RAIN WATER HARVESTING AND WASTE WATER RECYCLING

- REASONS OF SHORTAGE OF WATER.
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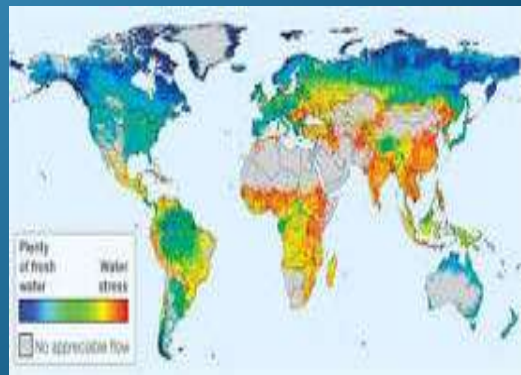

RAIN WATER HARVESTING AND WASTE WATER RECYCLING

- SIZE OF STORAGE TANK.
- MINIMIAZTION OF THE PROBLEM.
- ATTRIBUTES OF GROUND WATER.
- WASTE WATER RECYCLING.
- WHAT IS WASTE WATER RECYCLING.
- WASTE WATER RECYCLING PROCESS.
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- ADVANTAGES.
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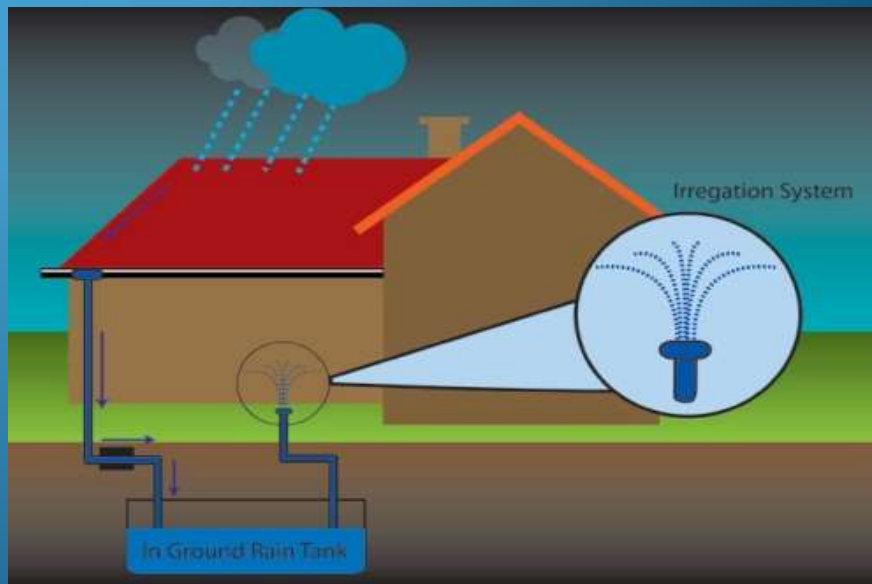


REASON FOR SHORTAGE OF WATER

Population increase

Industrialization

Urbanization

(a) Increase in per capita utilization

(b) Less peculation area

© In places where rain fed/ irrigation based crops are cultivated through ground water

