more than partial outside the path of totality, and even within the path it is still partial. Inevitably, then, totality whenever it occurs, is always the climax to an experience which begins and ends with partiality. Fig-4.

When the shrinking visible part of the photosphere becomes very small Bailey's beads will occur. These are caused by the sunlight still being able to reach Earth through lunar valleys, but no longer where mountains are present. Totality then begins with the diamond ring effect, the last bright flash of sunlight. Fig-5.

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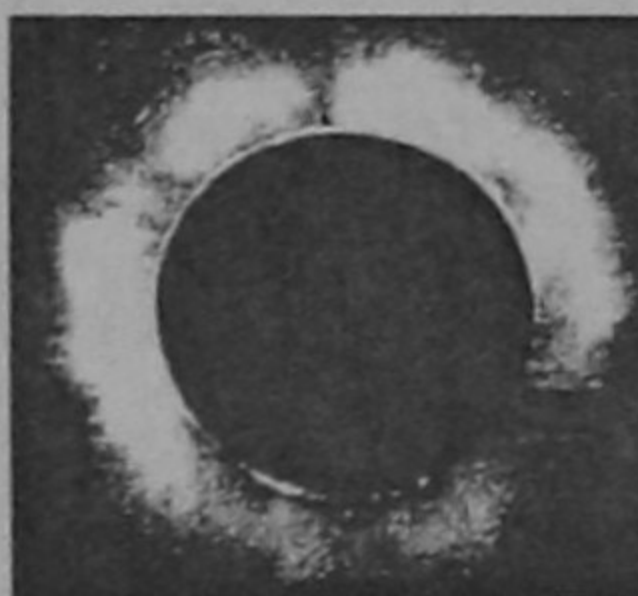


Fig-1: 1999 total eclipse

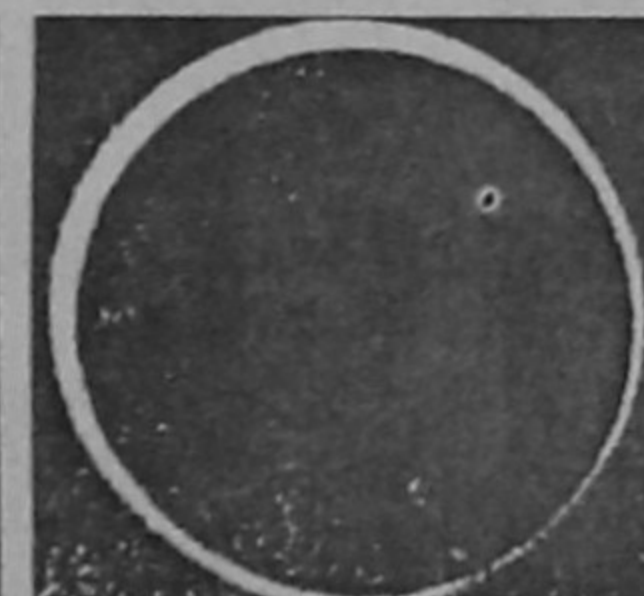


Fig-2: Annular eclipse

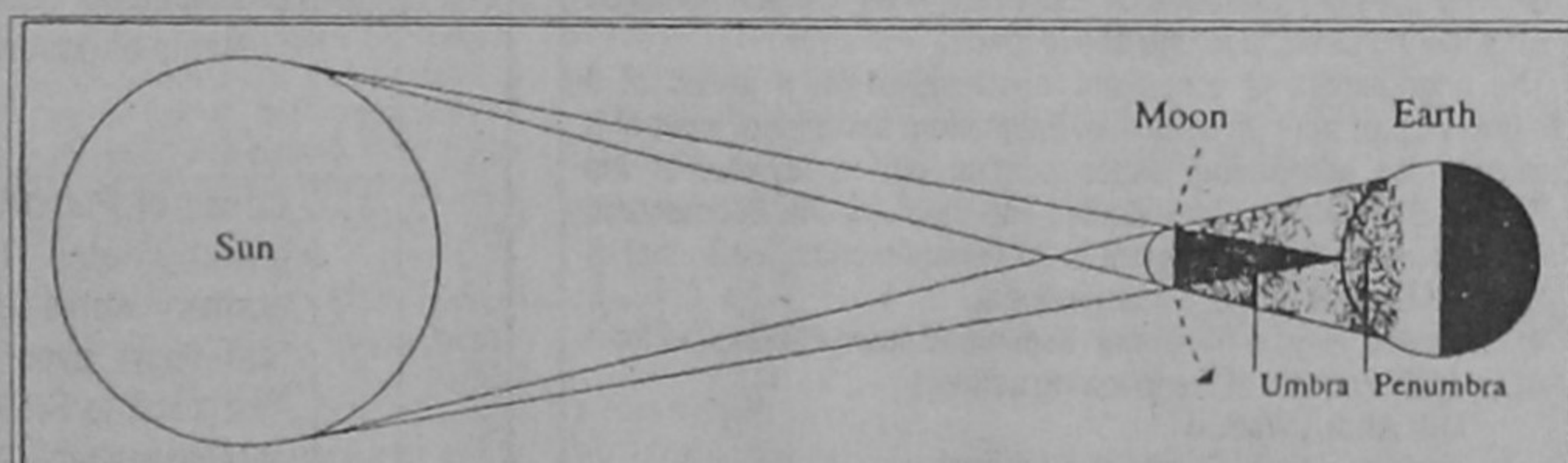


Fig-3: The umbra and penumbra of the Moon's shadow during a solar eclipse.

