Biodiversity and Water-

Is The Circle Broken?

Institute Name: Prakriya Green Wisdom School, Bangalore

Theme(s): Water and Biodiversity

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Note to the Earthian Group

The total numbers of students who are participating in the Wipro Earthian 2013 from Prakriya Green Wisdom School is 22. We were divided into 3 vertical groups. For the data collection for activities listed under Section A, we also divided ourselves into three horizontal groups (these horizontal groups had a mix of students from the 3 main groups). These horizontal groups worked on data collection/experiments for Water Demand, Water Quality and Water Trail. The data collected was analyzed and findings were shared across all the three vertical groups. *Thus, the figures for water trail and demand for water in the school and the experiments done for water quality are identical for all three groups.*

However, each vertical group worked independently on the following:

- The analysis and interpretation of data collected
- Conclusions based on our findings/analysis required for Essay 1 (Section B).
- Linking our findings to the macro theme we have chosen for Essay 2 (Section B).

Since we don't have a water meter, for some of the activities listed in the activities booklet, we interviewed multiple sources and arrived at our own estimations. We interviewed

- Founder trustee of the school
- Campus manager (current & former)
- Garden Coordinator
- Kitchen/Canteen Coordinator
- Gardener
- Water pump operator.

INTRODUCTION

Water. Whenever one hears this word, flashes of gurgling brooks, murmuring streams, roaring waterfalls, and unending oceans come to our mind. After an exhausting game of basketball….it is this fluid we gulp down our throats with greed. No wonder, this chemical compound which has two atoms of hydrogen and one atom of oxygen is called the "elixir of life"!

The Earthian project could not have come at a more appropriate time than this! Our school bus passes through the village of Chikkanayakanahalli and we see almost every day, people queuing near and/or collecting water from the public taps. This has opened our eyes to the reality of the "water situation" in the real world.

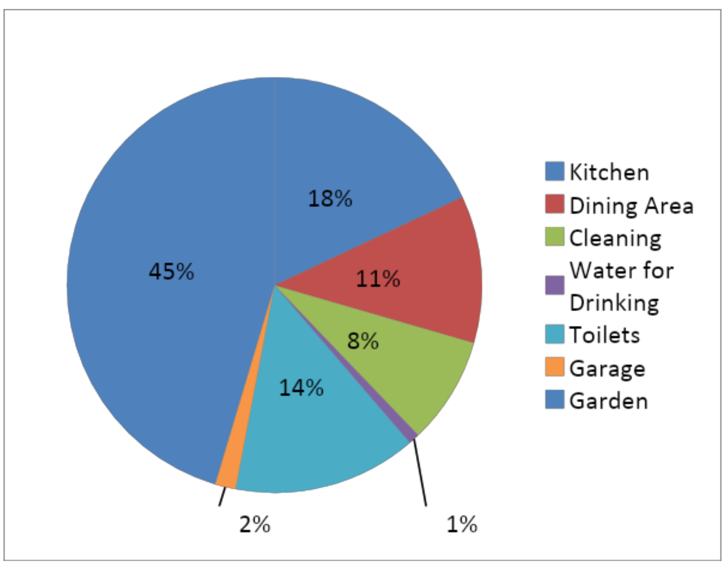
This project focuses on these intertwined aspects of water: the demand for water, the supply of water, quality of water and finally what we do with the so-called "waste water". Through a set of suggested activities, we have tried to see how this cycle works within the confines of our school, study the interdependence between all aspects of water and understand for ourselves whether the "water cycle" within the school is sustainable.

Section 1: Demand for Water & Source of Water

Table 1. Total amount of water used per working day at different End Use locations

End Use Location	Amount (litres)	%
Kitchen	4,010	18%
Dining Area	2,553	11%
Cleaning	1,860	8%
Water for Drinking	190	1%
Toilets	3,185	14%
Garage	360	2%
Garden	10,100	45%
Grand Total	**22,258**	**100%**

Figure 1. Percentage of water used per working day at different End Use locations



We, in Prakriya, consume about 32 liters of water / working day.

1. The next question we wanted to explore was in terms of "How do we use this water?"
2. The more we examined, the more we realized that water usage pattern across all end-use locations in themselves are just an indicator; whether we are water prudent does not get answered by merely looking at these figures.
    - Where do we get our water?
    - Where is the water for the garden coming from?
    - Who is using the rain water?
    - Why are we not using recycled water for drinking?
    - How are we pumping the bore well water and who uses this water? Is it potable?
3. The more we asked these questions the more we realized that the linkages are much more complex and interwoven. So, decided to dig deeper and see!

