Water Conservation & Rainwater Harvesting

Water footprint (India)

- ✓ India's annual Rainfall + Snowfall run off = 1600 Billion cubic meters
- ✓ Assuming 50% reaches the seas, we have the net run off of 800 billion cubic meters. That is 800,000 billion liters.
- ✓ In other words, the annual water endowment to India is *800,000,000,000,000 Liters*
- ✓ Population of India is 130,000,00,00.00
- ✓ Annual water endowment per person = 800,000,000,000,000/130,0000000 = 6,15,384.00 Liters.
- ✓ Say 6,15,000 liters is the annual endowment of water per person in India
- ✓ This translates to 6,15,000/365 = 1,684.00 liters per person per day.

Think About it !!

- Density of water is 1000 kg/m3.
- Each individual consuming 1600 liters of water a day is equivalent to energy of 1600 Kgs.
- That is 1.6 Tons equivalent. So, an individual of 80 Kgs consumes an energy equivalent of 1.6 Tons. **{1 : 20}**
- That is 20 times his weight every day.
- A tiger weighing 350 kgs consumes a deer of 40 kgs for 3 days. **{25 : 1}**

Domestic Water Foot-print (India)

Use	Litres/person
Drinking	3
Cooking	4
Bathing	20
Flushing	40
Washing-clothes	25
Washing Utensils	20
Gardening	23
Total	*135*

Water Foot-print

- With 135 LPCD being the direct component, the indirect component of the water footprint is (1,684-135) = 1,549 LPCD say 1,500 LPCD.
- In summary, our water footprint looks like

✓ Direct component (Domestic consumption): 135 LPCD or 8%

✓ Indirect component: 1,549 LPCD or 92%

- This 1500 liters is a combination of water used for food, fuel, consumables, paper etc.

Cost of water (India)

- True cost of water varies from 50 to 100 a KL
- It is more than rupees 150 Per KL in heavily water stressed communities .

Think About it :

✓Individual annual consumption of water per year : 615.00 KL.

✓That is 615.00 x 75 = 46,125 Rupees a year = 126.0 rupees a day.

✓This cost increases every year.

Rainwater harvesting

(Supply Side)

Activity of capturing the rain and storing it for direct use or recharging into the groundwater.

Simply.. **catching rain where it falls and using it !!**

Water Conservation

(Demand Side)

Process/ Habit of Judicious use of Harvested water.

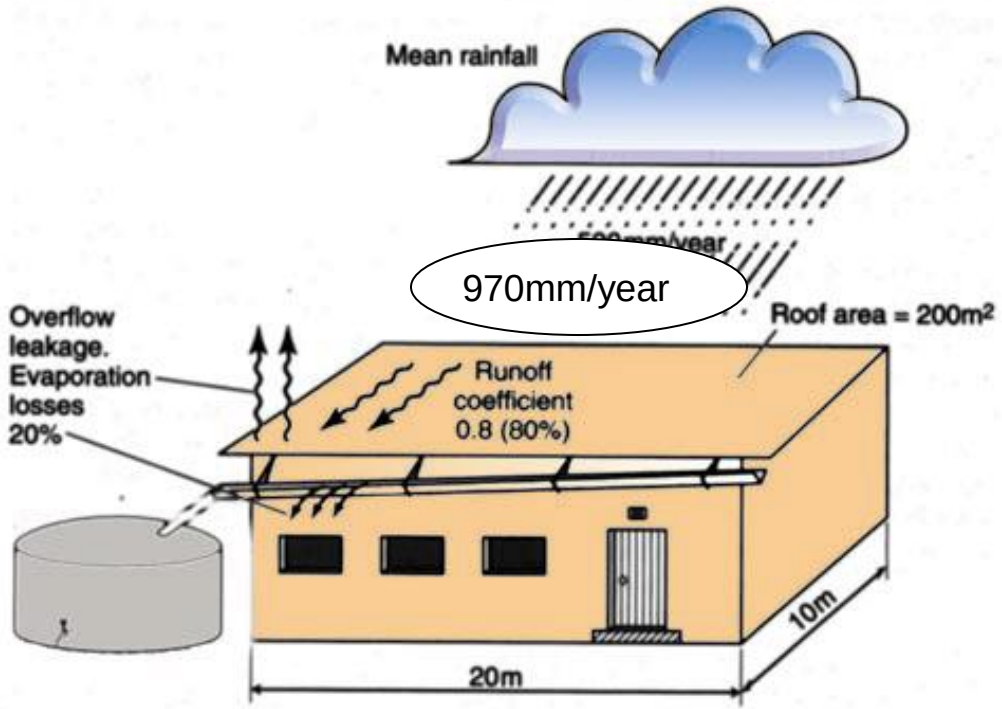
Why de-centralization

- Area of Bangalore : 710 Square Kilo-meters .
- Rainfall on this surface : 950 mili-meters
- Total run off : 71,00,00,000 x 0.5 x 950 = 33,72,50,000 kil0 liters
- Population of Bangalore : 1,20,00,000.
- Daily water demand = 1,20,00,000 x 135 = 1,620,000Kilo Liters
- Days of rainwater = 33,72,50,000 / 1,62,00,00 = 208.00 days
- **That is 56.0% of the City's annual demand !!**

