Managing Water Crisis in Apartment Communities: Sustainability at its roots

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"When the well is dry, we learn the worth of water", said Benjamin Franklin. No other quote can best describe the current situation that persists in most parts of the world, particularly India. We have just started realizing the importance of water, but we still lack greatly when it comes to conserving this precious resource. Is it lack of concern or the feeling that it is just another problem that can be thrown onto someone else's shoulder's to manage? Unfortunately apartment communities have been left to fend for themselves.

We are let to manage our water Ourselves :

Our happy future now basically depends on year round availability of fresh water. In fact this is one feature whose availability we make sure before establishing our permanent residence. Urban cities are now facing acute water shortages, particularly summer. Inadequate and unreliable public water service infrastructure forces private apartment communities to self-supply and fend our self. Failure of rains, groundwater depletion and quality degradation, climate change etc. make the system worse. Hence here comes the question of how to manage the available sources.

Water Resources:

There are two ways of managing our water resources which is becoming scarcer on a daily basis. One is to obtain water from all sources possible (mainly groundwater through bore system, rain water harvesting RWH and tanker Lorries), utilize it and then throw it all away again using tanker Lorries or through sewer line to a centralized treating system. Do we even realize that we are actually throwing away a part of our asset? This management has a variety of results, none that will make you happy. Firstly we end up depleting our groundwater resource to an extent where it no longer has the quality required for consumption.

Land Subsidence:

Another major side effect of groundwater depletion is land subsidence. How would we feel about the ground sinking a few inches? That's exactly the road we are headed towards. Over pumping of groundwater causes depletion of water table, decrease of underground water pressure and creation of voids. These result fine materials that held water compacted and the land above starts sinking a few inches to several feet. This is called land subsidence. Land subsidence damages buildings, develop cracks, roads, pipelines and other infrastructure. In India we see this phenomenon through cracks that occur on buildings but we end up blaming it on the weather.

Depletion of Water Table:

India is the largest user of groundwater and its exploitation for agriculture, domestic and industrial applications. Urban cities are thickly populated and many building constructions are in violation of standard norms. Many inside city places with water table of less than 3 meters before 1990 have to dig bore wells of more than 100 meters in 2010, due to large scale urbanization. Our current management system only makes this situation much worse.

Water Governance:

The only solution for better administration is water reuse which is our second option and only sustainable method of ensuring water supply in future. We manage to take bath with 1/2 bucket, and are able to face wash and shave with a mug of water when water is shut down or there is a sudden pump failure. We go to the extent of telling to drink less when there is limited water. But we forget to conserve water during normal days when we have adequate supply. Conservation requires proper water governance.

For wellbeing and life style, we need a minimum quantity of water throughout year. This is possible only if we could able to manage water through harvesting, storing underground by recharge, conservation, recycle and reuse and efficient use of water, irrespective of variations of rain, draught, climate change etc. More than thousands of references of good water governance can be seen across globe since medieval days and large systems after 1900, on how people are able to manage water scarcity and against odds.

Sewage is 99.9% pure water + 0.1% waste:

The wastewater that is generated from our houses has a mere 0.09% of actual waste. The rest 99.9% is pure fresh water from the ground. The fact that many of us hardly realize the value of the water we consume shows ignorance. In sustainable water management, Water acts like rubber conveyor for transporting the wastes to the treatment plant, and returns to the main water supply after getting treated at STP through groundwater recharge-discharge cycle.

Groundwater Recharge and REUSE:

Water harvesting and REUSE are the major elements of sustainable water management. One common factor for all ground-water systems, however, is that the total amount of water entering, leaving, and being stored in the system must be conserved. Hence all the inflows, outflows, and changes in storage should be accounted. The inflows are harvested water from rains and recharge water after reuse and recycle through sewage treatment plant.

Reuse can be adopted only if the wastewater is treated to good quality of both BOD and TSS less than 10 ppm, and Coli form less than 10 MPN. Many conventional Sewage Treatment Plants in private apartment communities failed to give reusable quality due to various reasons. This makes apartment communities in water pollution, water scarcity, heavy dependence on costly tankers for sewage hauling and fresh water source.

The purposes of groundwater recharge by treated water are:

(1) To give further treatment through underground bacteria and filtration

(2) To augment potable or non potable groundwater source

(3) To provide storage, and

(4) To control or prevent ground subsidence.

3R TECHNOLOGY:

The primary objective of 3R Technology is to ensure treated water of the first degree to our apartment communities. Using the Sequential Batch Reactor (SBR) procedure of treating waste water, we have been able to produce clean water to the extent of <5pp m BOD which is being reused for non potable purposes and is also sent underground to recharge our groundwater storage.

The first question when anyone suggests a new technology is with regard to its cost. But how many of us realize that the current rate of spending will only increase. We currently use tanker Lorries both for water supply and for disposal. Can we really afford it? Typical cost of purchase of tanker loads of water during scarcity is Rs 800 to 1000 per Load of 10,000 Liters. Also we are not sure of the quality of this water, while we face very arduous delay, tension in dealing with tankers and loosing productive morning hours in competition and non-availability of even tankers. A few months of shortage warrant sizable investment in purchasing tanker waters in addition with hardships.