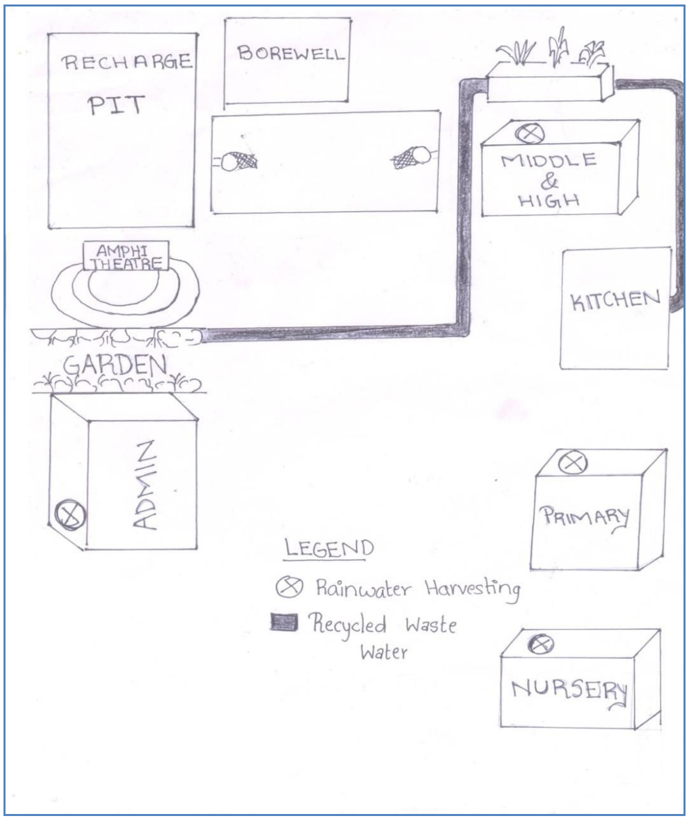
And that took us on ***a WATER TRAIL.***

Table 2. Sources of water in our school (liters per working day)

Source	Total Qty
From borewell	18,590
Rainwater	7000
Grand Total	25,590

The water trail in our school starts from the bore well – located at the far end of the campus. As the trail winds and turns, we see that there are rain water harvesting tanks, water recharge pits and let us not forget the waste water recycle unit. (Note: Refer Appendix 1: Section B for details)

Figure 2. Map of school with rain water harvesting tanks and recycled waste water trail



Bore well: ***(refer appendix 2).***

Given below are some of our observations and findings:

- Water is available at 360ft in the bore well.
- The water pumped is salty.
- It requires 3-4 units of electricity to run the pump for an hour.

- Switching on the pump for 12 hours per day gives us about 28,600 liters of water per day.
- When not used the extra water from the bore well is stored in an overhead tank.
- There are seasonal variations in the supply of bore well water. The pump is in operation more frequently during the summer months.

Rainwater: In a way, we are water prudent in that we harvest rain water in eight different locations - middle & high, primary, nursery, office, dining area, kitchen and one above the art room. The rain water collected is stored in storage tanks.

This water goes through a filtration process (See Appendix A: section B for the diagram of the filtration process) and then distributed to various sections.

Surprise! Surprise!

We as a school prided ourselves for putting in place water sustainable practices such as rain water harvesting. So, it came as a surprise when we learnt about the rain harvesting potential of a location! With this knowledge came the questions; is it possible that we are not harvesting all the rain water that we possibly can harvest?

Table 3. Rain Water Harvesting Potential

Type of surface	Location	Total Area (sq.m)	Runoff co-eff	Annual rainfall for the region (cm)	Potential for harvesting (kl/annum)
Concrete roof	Admin, N, P, M/H	2795	0.9	0.8	2012
hard (Paved areas)	FB, BB, TB, SP	2897	0.4	0.8	927
soft	remaining school	10,964	0.4	0.8	3508
Wooded area	Devarkadu, long jum	1080	0.2	0.8	173
hard & soft	Amphitheatre	475	0.6	0.8	228
Total					6849

6849 kiloliters/year is the rain water harvesting potential of our school, i.e. the amount of rain water that we can harvest. However, we are at present harvesting only 1260 kiloliters of rainwater! ***Does this mean we are not harvesting rain water enough?***

This brought us to the next part of the water trail namely, the **recharge pit**.