Decrease in surface area of Lakes

Deforestation

(i) Less precipitation

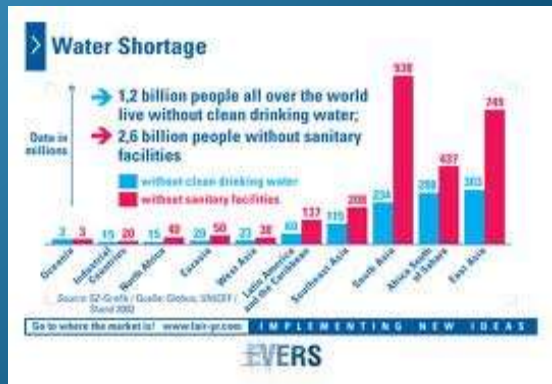
(ii) Absence of Barriers

(a) Rain drops checked by leaves of tree

(b) Water slowly descends through twigs & trunk

(c) Humus – acts as reservoir

(d) Tiny creatures – helps percolation



WHAT IS THE SOLUTION

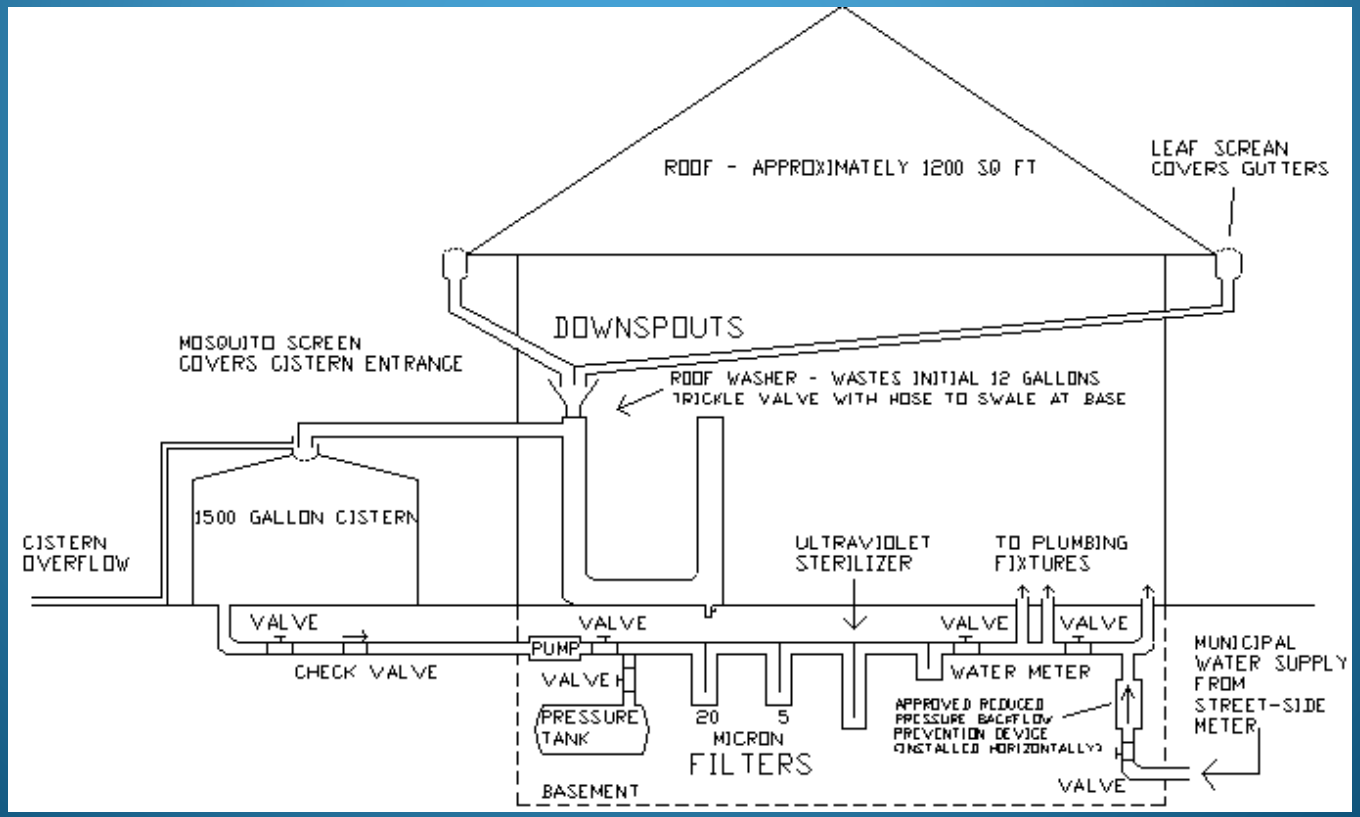
- Rain water is the ultimate source of fresh water
- Potential of rain to meet water demand is tremendous
- Rain water harvesting helps to overcome water scarcity
- To conserve ground water the aquifers must be recharged with rain water
- Rain water harvesting is the ultimate answer

WHY RAIN WATER BE HARVESTED

- To conserve & augment the storage of ground water
- To reduce water table depletion
- To improve the quality of ground water
- To arrest sea water intrusion in coastal areas
- To avoid flood & water stagnation in urban areas