Water: What price to pay?

DR. SYED ISHTEAQUE ALI JINNAH

THE government increased with effect from July 1, DWASA Water Tariff for domestic purposes from Tk 5.75 per 1000 litre to Tk 6.04, an increase by 5%. The Tariff also increases from Tk 19.15 to Tk 20.11 per 1000 litre for commercial and industrial consumers. Although it was presumed that the price hike would be in the level of 30%, this has now been lowered and is done in line with DWASA regulations, still maintaining the cheapest water rate in the world.

Apparently, this gives an impression that the decision is very much pro-people and in line with the commitments of the newly-elected government to offer better and quality services and products to the city dwellers. How much of this is really true? We need to take a practical look into.

It is said that Dhaka city now

has a population of 10-12 million of which around 40% are poor i.e. about 4.8 million living mostly in the slums and fringes and are mostly without DWASA water services. As per a recent information from a Talk Show in the TV Channel ATN on the subject, DWASA's present capacity is meeting the water needs of 60% of its clients which, calculated on the figure of 60% of Dhaka's population (7.2 million) comes to around 4.32 million people.

Worst of all, the recent water crises in the city have turned people shouting for more capacity of DWASA which means more investments. Projects are also being undertaken for replacement of old water pipes (believed to have leakage and cause contamination) of the city that is anticipated to cost about Tk 1400 crore! And, to remember, these will be loan money from World Bank, Asian Development Bank and others that will be adding new burden on the shoulders of this poor country. All these lead

one to ask whether facing challenging situations at almost regular intervals, have we not learnt anything to help ourselves?

What is wrong with the water supply system of Dhaka city? Why are such great amounts of money required for the services of a handful? Don't we have any other means to help ourselves? And most importantly, are those in Dhaka city who enjoy the DWASA water supply, so poor that they need to be fed with the cheapest water in the world?

If we believe in the statistics of DWASA, against a total demand of 2100 million litres in Dhaka city and Narayanganj town, DWASA is supplying 1917 million litres but has a capacity of producing 2063 million litres per day. That means presently 146 million litres per day or not being produced because of a range of issues that are mostly technical in nature. However considering the recent water shortage and the huge noise that

was made, one really tends to question the accuracy of these figures. Take for example the case of the around 40% fringe and slum dwellers of the city who are mostly out of DWASA water supply, how can one believe that 91% of the so-called clients of DWASA are covered by its supply?

According to the consumers' charter of DWASA, water supply is also an eligibility and not a luxury for the poor people of the city. If we believe in the data provided by DWASA regarding its present water supply, it means that per capita water supply in Dhaka and Narayanganj has reached almost 160 litres per day including the 40% that are without any legal DWASA water connection and exactly are crying for a meager 20 litres per day!

With that intent, here are some suggestions that might help if taken seriously by the decision-makers:

• According to DWASA's own information, there is a system

loss of 34.81% (2008-2009). This by all means, needs to be reduced substantially and quickly, which we believe, with some sincerity, DWASA is capable of doing.

• DWASA needs to introduce the system of 'Progressive Tariff' for the water it supplies: Just like we have in case of Power, there should be a system where rates will vary according to the amounts consumed. After a relatively cheaper rate for an initial amount, this should go up as the amount of water consumed goes up. This will have a two-fold benefit: First, as the rates for higher amount will be higher, it will make the consumers more conscious about the use of water. This will save substantial amount of water which can be diverted to those presently suffering from water shortage. Secondly, this will bring additional revenue for DWASA for the same amount of water supplied.

• Steps need to be taken to

introduce a 'safety-net' for the poorer sections of the population. This is not only because of limitations in their ability to pay at higher rates but also because in slum and fringe areas, number of households using water from same source is considerable.

• The city authorities like DWASA, RAJUK, Dhaka City Corporation should undertake efforts to create awareness among the dwellers to introduce sanitary facilities having 'normal' and 'limited quantity' devices for use of flush water. This will ensure that for urination and other small needs, normal flushing that spills 4-5 litres of water is not used and will save a lot of water.

• City dwellers need to stop using supply water for car wash and/or gardening. For this, RAJUK and all Private Developers should be asked to strictly ensure that all plans for new construction of buildings have the provision for 'Rain Water Harvesting Reservoir' in



their undertakings. This will enable, at least during the rainy season, the use of rain water for such purposes and even for domestic purposes when required.

• Last but not the least, DWASA needs to understand that the groundwater extraction has already reached an alarming stage it is said that every year, the level in Dhaka city is going down by 5-6 m which can very well bring massive disaster in the near future. This has to be

changed to surface water which means relying more on the neighbouring rivers. But their present condition prevents that. The city dwellers feel that in stopping the pollution of the Dhaka rivers, along with the relevant Ministries, Departments, Industries, DWASA also needs to come forward and participate in this movement.

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