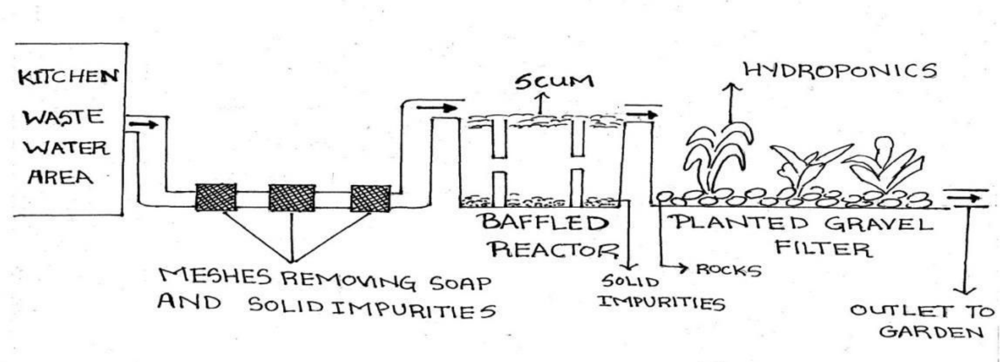
Recharge pit:

Most of the rain water runoff gets collected in the recharge pit. The total capacity of the pit is 618Kl. It allows the collected rain water to replenish the ground water. It is a natural pit and therefore permits the absorption of water by the soil.

The final part of the trail takes us to the **Recyclable Waste Water Unit**

Recyclable Waste Water Unit: (Refer to appendix 1: Section B) Some of our observations and findings are listed below:

- We don’t have a waste water treatment plant (WWTP) in the campus.
- Water from the dining area goes directly to the RWW unit. See figure given below

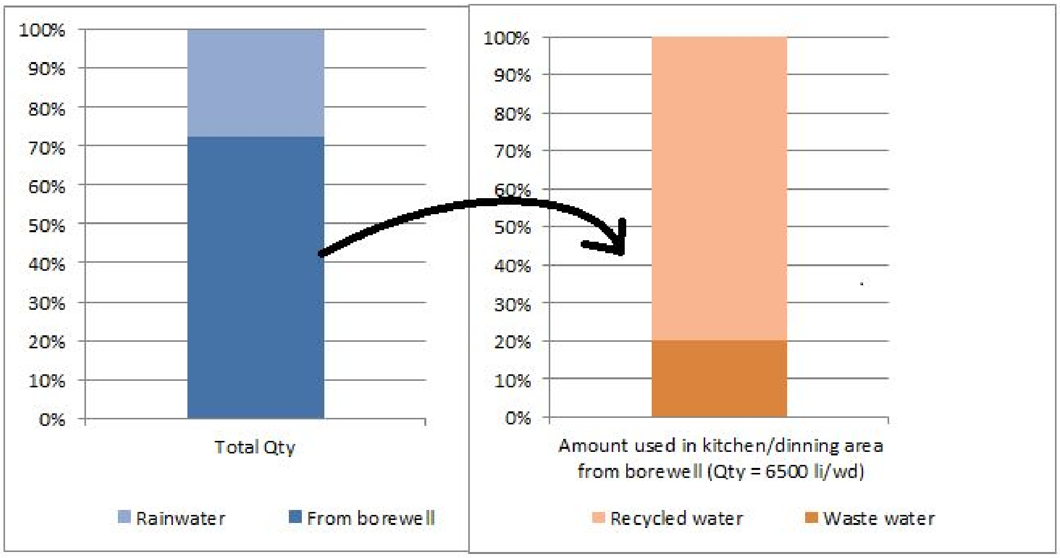


- The waste water goes through two filtration processes. The treated water has some salts, organic matter and bacteria.
- This water is not potable; hence used in the garden

So, how much water is recycled?

ǒ ***The kitchen/dining area uses up about 6500 liters of bore well water/day. Of this about 80% is recycled.***

Figure 2. Graph showing the recyclable waste water



After our analysis of the water trail in our school, we were left wondering whether we can proudly proclaim that our water practices are sustainable. (After all, demand < supply) Not so fast, we can hear you say. ñWhat about quality?ò We did just thaté

WATER QUALITY:

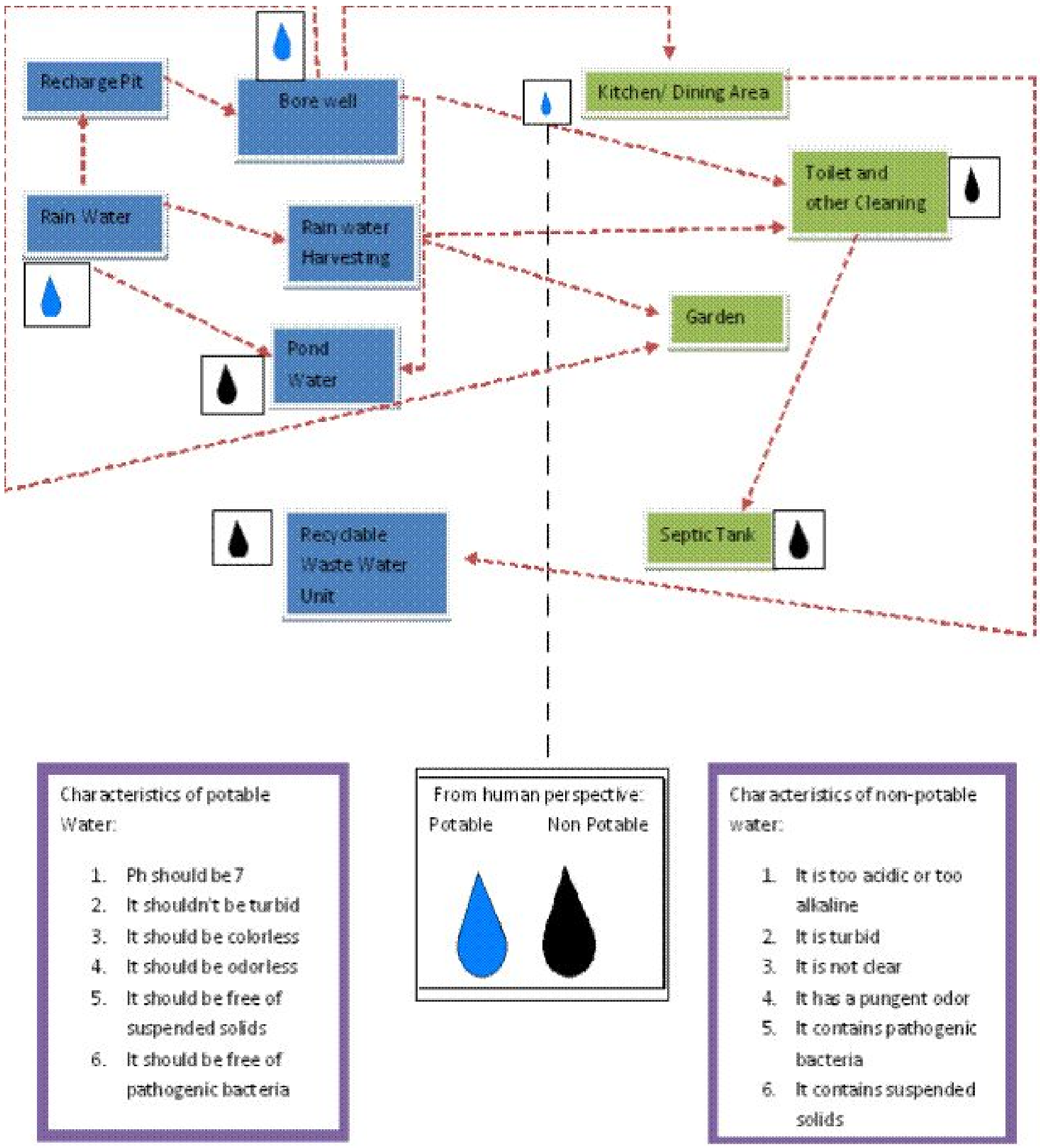
We conducted the following experiments to test the quality of all the "different" water that is in our school: pond water, tap water, recycled waste water, bore well water and finally drinking water.

Table 4. The physical properties of each of the samples:

PHYSICAL PARAMETERS	RECYCLED WASTE WATER	RAIN WATER	DRINKING WATER	TAP WATER	POND WATER
COLOUR	Greyish black	Mostly clear	Clear	Clear	Muddy
ODOUR	Pungent, stinky odour	Odourless	Odourless	Odourless	Odourless
TURBIDITY	Very turbid	Almost clear	Clear	Clear	Turbid
SUSPENDED SOLIDS	Suspended living matter like worms and leaves	Few suspended particles like mud and dirt	None	None	Dirt, leaves, living matter like worms and tadpoles
TEMPERATURE	23 °C	24 °C	23 °C	24 °C	24 °C
pH	8	6.5-7.5	7	7	6
SOURCES	Kitchen/ dining area	Rain water storage tanks	Bore well water purified via 'aqua guard.'	Bore well	Monsoons and borewell.

We also tested pond water, tap water, drinking water, rain water and recycled waste water according to the tests given in the activity booklet. (See Appendix 1C) .After conducting and completing all the activities as given in the activity booklet, these were the linkages we were able to establish:

Figure 3: Linkage between Demand for, supply of and quality of water in Prakriya



- As we tested the samples for quality, it dawned on us that these tests look at quality from the point of view of the humans:

    1) Pond water is slightly acidic; unfit for humans.

    2) Recycled waste water ï contains bacteria; unfit for humans.

    3) Rain water not acidic- fit for humans.

- We also saw the pond to be alive and thriving with tadpoles, frogs, fish, and water snakes.
- There are pathogenic bacteria in the recycled waste water. Not good for us humans, but it's a thriving ecosystem on its own!

- In fact these observations by some of us, prompted us to look at Biodiversity in our Essay 2. That's for later!

CONCLUSION

So here lies the question: is our water management sustainable? There is no single answer to this question.