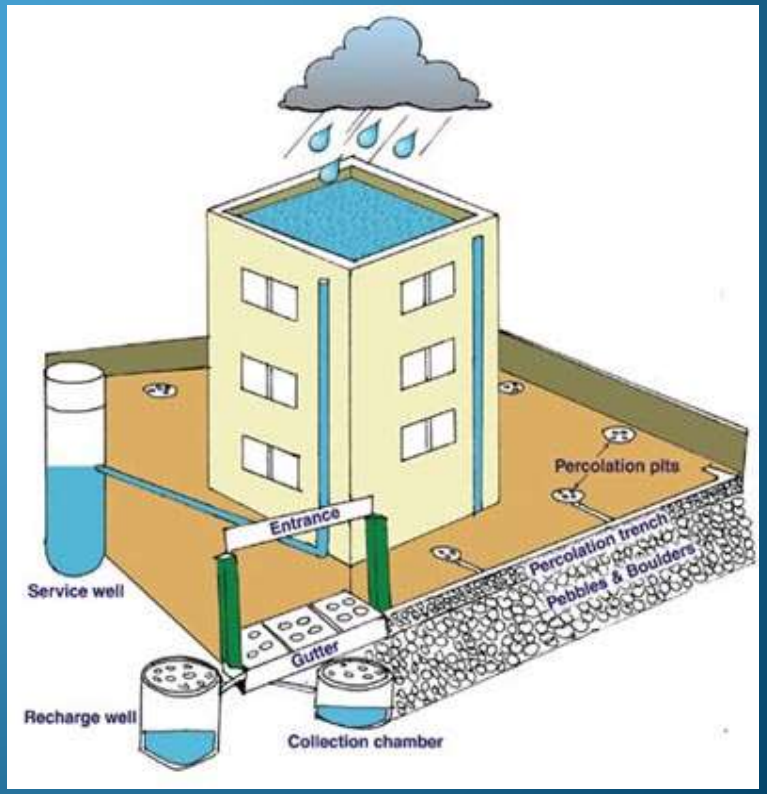
WHAT IS RAIN WATER HARVESTING

- It is the activity of direct collection of rain water
- Rain water can be stored for direct use or can be recharged into the ground water aquifer



RAIN WATER HARVESTING PROCESS

- **Rain Water Harvesting RWH- process of collecting, conveying & storing water from rainfall in an area – for beneficial use.**
- **Storage – in tanks, reservoirs, underground storage- groundwater**
- **Hydrological Cycle**

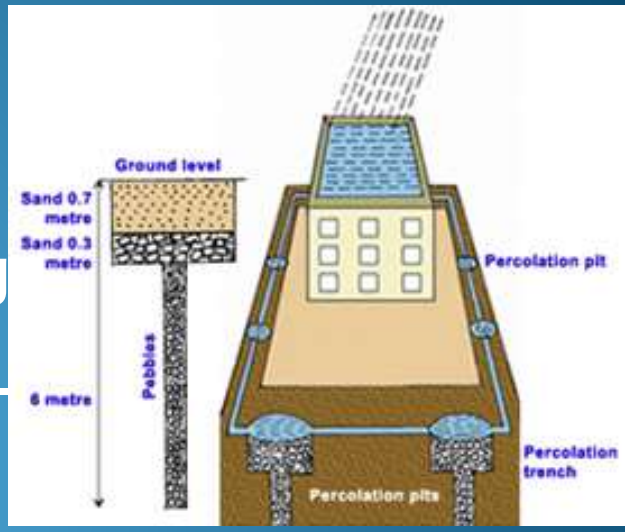


RAIN WATER HARVESTING PROCESS

- **RWH - yield copious amounts of water. For an average rainfall of 1,000mm, approximately four million litres of rainwater can be collected in a year in an acre of land (4,047 m^2), post-evaporation.**
- **As RWH - neither energy-intensive nor labour-intensive**
- **It can be a cost-effective alternative to other water-accruing methods.**
- **With the water table falling rapidly, & concrete surfaces and landfill dumps taking the place of water bodies, RWH is the most reliable solution for augmenting groundwater level to attain self-sufficiency**