Why de-centralization

- Area of my house : 110 Square Meter .
- Annual Run off 950 mm
- Total run off : 110 x 0.85 x 950 = 88.8 kil0 liters
- People in My house : 4
- Daily water demand = 04 x 135 = 540.00Liters
- Days of rainwater = (88.8 x 1000) / 540.0 = 164.00 days
- **That is 45% of or demand !!**

Estimating rooftop Rainwater run off ?



Runoff (liters)
=A x R x C

A=Area in Sq M

R=Rainfall in mm

C=Runoff coefficient

An example

- A=200 m^2
- R = 970mm
- C=0.80

Runoff = 1,55,200 ltrs

Simple Green Nudges

1. Basic Toolkit : https://sonublogs.blogspot.com/2021/10/environment-action-basic-toolkit.html
2. Toolkit Ver 2: https://sonublogs.blogspot.com/2021/10/environment-action-toolkit-part-2.html

3. Youtube channel : https://www.youtube.com/c/HinrenEngineering

Storage or Recharge?

- When rain is well distributed (NE, parts of Southern India)
- When water availability for domestic/industrial purpose is scare eg. parts of Rajasthan, Gujarat etc.
- Where municipal supply is very costly.

- If the number of rainy days is less i.e. rainfall concentrated in few days and demands larger storage
- When there is rapid decline in the groundwater table
- Where water quality is bad (Surface Run-off)
- When you don't know how to use stored water

Or both?

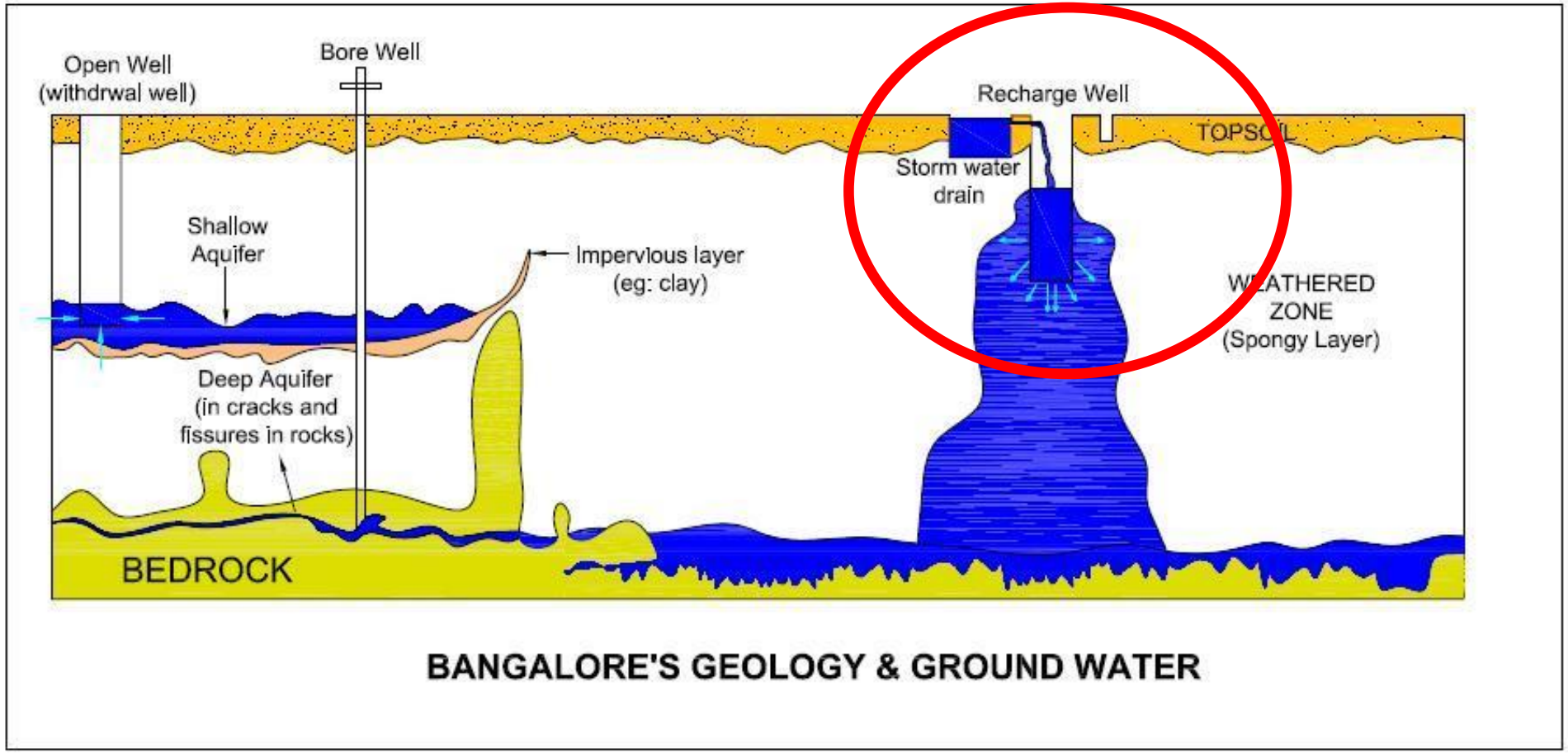
Ground water Recharge:

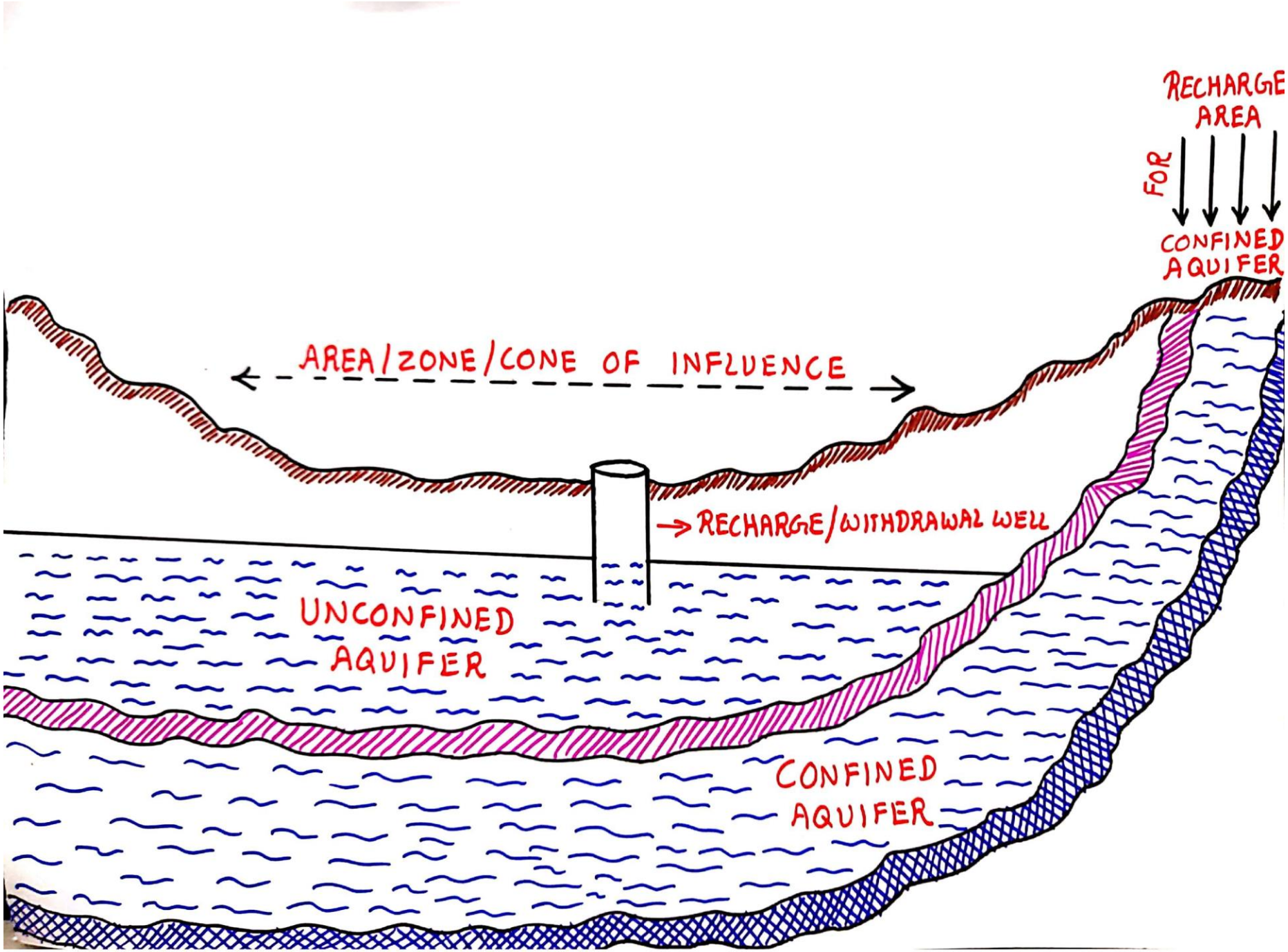
Process or practice to raise the level of ground water !!