- At one level, we are using water prudently.
    - ***Only three taps are leaking. And that too, as we are speaking have been fixed.***
    - ***We are recycling waste water.***
    - ***We are harvesting rain water in eight different locations.***
    - ***The non-recyclable waste water does not leave the school. So, we are not contributing to pollution.***
    - ***We help in recharging groundwater through the recharge pit.***

So, can we say that all is well?

What the school can do?

- ***Make sure all the leakages are fixed as soon as they arise.***
- ***Set up more rain water harvesting tanks wherever possible.***
- ***Try using solar energy to pump water from bore well?***
- ***Technology ï as a school we do try to be as nature friendly as possible, however, in some places such as the bore well pump, we should attach water meters and electricity meters so that we can know the exact amounts of water and electricity we consume.***

Outlook for future:

- ***We are still largely dependent on bore-well water, and we do not know for how long it will last. (There is a construction boom in Bangalore, especially in Sarjapur Road) And when it does run out, then what?***
- ***And what if due to the constructions going on, so close to our school campus, the quality of water that we pump gets affected? We will then have to spend more on the filtration of water for drinking purposes in our school.***
- ***Another worrisome aspect. Our dependence on electricity. A small school like ours uses up to 3-4 units of electricity per hour to pump water from the bore well, which is about 42 units of electricity per day! Based on this, one can only***

imagine the amount of electricity is required for a school bigger than ours that has a bore well. Or why not imagine the amount of electricity required only for the pumping of water for the whole of Bangalore city?

<u>Our learnings</u>

ǒ ***Prakriya is just a microcosm of the vast world out there; thus, knowing, and understanding these aspects of water would not only enable us to look at water with a sense of sacredness but also, as we grow, to use it more prudently such that it is available for all life forms on our Earth.***

ǒ ***The ramifications of development and using fossil fuels é we used to think that ñit wonôt affect us.ò This project opened our eyes to the reality that Water is mother of all Life. Without her???***

The End

Part B – Essay 2

"We were not driven from Eden. Instead, we destroyed most of it" - E.O. Wilson.

The theme we have chosen to explore in our analytical essay is biodiversity; while the main focus will be on biodiversity, we will also explore some aspects of agriculture and urbanization that directly or indirectly link issues of water sustainability to biodiversity loss.

What is biodiversity? Biodiversity consists of all the embedded ecosystems on our planet. Taken literally, it refers to all the life forms on earth, from the unicellular to multi-cellular, from the microscopic to the gigantic, from the domesticated to the wild, from the terrestrial to the aquatic, from the insects to the mammals, from the cell line to the genetic materials; it includes all the plants, animals and micro-organisms.

So, what propelled us to focus on biodiversity?

The answer for this lies in the findings stated in Essay 1. While we as a school have been successful to some extent in managing the demand-supply-quality aspects of water, we wondered how this city of ours manages its water situation. As we discussed, we realized the water demand- supply -quality aspects have a very narrow focus. It mainly focuses on the consumption of water from a very anthropocentric perspective. We humans consider ourselves the centre of the universe, however in reality we are just a tiny part of the ecosystem. What about all the creatures with whom we share this planet?

The following table shows some of our fellow earthlings with whom we share our home:

Table 1: The different creatures we share our planet with

Species	**Population**
Bacterium total	4 quadrillion quadrillion
Ants (many species)	10 billion billion
Marine fish	billions..billions
Cattle	1.4 billion

Termites	billions..billions
Humans	7 billion
Antarctic krill	500 trillion
Sheep	1.1 billion
Domestic chicken	18.6 billion
Great whales (10 species)	3 million
Elephants (2 species)	0.5 million

Source: http://www.npr.org/blogs/thetwo-way/2011/11/03/141946751/

Together we form the biodiversity of our planet and for this biodiversity to thrive, water is essential.Biodiversity also affects the quality of water on Earth, greatly lessens the impact of pollution and helps in the Earth's self-regulatory mechanisms.

In the experiments related to quality that we did in Section A, we mainly looked at whether the water was fit for human consumption that is, whether it is potable. However,we discussed earlier that we share this planet with other living and non-living beings as well. As the Earth evolved over millions of years, many ecosystems evolved and thrived along with it. The interdependence between all the visible and invisible creatures in varied ecosystems creates conditions for life to sustain itself. ***Life***

supports Life.