RAIN WATER HARVESTING METHODOLOGIES

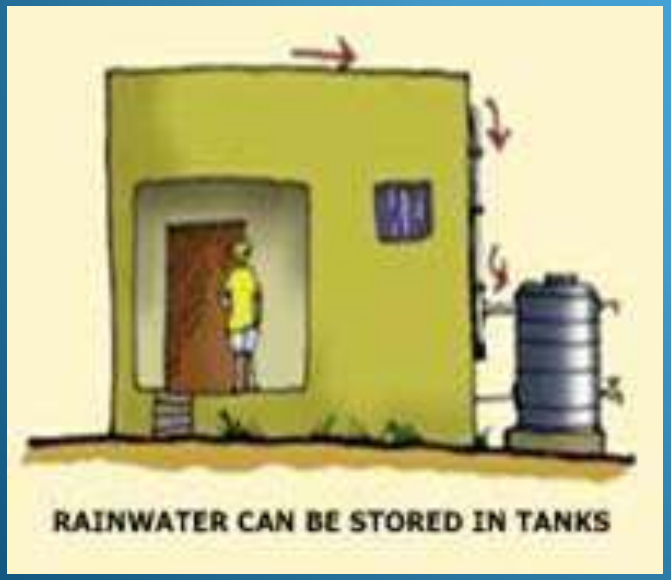
- Roof Rain Water Harvesting
- Land based Rain Water Harvesting
- Watershed based Rain Water harvesting
  - For Urban & Industrial Environment –
    - Roof & Land based RWH
      - Public, Private, Office & Industrial buildings
      - Pavements, Lawns, Gardens & other open spaces



HARVESTING SYSTEM

Broadly rainwater can be harvested for two purposes

- Storing rainwater for ready use in containers above or below ground
- Charged into the soil for withdrawal later (groundwater recharging)



RAIN WATER HARVESTING TECHNIQUES

- There are two main techniques of rain water harvestings.
- Storage of rainwater on surface for future use.
- Recharge to ground water.
- The storage of rain water on surface is a traditional techniques and structures used were underground tanks, ponds, check dams, weirs etc
- Recharge to ground water is a new concept of rain water harvesting and the structures generally used are :-

- **Pits** :- Recharge pits are constructed for recharging the shallow aquifer. These are constructed 1 to 2 m, wide and to 3 m. deep which are back filled with boulders, gravels, coarse sand.

RAIN WATER HARVESTING TECHNIQUES

- **Trenches**:- These are constructed when the permeable stram is available at shallow depth. Trench may be 0.5 to 1 m. wide, 1 to 1.5m. deep and 10 to 20 m. long depending up availability of water. These are back filled with filter materials.
- **Dug wells**:- Existing dug wells may be utilised as recharge structure and water should pass through filter media before putting into dug well.
- **Hand pumps** :- The existing hand pumps may be used for recharging the shallow/deep aquifers, if the availability of water is limited. Water should pass through filter media before diverting it into hand pumps.
- **Recharge wells** :- Recharge wells of 100 to 300 mm. diameter are generally constructed for recharging the deeper aquifers and water is passed through filter media to avoid choking of recharge wells.

RAIN WATER HARVESTING TECHNIQUES

- **Recharge Shafts** :- For recharging the shallow aquifer which are located below clayey surface, recharge shafts of 0.5 to 3 m. diameter and 10 to 15 m. deep are constructed and back filled with boulders, gravels & coarse sand.
- **Lateral shafts with bore wells** :- For recharging the upper as well as deeper aquifers lateral shafts of 1.5 to 2 m. wide & 10 to 30 m. long depending upon availability of water with one or two bore wells are constructed. The lateral shafts is back filled with boulders, gravels & coarse sand.
- **Spreading techniques** :- When permeable strata starts from top then this technique is used. Spread the water in streams/Nalas by
making check dams, nala bunds, cement plugs, gabion structures or a percolation pond may be constructed.