Ground water Recharge: HOW ?

1. Consume less.
2. Don’t pollute.
3. Plant trees.
4. Plant more trees.
5. **Make trenches .**
6. **Make Recharge wells .**
7. **Storm water drain management .**
8. **Infiltration wells.**
9. Lakes.

Approximate Geology (Bangalore)





Ground Water Recharge Considerations:

- SAFETY !!
- Size and nature of catchments
- Site conditions like rainwater outlets, drains, flow direction, availability of space
- Rainfall **intensity**
- Geology: Type of soil or rocks
- **Hydro-geology:** Groundwater level & porous strata
- **Quality of Water** used for recharge
- Dependence on municipal & groundwater sources
- Possibilities of using harvested water

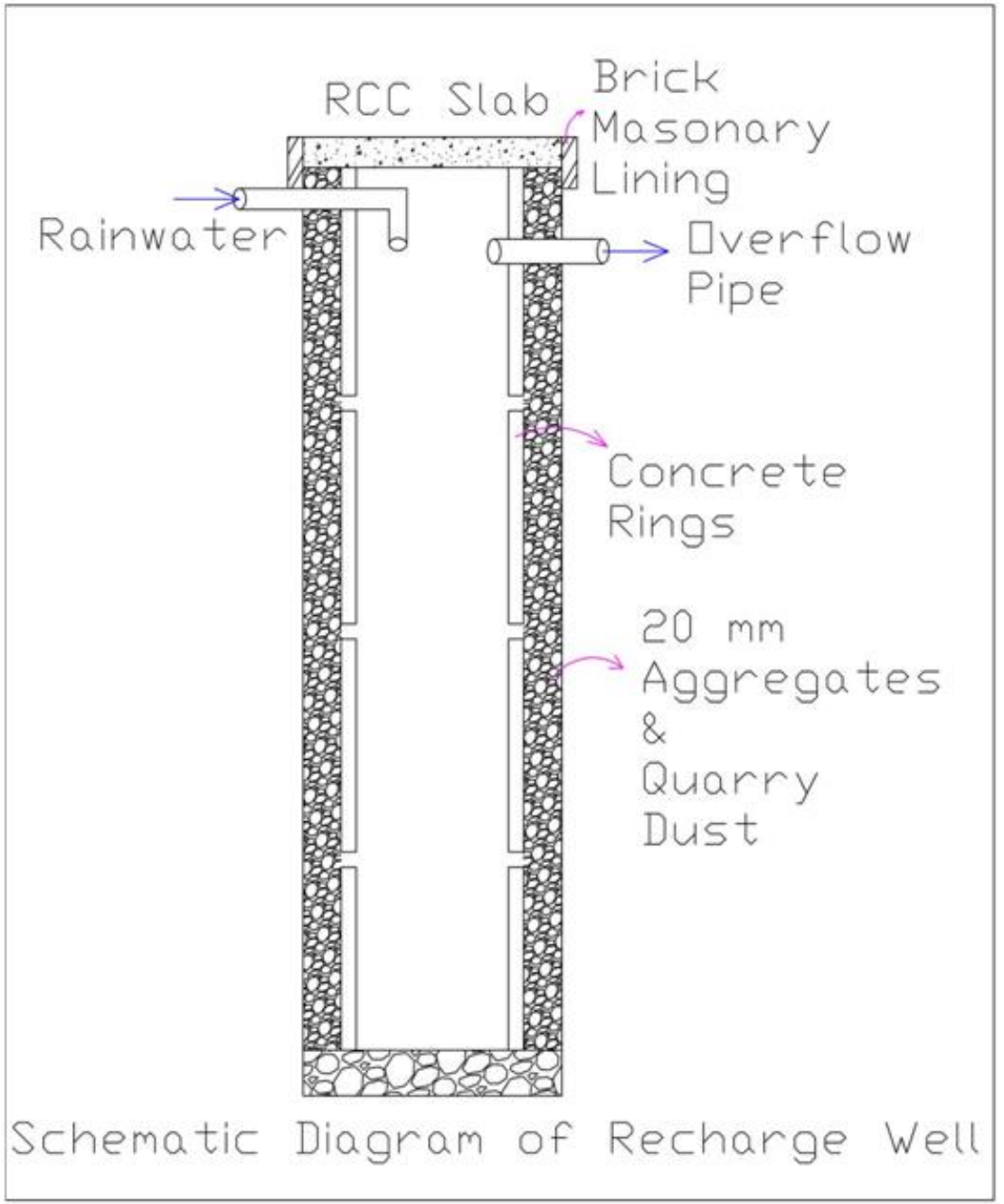
All designs depend on the size of catchment and are site specific.