Artist: Rohit Rao

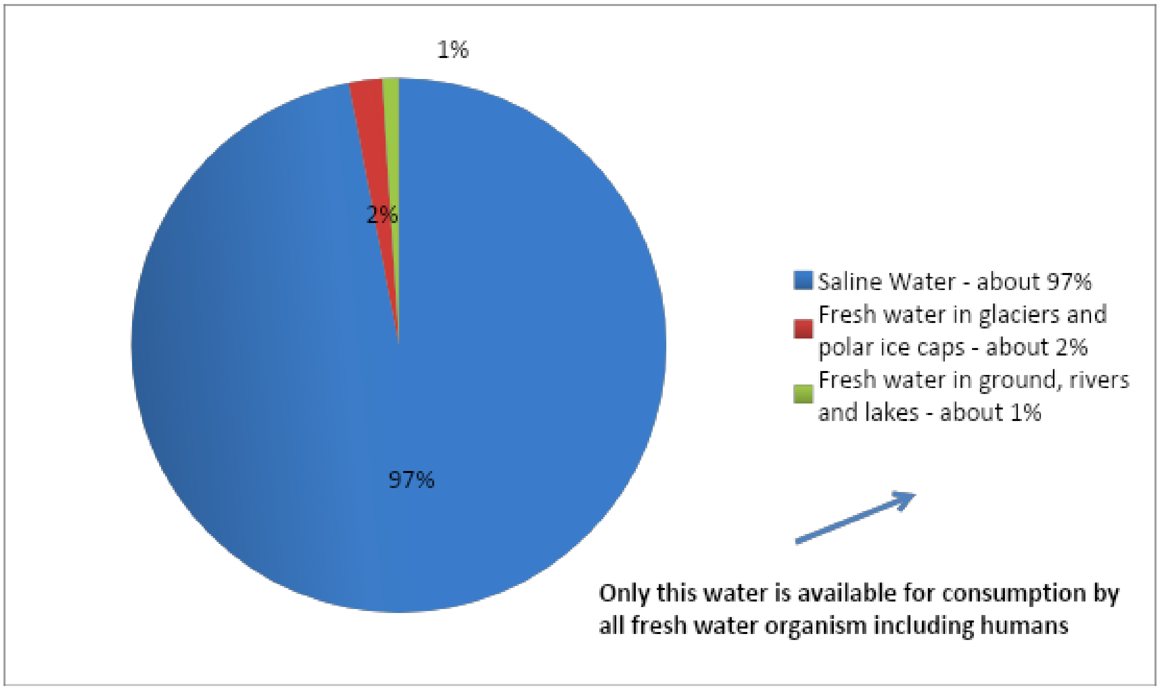
It is estimated that about 10-14 million species inhabit the Earth. So far about 1.8 million species have been identified, named and catalogued. (Source: www.sciencelearn.org.nz)

Since water is the lifeline, for almost all creatures, it should be used sustainably, that is, not only thinking about the requirements of the present, but also keeping in mind the needs of the future generations of all beings.

Often we hear about 'water scarcity'. We wanted to explore whether this scarcity is real or imagined. If it is real, we wanted to see how much we are contributing to it.

Below is a pie chart showing the distribution of water on the earth.

Figure 2: Pie chart showing distribution of water



Source: UN Water Statistics (slight modifications made)

About 7 billion people and 14 thousand species of identified animals and other creatures have to share this 1% of Earth's fresh water.

Table 3: Human Population Growth

Year	Population	Year	Population	Year	Population	Year	Population
1	200 million	1850	1.2 billion	1965	3.3 billion	1995	5.7 billion
1000	275 million	1900	1.6 billion	1970	3.7 billion	1999	6 billion
1500	450 million	1927	2 billion	1975	4 billion	2006	6.5 billion
1650	500 million	1950	2.55 billion	1980	4.5 billion	2009	6.8 billion
1750	700 million	1955	2.8 billion	1985	4.85 billion	2011	7 billion
1804	1 billion	1960	3 billion	1990	5.3 billion	2025	8 billion

Source: http://geography.about.com

As the data shows, there is no denying that the demand for water has risen due to rising numbers of human beings. As we researched, read about and discussed we realized that there are more complex, intertwined issues related to scarcity than what meets the eye. We discovered that the issue of water scarcity is directly linked to the manner in which we have treated and engaged with the natural world around us.

We are going to explore the man-made water scarcity from the these two angles:

- ***Our mismanagement of this precious gift and***
- ***Our misplaced priorities.***

It may be time to set our priorities right regarding water, and learn to manage this resource better.

Mismanagement of Water:

Agriculture has been flourishing in India since 9000 BCE. Post-independence, we were faced with the daunting task of feeding the rapidly increasing numbers. This led India to opt for the Green Revolution methods. Though we as a nation became self-sufficient in food grain production, the far-reaching ill effects of Green Revolution on water and through it on biodiversity can't be denied.

The mismanagement happened at multiple levels:

- The excessive dependence on external inputs like Dwarf HYV seeds and chemical fertilizers and pesticides led to the increased demand for water. This meant over consumption of surface and ground water.
- Shifting from one-crop per season per year to double cropping meant that water for agriculture needed to be available even during non-monsoon months. So, large-scale multi-purpose irrigation projects were undertaken. Bringing

more land under cultivation and construction of these large-scale irrigation projects meant loss of forest cover and consequent loss of bio-diversity.