ADVANTAGES

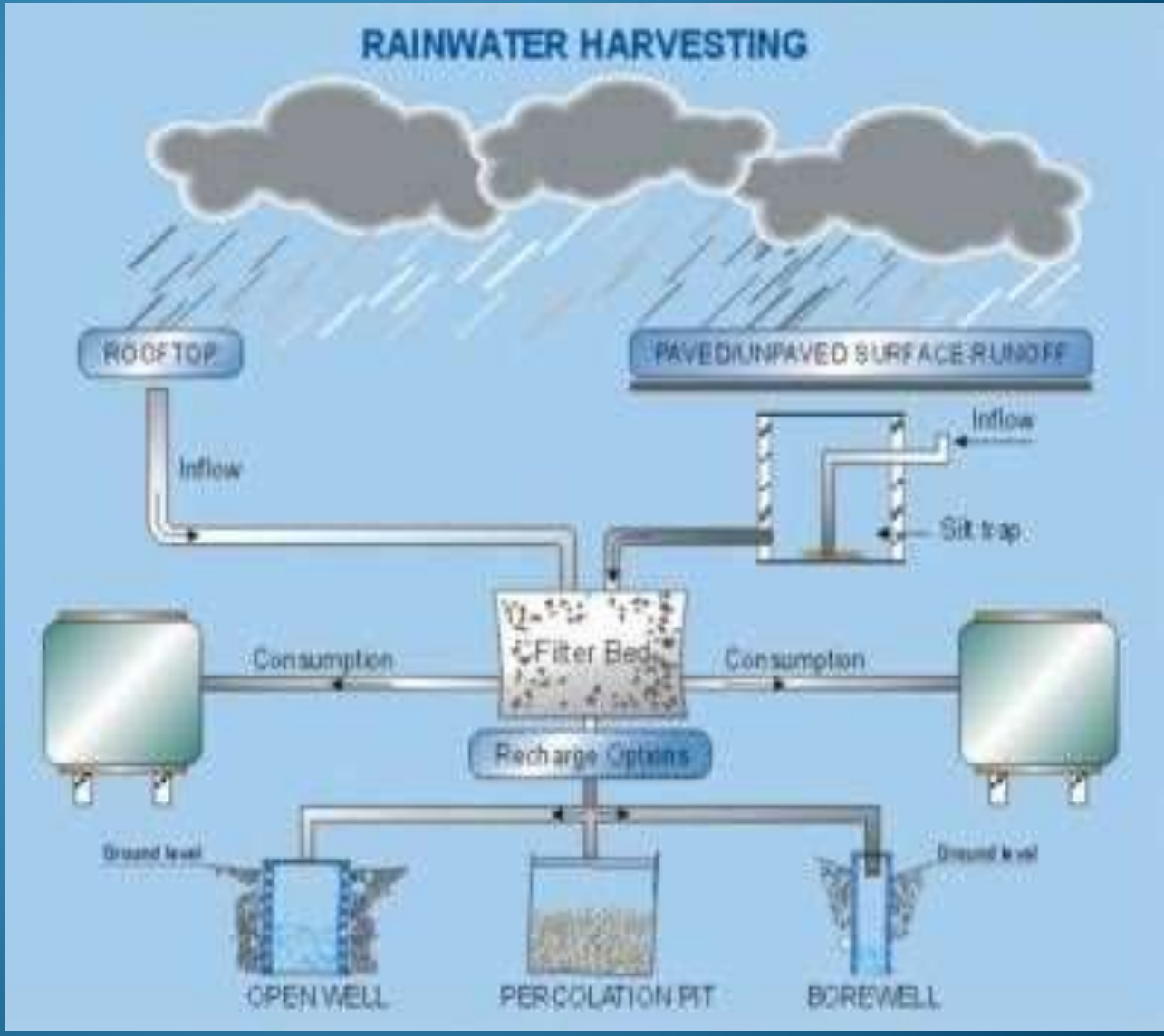
- Provides self-sufficiency to water supply
- Reduces the cost for pumping of ground water
- Provides high quality water, soft and low in minerals
- Improves the quality of ground water through dilution when recharged
- Reduces soil erosion & flooding in urban areas
- The rooftop rain water harvesting is less expensive & easy to construct, operate and maintain
- In desert, RWH only relief
- In saline or coastal areas & Islands, rain water provides good quality water