Recharge well

1. Open Well .
2. Diameter depends on Space available.
3. Depth depends on soil strata and diameter .
4. Deeper the well , better the recharge
5. Chances of good strata with depth.
6. Hydrostatic pressure given by P = p. g. h

A Recharge well takes water run-off from rooftops, paved areas and roads, filters it and sends it underground to increase the water table.

Unlike a conventional well which taps into the aquifer, the recharge well sends water into the aquifer.



Schematic Diagram of Recharge Well

The pit has reach the silt layer

Pit and concrete rings

Placing of the rings

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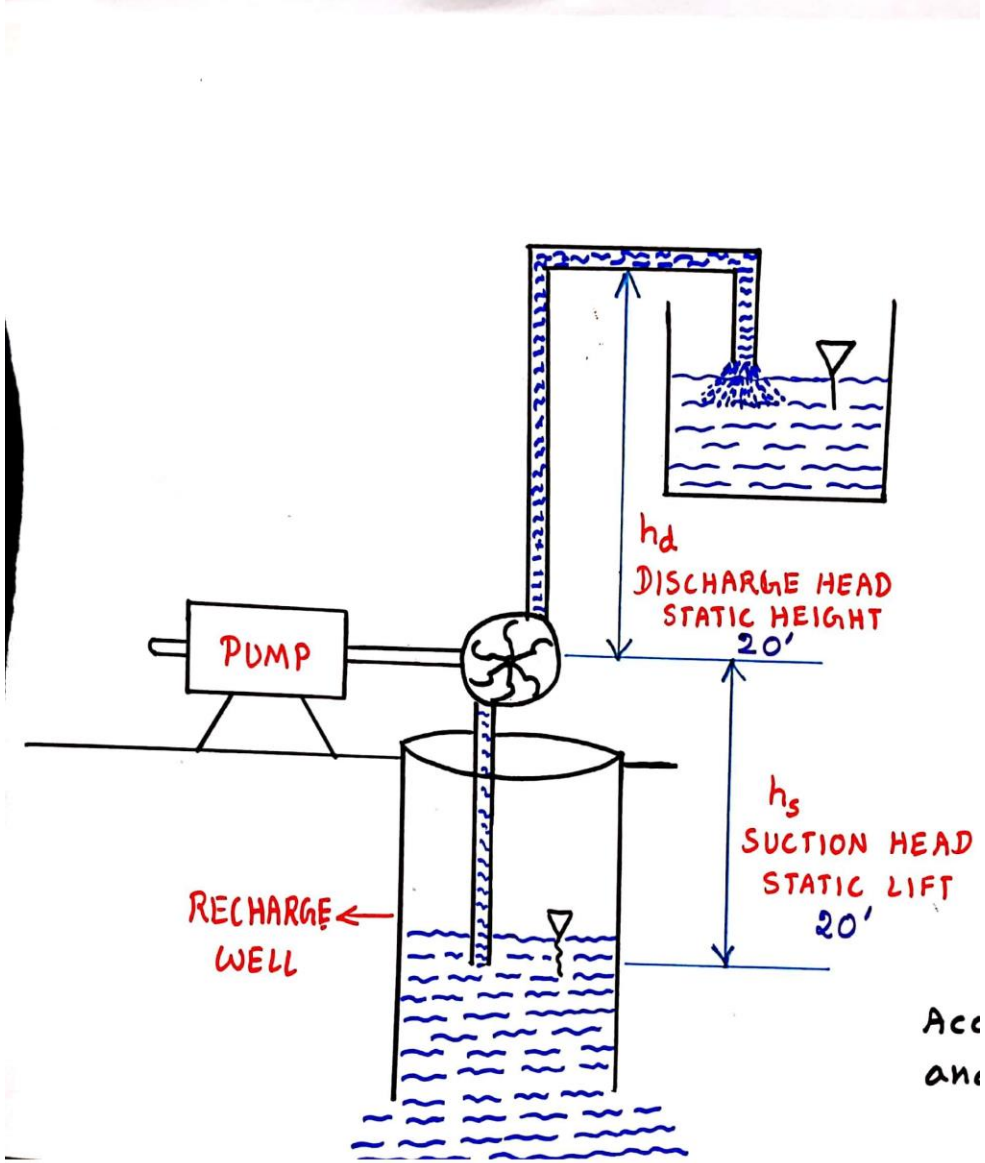
Economics of Shallow Aquifer Water



- Suction Head Hs = 20 Feet
- Discharge Head Hd = 20 Feet
- Total Head = 40 feet
- Pump Capacity : 0.5 HP
- Discharge for a head of 40 feet = 1500 Ltrs per Hour