SAMPLE WATER SCACITY MANAGEMENT ECONOMICS:

Assuming 250 Flats are constructed in a 1-Hectare land in suburban Chennai. The only water source for the apartment people is ground water, along with recharged rain water, within the complex, as Municipal Corporation yet to provide water and sewerage facilities. Average Rain Fall of Chennai is 1200 to 1300 mm. The Apartment consists 2 & 3 bed room Flats with average 4 persons in a flat. Total people living = 4x250=1000 nos. Total Rain water per annum = 10,000m x 1.3m = 13000 cu.m or 13,000,000 Liters per person per year. or 365 Liters per person per day, if entire rain water is harvested. Unfortunately 30% of rainwater is infiltration into groundwater as recharge with proper RWH system and hence 10,000 sq.m x1.3x0.3x1000 = 3,900,000 Liters is recharged to the land, with proper RWH system. Hence rain water available per person per day is 3,900,000/(1000x365) = 10.7 Liters from the sub surface groundwater (renewable). If 135 Liters per person is used from this groundwater, then 135-10.7 = 124.3 Liters per day is from deeper nonrenewable groundwater (formed over 1000 to 5000 years). This is very alarming and this is what we exercise at present and faces all water crisis problems. Unless we recycle through reuse and recharge, groundwater depletion, land subsidence, decline of water quality and related problems emerge.

Typical water consumption per capita per day is given in the following Table

Per Capita Water Requirement - Split up of 135 Liters/ca/day	
Flushing	29%
Bathing	15%
Cooking	3%
Drinking	2%
Gardening	17%
Washing utensils	15%
Washing cloths	19%

Typical Water Balance

PEOPLE STRENTH - 1000

PER CAPITA WATER CONSUMPTION - 135 LITERS PER DAY

Total Water Requirement per day - 1000 x 135 = 135,000 Liters / Day

STP Capacity Required - 90 % of Water Consumption = 1,20,000 LPD approx.

Reusable Water from STP at 95% = 1,14,000 LPD

Toilet Flush at 30% of WATER USE = 1,35,000 x 0.3 = 40,500

Hence Borewell Water required = 1,35,000 - 40,500 = 94,500 LPD

If 20% or 27,000 LPD Drinking water is purchased at Rs. 80/cu.

Borewell Water required = 94,500 - 27,000 = 67,500 LPD

Borewell Water Cost including pumping, softening, filtration at

10 Rs/cu.m for 67,500 LPD = Rs. 10 x 67.5 = Rs. 675 per day

Purchase water cost for 27,000 at Rs.80 / cu.m = Rs 2,160 / day

Water Cost for 1,35,000 LPD = 675 + 2160 = 2,835 Rs. /day

STP Treatment Cost :

15 HP Power for Blower and pumps

(with Rs. 7/kwh and Rs 2000 as O&M Charges)

15 HP (11.4kw) x 24 Hrs = 274 kwh ;

274x7 + O&M = 1918+ + 2000 O&M = **3,918 Rs/day for 1,20,000 LPD**

Total Water Cost including STP Treatment = 2,835 + 3918 = 6,753 Rs./day

(If entire water is purchased during summer months due to water scarcity the
Total Water Cost for 1,35,000 LPD = 135x80 + 3918 for STP O&M = Rs. 14,718 Rs./day)

IF THERE IS NO STP, Economics loss and water pollution

CASE -1: Use of 100% Tanker water + Sewer Line Disposal

Water cost at Rs. 80/ cu.m for 1,35,000 LPD = 135x80 = Rs. 10,800 /day

Entire water is left to Sewer Line and Sewer Bill @ Rs 5/cu.m for 135,000 LPD

= Rs. 675 /day

Total Water Cost = 10,800 + 675 = Rs 11,475 /day

CASE -2 20% Tanker water + 80% Borewell Water + Sewer Line Disposal

Water cost at Rs. 80/ cu.m for (1,35,000 x 20% = 27,000 LPD)

= 27x80 Rs/cu.m = Rs. 2,160 /day

Entire water is left to Sewer Line and Sewer Bill @ Rs 5/cu.m for

135,000 LPD = Rs. 675 /day

Bore well Water Cost (Pumping + Filtration + O&M)

at Rs. 10/cu.m for 1,08,000 LPD = 10 x 108 = Rs. 1080 /day

Total water Cost = Rs 2160 + 675 + 1080 = Rs 3,915 / day

CASE-3 Use of 100% Groundwater + Sewer Line Disposal

Bore well Water Cost (Pumping + Filtration + O&M) at Rs. 10/cu.m

for 135,000 LPD = 25 x 135 = Rs. 3,375

Entire water is left to Sewer Line and Sewer Bill @ Rs 5/cu.m

for 135,000 LPD = Rs. 675 /day

Total water Cost = Rs 3,375 + 675 = Rs 4,050 / day

CASE-4 Use of 100% Groundwater + STP (without TOILET FLUSH Reuse)