THE ROOF CATCHMENT ARE SELECTIVELY CLEANER WHEN COMPARED TO THE GROUND LEVELCATCHMENT

- Losses from roof catchment are minimum
- Built & Maintained by local communities
- No Chemical contamination & only required filtration
- Available at door step with least cost

RAIN WATER HARVESTING SYSTEM

- Roof catchment
- Gutters
- Down pipe & first flushing pipe
- Filter Unit
- Storage Tank



SIZE OF STORAGE TANK

- Based on
  - No. of person in the House hold
  - Per capita water requirement
  - No. of days for which water is required

HOW THE PROBLEM CAN BE MINIMIZED

By providing pipe water system with source (electric based)

(a) Surface water

(b) Deep tube wells

Recharging stratas through rainwater harvesting methods

(No. of villages of lower range concentration can be decreased)

Storing rain water for drinking purpose

(a) In areas where electricity problem is more

(b) In areas where concentration is more

© In areas where PWS is uneconomical

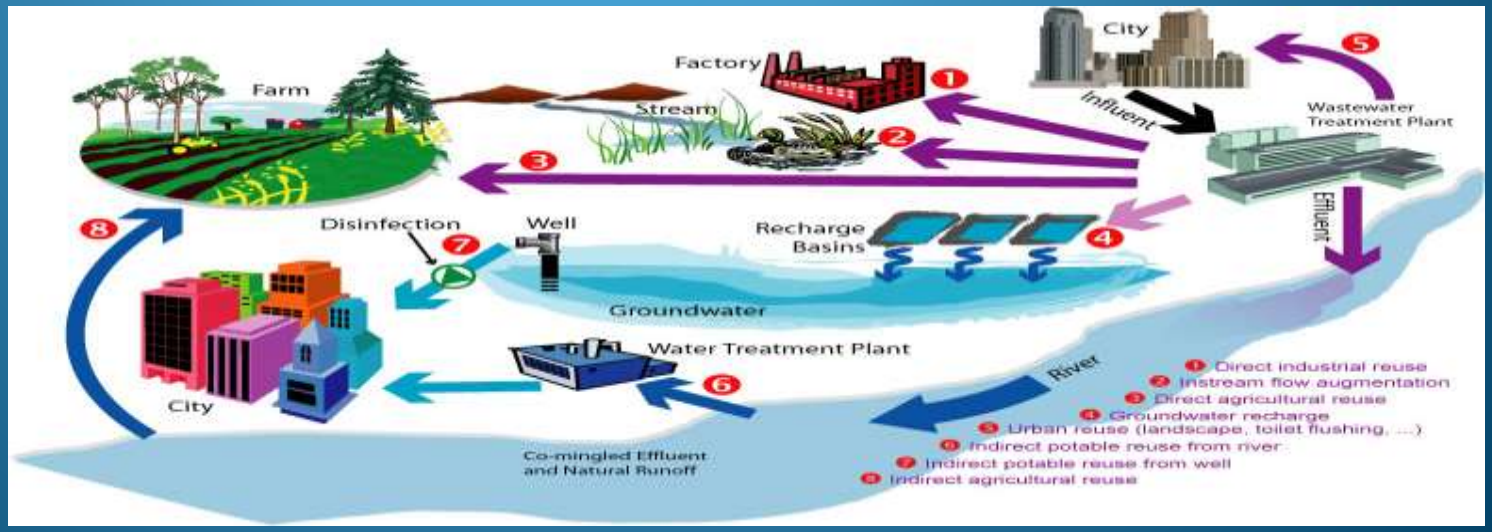
(d) In areas where dependable source is not available

ATTRIBUTES OF GROUND WATER

- There is more ground water than surface water
- Ground water is less expensive and economic resource.
- Ground water is sustainable and reliable source of water supply.
- Ground water is relatively less vulnerable to pollution
- Ground water is usually of high bacteriological purity.
- Ground water is free of pathogenic organisms.
- Ground water needs little treatment before use.
- Ground water has no turbidity and colour.
- Ground water has distinct health advantage as art alternative for lower sanitary quality surface water.
- Ground water is usually universally available.
- Ground water resource can be instantly developed and used. There is no conveyance losses in ground water based supplies.
- Ground water has low vulnerability to drought.
- Ground water is key to life in arid and semi-arid regions.
- Ground water is source of dry weather flow in rivers and streams.