✓ Electricity Consumption = 0.5 HP x 1 Hr = 0.38 KW x 1 Hr = 0.38 Kwh

✓ Energy Consumption = 0.38 units for 1500 Ltrs of water

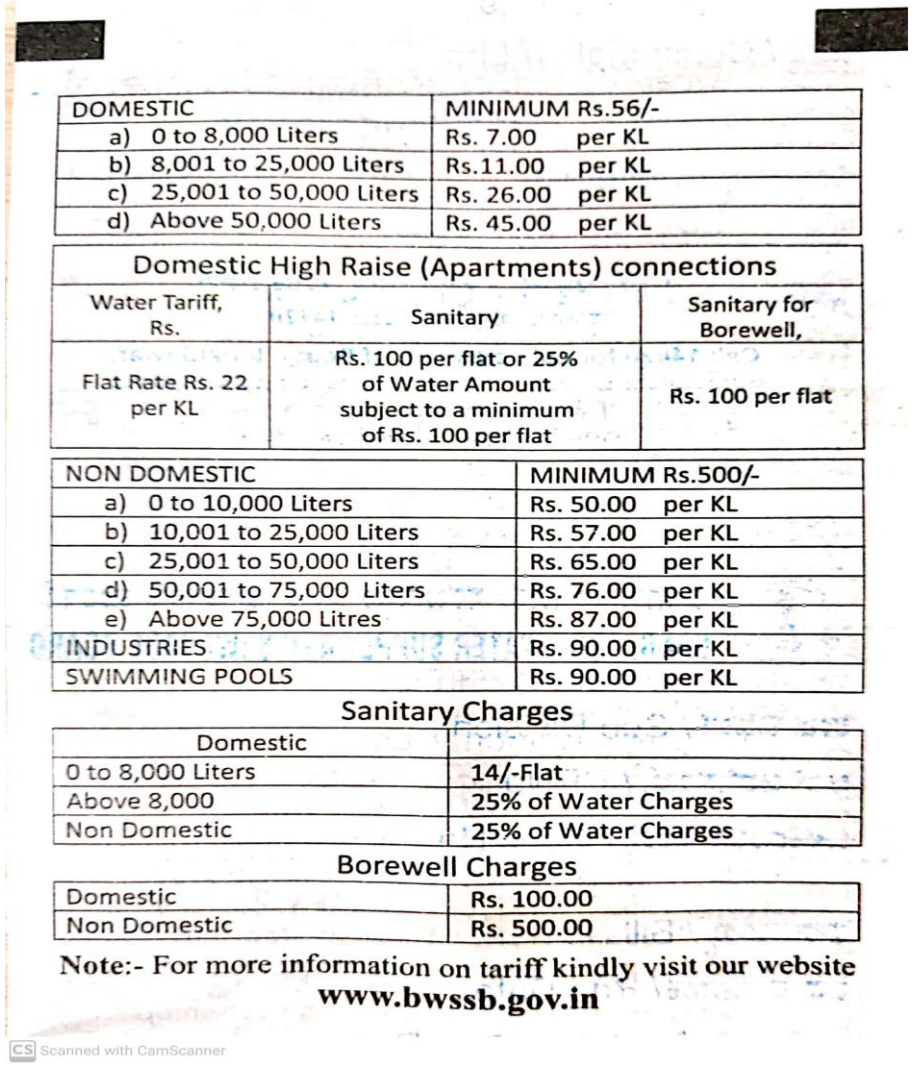
✓ @ 5 rupees per unit; Cost of energy = 5 x 0.38 = 1.9 Rupees for 1500 Ltrs

❑ OR 1.26 Rupees for 1000 Ltrs

Accounting for Capital cost , interest , Maintenance etc;

Cost of water = 2 Rupees per Liter

Price Comparison



DOMESTIC	MINIMUM Rs.56/-
a) 0 to 8,000 Liters	Rs. 7.00 per KL
b) 8,001 to 25,000 Liters	Rs.11.00 per KL
c) 25,001 to 50,000 Liters	Rs. 26.00 per KL
d) Above 50,000 Liters	Rs. 45.00 per KL

Domestic High Raise (Apartments) connections		
Water Tariff, Rs.	Sanitary	Sanitary for Borewell,
Flat Rate Rs. 22 per KL	Rs. 100 per flat or 25% of Water Amount subject to a minimum of Rs. 100 per flat	Rs. 100 per flat

NON DOMESTIC	MINIMUM Rs.500/-
a) 0 to 10,000 Liters	Rs. 50.00 per KL
b) 10,001 to 25,000 Liters	Rs. 57.00 per KL
c) 25,001 to 50,000 Liters	Rs. 65.00 per KL
d) 50,001 to 75,000 Liters	Rs. 76.00 per KL
e) Above 75,000 Litres	Rs. 87.00 per KL
INDUSTRIES	Rs. 90.00 per KL
SWIMMING POOLS	Rs. 90.00 per KL