Table 4: Loss of Forest lands (1950 – 1976)

Purpose	**Area (000 ha)**
River Valley projects	479
Agriculture	2506
Construction of roads	57
Establishment of Industries	127
Others	965

Source: The fissured Land – Ecological History of India, Page 19

Technology aided us in extracting more ground and surface water (see table given below); this created an illusion of water being available aplenty. Over consumption was the direct consequence of this.

Table 5: Number of Tube wells in Punjab

Year	**Tube wells (in lakhs)**		
	Diesel operated	**Electric operated**	**Tota l**
1970	1.01	0.91	1.92
1975	3.04	1.46	4.5
1980	3.2	2.8	6
1982	2.9	3.33	6.23

Source: Violence of Green Revolution, page 141

Irrigation projects resulted in the shrinking of rivers downstream, which affected aquatic ecosystems and indigenous communities.

- Mono cropping of wheat and rice led to irreparable loss of species and genetic biodiversity. According to Dr. Rachharia, a well-known rice scientist, **400,000 varieties of rice existed in India during the Vedic period.** Under the Green Revolution, traditional crops like maize, millets, pulses and oilseeds were replaced by monoculture varieties of HYV wheat and rice. This over a period of time affected the genetic pool.
- The water run-off from the fertilizers and pesticides used in the fields contaminated both surface and groundwater of that region. This caused rapid growth of algae and other water plants in surface water bodies and impacted aquatic life. The excess nitrogen in fertilizers also imbalanced the nitrogen cycle, leading to eutrophication and affecting the water quality and the marine life forms.
- E. O. Wilson, an eminent socio-biologist, points out there are several million species of microorganisms in a ton of soil, most of them unknown. Excessive irrigation combined with use of fertilizers and pesticide leads to the salinity of the soil, this in turn leads to the loss of earthworms and microorganisms present.

Misplaced Priorities:

Post liberalization, India like many other countries jumped on to the development bandwagon, imported the western model and implanted it here with no questions asked!

The unplanned urbanization, the scant regard for ***the part and the whole*** and losing sight of the interconnections in Nature are the direct consequence of this! To understand this story of urbanization, we didn’t have to go very far. It was there for us to see right in our own backyard.

Sarjapur used to be an open, wooded area just a while ago. We remember seeing monkeys, hearing birdcalls, seeing intricately woven spider webs during our nature walks. The thriving Haddu Siddapura Lake and Gattihalli Lake were our favourite destinations. We had identified different species of birds, snakes, frogs and insects during our night-outs and nature walks. A living biology laboratory was right in front of us to explore and experience! Today, all of this is a thing of the past. Where all the creatures have gone will continue to remain a mystery to us. Where do they go when their homes have been destroyed? Do they die? And if they survive, how do they do so? We also wonder about what had happened to the water that brimmed with life in these lakes. These are questions, which we have not yet been able to find the answers to.

This is happening not only in our neighborhood, but across Bangalore. Bangalore was known as the garden city, the city of lakes. The lakes in our city Bangalore were numerous until the 20th century.

Table 5: Lakes in Bangalore and what they became

Lakes	**What they became**
Shoolay Lake	Football stadium
Akkithimmanhalli Lake	Corporation Hockey Stadium
Sampangi Lake	Kanteerava Sports Complex
Dharmanbudhi Lake	Kempegowda Bus Station
Challaghatta Lake	Karnataka Golf Association
Koramangala Lake	National Golf Association
Siddikatte Lake	KR Market

Source: Wikipedia

The lakes of Bangalore form a chain of reservoirs in the three valleys namely Hebbal Valley, Koramangala and Challaghatta Valley, and Vrishabhavati Valley. Each valley at the ridge top gives birth to small streams which are interlinked to each other through a series of self-sustaining lake ecosystems. Scientists believe that rapid urbanization has led to the break down of these interlinks which has led to a drastic decrease in the number of lakes in the city. While in 1961 there were 262 lakes, official statistics today mention 117 lakes, but only 33 lakes are still more or less visible on satellite imagery.

More and more lakes are still vanishing.

From an anthropocentric viewpoint, this only marks a red flag. But from an ecological perspective, this is nothing but callous destruction of diverse ecosystems. It is a loss of habitat for birds, insects, amphibians, and other animals. Don’t we need to remind ourselves that we are part of the web as well? What we do to the web we do to ourselves.