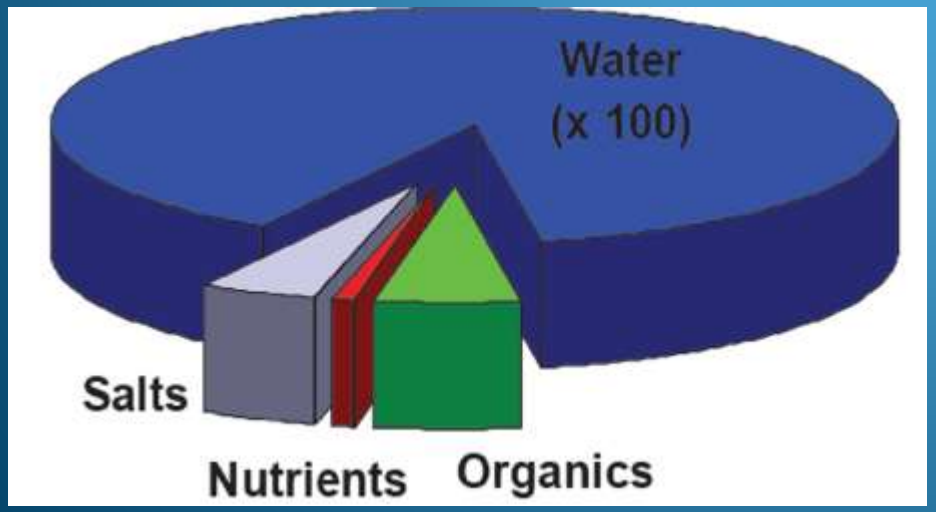
WASTE WATER RECYCLING

Current water shortages and the cost associated with freshwater have made water reuse and recycling of major importance. Reused water is currently used for non-potable purpose , such as agriculture , landscape , public parks and golf course irrigation , industrial process water etc. Benefits of reuse includes protection of ecosystems and reduction and prevention of pollution. This paper focus on the environmental & health considerations related to utilization of treated water.



WASTE WATER RECYCLING

Waste water treatment organic farming are well establish in the world today . However joining them together is a special feature of waste water recycling.



RECYCLING PROCESS

- **Primary Treatment**

Primary treatment uses simple mechanical and physical processes to remove approximately half of the contaminants from wastewater.

- Bar screens: To begin the water recycling process, incoming raw sewage is routed through mechanical bar screens, removing large solids such as sticks, rags, and plastic material from the wastewater stream. A horizontal rake on a toothed gear drive rakes the bars and removes the captured material to a conveyor that deposits the material into a dumpster for removal to the sanitary landfill.
- Grit chamber: As wastewater flow enters aerated grit chambers, the stream is saturated with fine air bubbles to encourage the settling of fine grit particles.

RECYCLING PROCESS

- Primary clarification: The wastewater continues to primary clarifiers, where the flow velocity is slowed to promote solids settling. Bio-solids removed at this point are digested, dewatered, and used for beneficial purposes like conditioning soil or composting.

➢ **Secondary Treatment or "Bug Farming"**

Secondary treatment uses biological processes to remove most of the remaining contaminants. Many operators of WRC's consider themselves "bug farmers" since they are in the business of growing and harvesting a healthy population of microorganisms.

- Aeration Basins: Water flows into aeration basins where oxygen is mixed with the water. Bacterial microorganisms consume the organic material as food. They convert non-settleable solids to settleable solids and are later themselves captured in final clarifiers, ending up in wastewater biosolids.

RECYCLING PROCESS

- Final Clarifiers: Most of the solids that settle out in final clarifiers are thickened and digested, but some are returned to the aeration tank to reseed incoming water with hungry microorganisms.

➢ **Advanced Treatment and Disinfection**

After the bugs do their work, water is filtered through sand before undergoing chemical disinfection in chlorine contact chambers, used to kill any remaining microorganisms. It is not desirable to have residual chlorine in the rivers and lakes, so chlorine is then removed using sulfur dioxide. This protects the aquatic life in the receiving stream.