Sanitary Charges

Domestic	
0 to 8,000 Liters	14/-Flat
Above 8,000	25% of Water Charges
Non Domestic	25% of Water Charges

Borewell Charges

Domestic	Rs. 100.00
Non Domestic	Rs. 500.00

Note:- For more information on tariff kindly visit our website **www.bwssb.gov.in**

Price of tanker water is about 120 rupees a kilo Liter

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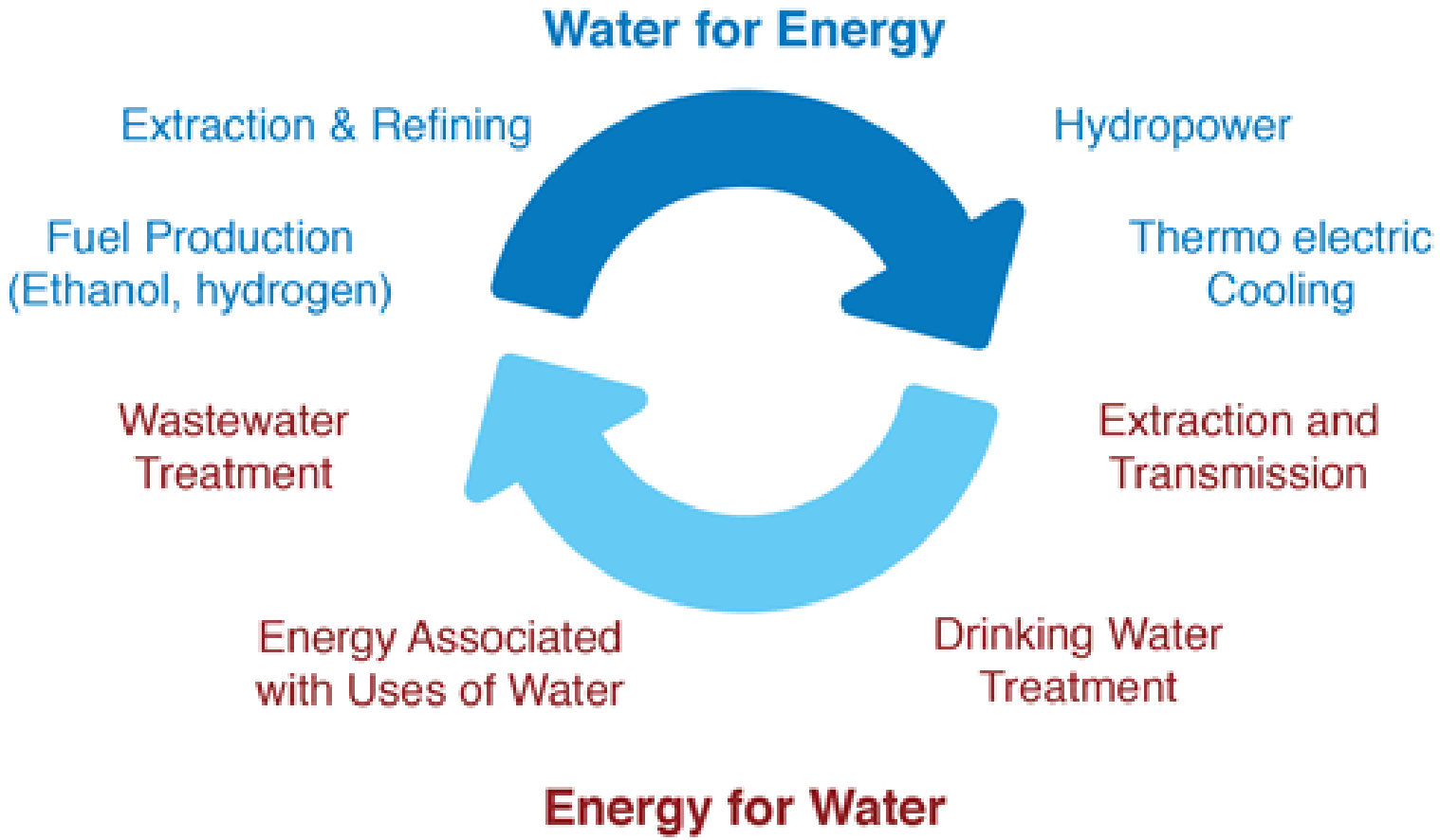
Concluding Remarks: RWH

- Safety first : Personal and environmental .
- Sound Engineering.
- Proper Maintenance.
- Skilled workforce.
- Knowledge dissemination .