Total water consumption = 1,35,000 LPD

Bore well Water Cost (Pumping + Filtration + O&M) at Rs. 10/cu.m

for 1,35,000 LPD = 10x135 = Rs. 1350 /day

STP Treatment Cost :

STP Treatment cost = Rs3,918 Rs/day for 1,20,000 LPD

Total water Cost = Rs. 1,350 + 3,668 = Rs. 5,018 /day

CASE-5 Use of 100% Groundwater + STP (with TOILET FLUSH Reuse)

Total water consumption = 1,35,000 LPD

Toilet Flush at 30% using STP Treated Water = 1,35,000 x 30% = 40,500 LPD

Borewell Water Use = 1,35,000 - 40,500 = 94,500 LPD

Bore well Water Cost (Pumping + Filtration + O&M) at Rs. 10/cu.m

for 94,500 LPD = 10x94.5 = Rs. 945 /day

STP Treatment Cost :

STP Treatment cost = Rs3,918 Rs/day for 1,20,000 LPD

Total water Cost = Rs. 945 + 3,918 = Rs. 4,863 /day

As STP is a mandatory, poor STP operation results in water pollution causing diseases and polluting groundwater for further use, in spite of spending STP O&M costs.

With best performing STP along with Toilet Flush Reuse, the economic benefit is Rs. 1,000/day or Rs, 3,65,000/- per year, as in the Case-1, with 20% purchase water. This is the general case in cities given Metro water connection.

Without STP and RECYCLE, this one hectare site is losing precious 1,35,000 Liters/day Groundwater, causing irreparable damage to the land and land subsidence resulting in building structural damage over years. Water scarcity results in purchase of costly water during summer days affecting quality of life and heavy expenditure

SAMPLE APARTMENT WATER MANAGEMWENT ECONOMICS

(250 Apartments in 1Hectare Land with 1000 people living, consuming 1,35,000 L/day with 135L/ca.day)
Rainwater Harvesting with 1300mm rain with 30% infiltration - 3,900,000 Liters/year or 10.7 L/person/day
STP Capacity - 120 kLd with 15 HP(11.34kW) Power, Power Cost Rs. 7/kwh

	Purchase Water Cost	Borewell water cost	STP Treat-ment	Sewer Line Disposal Cost	Tanker Sewage Disposal	Total Water cost	REMARKS
100% (135 kL) Purchase water + No STP	10,800	Nil	NIL	600	Nil	11,400	Very High Water Cost - Rs 342/month for every person
20% (27 kL) Purchase water + 80% (108 kL) Groundwater + No STP	2160	1080	Nil	600	Nil	3,840	Unsustainable, Groundwater quality and level decrease, Land Subsidence, Water Crisis problems
100% (135 kL) Groundwater water + No STP + Sewer Disposal	NIl	1,350	Nil	600	Nil	1,950	Unsustainable Groundwater quality and level decrease, Land Subsidence, Water Crisis problems
100% (135 kL) Groundwater water + No STP + Tanker Disposal	Nil	1,350	Nil	Nil	7200	8,550	Unsustainable Groundwater quality and level decrease, Land Subsidence, Water Crisis problems Tanker noise, spills, etc.
100% (135 kL) Groundwater water + STP for REUSE	Nil	1,350	3,918	Nil	Nil	5,268	Sustainable Solution with Healthy Environment, but difficult & costly managing 40.5 kL treated water by gardening & Groundwater recharge. No water crisis
70% (94.5 kL) Groundwater + 30% (40.5 kL) Toilet Flush REUSE + STP	Nil	945	3,918	Nil	Nil	4,863	Sustainable Solution with Healthy Environment, without Water Crisis

As part of above exercise, Sewer Line Disposal has been included to highlight the importance of STP in groundwater recharge, which is vital to save huge losses due to land subsidence and related building damages, and future water scarcity problems. The saving by wasting groundwater to sewer line will cause irreparable damage to the groundwater asset for the future generations.

The revamping of STP of 900 kLD/day and REUSE at PSG Hospitals, Coimbatore during 2004 shown the benefits by changing the environment to Green and Cool comparing to pre-2004 barren water starving landscape. The author was the designer in converting the failed STP into successful operation and reusable quality.

TOILET Flush:

Studying the Table, the economic cost difference is small for Reuse in Toilet Flush - given in the Case-4. Two major issues are considered between Case-3 without Toilet Flush and Case-4 with Toilet Flush. One is the Infiltration rate for groundwater recharge. Using lesser water of around 80,000 LPD Treated water from STP (1,20,000 - 40,500) with Toilet Flush through gardening is easier, cheaper than using entire 12,000 LPD treated water from STP. However, where large area is available and require more water for gardening and other reuse, Toilet Flush can be eliminated.