- **Sand Filters:** When the flow leaves the final clarifiers it enters into effluent sand filters, any remaining particulate matter is filtered out. Sand filtering is the most common type of gravity filtration system. An advantage of the gravity filter is that part of its operation can be easily observed visually. Sand filters are generally placed between the final clarifier and disinfection.

RECYCLING PROCESS

- Disinfection and Dechlorination: After 20 minutes of chlorination to ensure the destruction of any pathogenic organisms, it's then dechlorinated with sulfur dioxide to safeguard the receiving stream.
- Outfall: The water, now fully treated and recycled, is ready for release to the environment. The point where recycled water is discharged to a stream or body of water is called the outfall.

➢ **Solids Processing**

The by-product of treated residues generated during the water recycling process are called bio-solids. As a natural organic fertilizer and soil conditioner, bio-solids provide a full complement of the essential nutrients and micronutrients necessary for healthy plant growth and can be used in agriculture (direct land application) or they can be made into compost for application on lawns, gardens, and trees.

RECYCLING PROCESS

- Thickener: Air is forced into water in a pressure chamber where the air becomes dissolved in the liquid. The mixture is then released into the sludge where the tiny air bubbles rise and carry the solids with them to the surface.
- Anaerobic Digester: Settled sludge in the primary clarifiers is pumped to anaerobic digesters for stabilization. The tank is usually completely sealed to keep air from getting inside. Anaerobic bacteria thrive in an environment without dissolved oxygen by using the oxygen which is chemically combined with their food supply.
- De-watering: Digested sludge is de-watered by either squeezing the water out of the sludge using mechanical means like a belt-filter press, or letting mother nature do the job by pouring the sludge onto drying beds.

USES

- Wastewater recycling helps you get the most from limited water supplies. It's a low-cost, environmentally friendly way to create fresh water for industry and agriculture.

- Waste Water & Process Technologies is on the forefront with a wide range of recycling solutions .This also offers a wide range of treatment technologies for reclaiming industrial waste water.

- Reduced stress on drinking water supplies Flexibility to suit specific applications Affordable cost Low environmental impact.

ADVANTAGES

- Could stop lots of pollutants to enter the natural process
- Could help nature to be cleaner and not plagued by weeds
- Could remove Chemicals that could have been harmful for environment
- Stops waste water seepage into natural water sources.

DISADVANTAGES

- Smell
- Cuts into natural process where every other person's crap is some organism's food.
- Chemicals used could be harmful in long run.
- Requires large area of land that could be permanently damaged.
- Air born pollution and germs.

CONCLUSION

As we know that there is scarcity of water in some of the states in India during the summer season. In some places the situation is very critical to handle if the rain is not sufficient. The reason behind this problem is wasting of clean water, not utilizing it properly and carefully. Other way is to conserve it by harvesting the rain water and keeping it in storage tank for the later use. This method will certainly reduce this problem to a great extent.

The other method is also very much helpful in conserving of water i.e. recycling of water. We usually throw waste water or if it is in open sun light it simply dries out. But by using some of the techniques we can purify the dirty water and can use for farming, cleaning and for other purposes.

BIBLIOGRAPHY

- Harvesting Rainwater for Landscape Use by Patricia H. Waterfall

San Diego County Low Impact Development Handbook - Stormwater Management Strategies (December 31, 2007) (PDF: 3.4Mb)

- Development. Washington D.C: McGraw – Hill, 1997. ISBN: 007 Corbill, Robert A.
- Standard Handbook of Environmental Engineering

, New York: McGraw – Hill, 1997.

- Discover Magazine , January 2003.Gerstein, Mark and Michael Levitt, Michael. "Simulating Water and The Molecules of Life".
- Scientific America . November 1998. 101 – 105.Gleick, Peter H. "Making Every Drop Count".
- Scientific America . Feb. 2001. 40 – 45.Glenn, Edward P., Brown, Jed, and O'Leary, James W. "Irrigating Crops With Seawater"
- Water Follies : Groundwater Pumping and The Fate of America's Fresh Waters, Washington, Island Press, 2002. 1-55963-400-6Grigg, Neil S.