Industrial and Domestic Pollution:

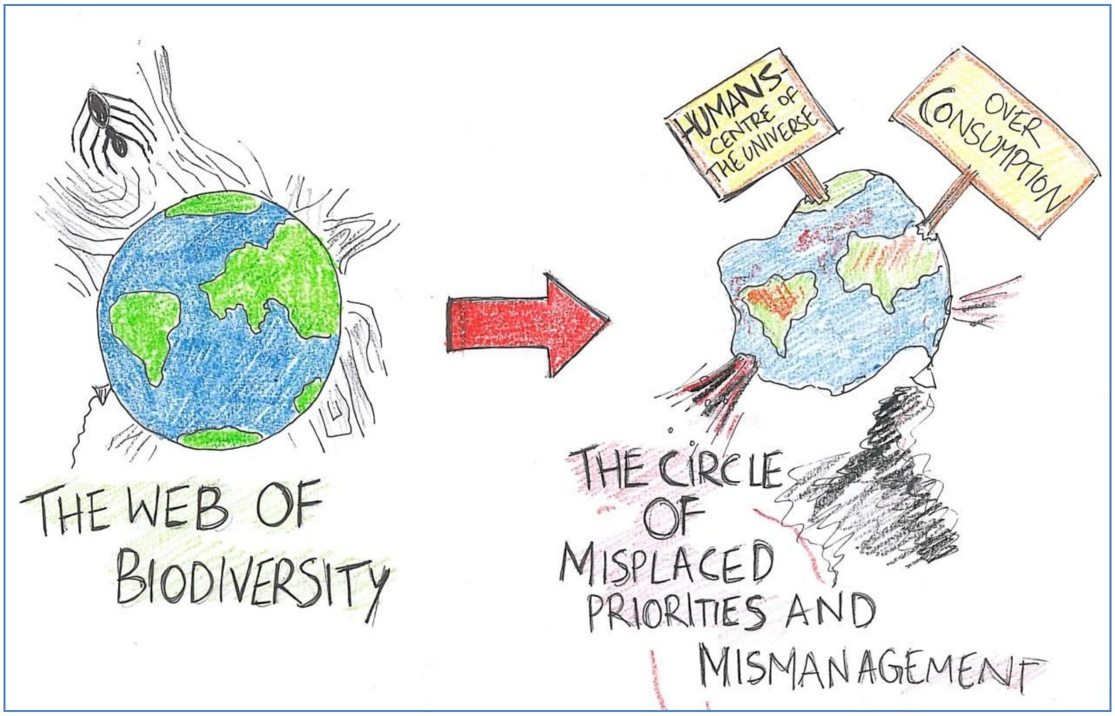
Domestic waste and organic waste are also dumped into water bodies, polluting them, often beyond the point of recovery. Mining industries, metal industries and others pollute surface water as well as the ground water.

Consider for example the case of Damodar River, which flows through Jharkhand and West Bengal. Estimates put the daily outfall of effluents at 60 tons of organic load, 2 tons of non-metallic toxins and 1.2 tons of toxic metal substances. In 1998, the Central Pollution Control Board classified the Damodar as heavily polluted, meaning that it is completely unsafe for human consumption and aquatic life.

Conclusion:

Every living organism on our planet is interconnected in the web of biodiversity, from the smallest to the largest.It is reckless on our part to think that we can do whatever we want with our planet and its vast range of diversity.To quote E.O. Wilson, “If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos.”

Wilson’s quote is something that we as humans should definitely keep in mind. Our species is only 1% of all organisms on Earth. However, human beings are trying to break out of this web and form a circle of their own: one of misplaced priorities and mismanagement. In the new circle, we are consuming more resources, be it for agriculture or industries or for urbanization, and are also polluting this life-giving miracle called water. This in turn, is impacting the very fabric of life on Earth.



Artist: Rohit Rao

Does this mean there is no hope anymore? Is there no light at the end of the tunnel?

However, aren't challenges times for opportunities too? The revival of Kaikondrahalli Lake, a lake just on Sarjapur road,clearly illustrates this.

Kaikondrahalli Lake was a man-made lake system made centuries ago, designed to catch and store water during the monsoons- almost like a very big rain gauge. The dying lake has been revived right in front of our eyes in a span of 3-4 years. Now, it is a thriving ecosystem by itself. With its revival it has attracted different creatures that have made it their home. As said earlier, Life supports Life.

It has become a habitat for birds like kites, eagles and moorhens. Checkered Keyback water snakes swim in the waters, with ducks swimming and quacking above. There are tree frogs in the trees and toads, which come out from the crevices when it starts to rain. There have been sightings of cobras, the king of snakes.

Cranes have also been visiting the lake now. As cranes are at the top of the bird food chain, it means that the lake has indeed been revived to its former glory.

The success story of Kaikondrahalli Lake tells us that we humans are also capable of making interventions that enable different life forms to co-exist.

The diversity of creatures on this planet consume only that much water of which they require, and therefore, they do not impact the water security of our planet. We, as a species seem to have lost sight of this truth. We should set our priorities right and recognize that all the creatures with whom we share this Earth have an equal right to thrive and exist.

ñAll things are connected like blood that unites us all. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself." Chief Seattle.

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