"Knowledge advances not by repeating known things but by refuting false dogmas"

~ Karl Popper

Need for a Holistic Approach :



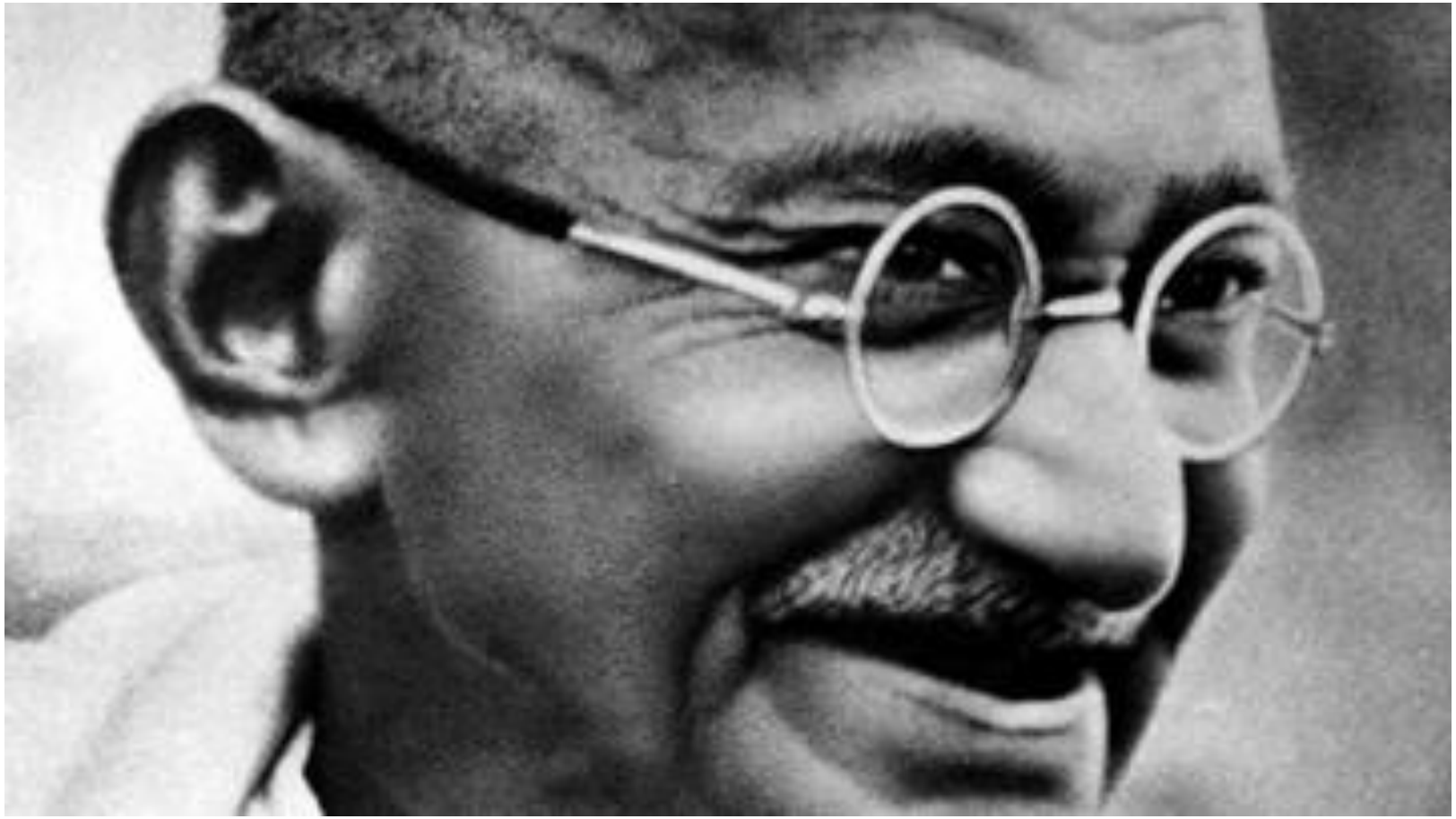
"The Energy problem is actually a water problem". Water and energy also affect food security and hence there is Water – Energy – Food Nexus.

Illustrations:

1. Using water to irrigate crops can promote food production but it also reduce river flows and hydropower potential.
2. Growing bioenergy crops under irrigated agriculture can increase overall water withdrawals and jeopardize food security.
3. Converting surface irrigation into high-efficiency pressurized irrigation may save water but may result in higher energy use.

What can be Done ? (Closing Remarks)

- Consume less
- Plant trees
- Get as decentralised as possible for Food, Water and energy .
- Pollute less.
- Preach less and practice more .
- Some of my personal initiatives : Read in my Blog .



Be the change you want to see in the world!!!!