

# (Introduction to Environmental Studies)

## B. Tech 3<sup>rd</sup> Semester

4<sup>th</sup> and 6<sup>th</sup> Semester



## Sustainable Development

# Rain Water Harvesting and Watershed Management

### Unit 6

#### Social Issues and the Environment

Depart: Chemistry  
Subject: Environmental Studies (CHM 2041)

## Topics to be covered :

- Sustainable Development
- Urban problems related to energy
- Rain Water Harvesting
- Watershed Management

## Sustainable development:

"**Sustainable development** is the development that **meets the needs** of the present **without compromising the ability of future generations** to meet their own needs."

The **Sustainable Development** objectives cover different aspects

- i) Social development,
- ii) Environmental protection
- iii) Economic growth,
  - The eradication of poverty and hunger so as to ensure a healthy life.

Sustainable development encourages us to

- i) To conserve and enhance our resource base,
- ii) Adopt clean and energy efficient technology.
- iii) To meet their basic needs of employment, food, energy, water and sanitation

Therefore, sustainability is made up of three pillars:  
1) Economy, 2) Society,  
3) Environment.



### Examples:

1. Using **recycled materials** or renewable resources when building is an example of sustainable development.
2. Building a new community in a previously undeveloped area without destroying the ecosystem or harming the environment is an example of sustainable development.

## The 17 sustainable development goals (SDGs) to transform our world:

- ❖ **No Poverty**
- ❖ **Zero Hunger**
- ❖ **Good Health and Well Being**
- ❖ **Quality Education**
- ❖ **Gender Equality**
- ❖ **Clean Water and Sanitation**
- ❖ **Affordable and Clean Energy**
- ❖ **Decent Work and Economic Growth**
- ❖ **Industry, Innovation and Infrastructure**
- ❖ **Reduced Inequality**
- ❖ **Sustainable Cities and Communities**
- ❖ **Responsible Consumption and Production**
- ❖ **Climate Action**
- ❖ **Life Below Water**
- ❖ **Life on Land**
- ❖ **Peace and Justice Strong Institutions**
- ❖ **Partnerships to achieve the Goal**

## Key aspects of Sustainable development:

- **Inter-generational equality**
  - ❖ Stop overuse
  - ❖ Reduce Impacts
  - ❖ Maintain ecological balance
  - ❖ Hard over a safe, healthy and resourceful environment to our future generation
  - ❖ Minimize gap between and within nations
  - ❖ Support economic growth of poorer countries
  - ❖ Provide technological help

## Measures for Sustainable development

- Using appropriate technology: concept of “Design with nature”
- **3-R approach: RECYCLE, REUSE AND RECOVERY**
- Promoting environmental awareness and education

## Urban problems related to energy:

Urban centers use enormous quantities of energy. This is because urban people have a higher standard of life and their lifestyle demands more energy inputs in every sphere of life.

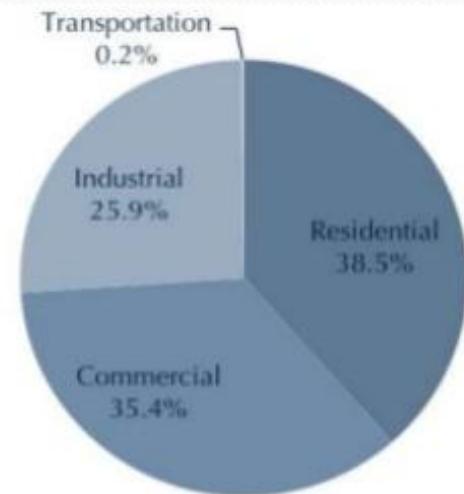
Energy use is closely related to development in industry, transport, communication, commercial, household and agricultural activities.

In the past, urban housing required relatively smaller amounts of energy than we use at present. Traditional housing in India required very little temperature adjustments as the material used, such as wood and bricks, handled temperature changes better than the current concrete, glass and steel of ultra-modern building. Cities are the main centers of economic growth, trade, education, innovations and employment.

The energy requirement of urban population is much higher than that of rural ones.

## Energy Demanding Activities:

- In developed countries (besides India) the amount of energy used is much higher compared to developing countries.
- Industrialized developed countries use energy for these purposes:
  1. residential and commercial
  2. industrial
  3. transportation
- In less-developed countries (for example India) most of the energy is used by individuals (electrical gadgets, houses, offices, business and establishment etc.)



## **Industrial Energy Consumption**

- i) Manufacturing accounts for 85% of industrial use**
- ii) Processing food and materials.**
- iii) Refining oil and gas**
- iv) Heat treating metal**
- v) Assembling cars**
- vi) Manufacturing activities like:**
  - Construction**
  - Agriculture**
  - Mining**
  - Water and waste water treatment etc.**
- Vii) Prevention and control of pollution**

## Some facts about water

- Only 3% of world water is fresh water and most of them are in the form of polar ice
- A recent report by Credit Suisse (Switzerland) stated that by
- 2025 18 countries will face serious water scarcity
- Every square mile of the developed land causes 16 million gallons of rain water directly enter in to river finally ocean
- Each person uses about 150 liters of water every day. About 60 liters of this is toilet flushing

# Rainwater harvesting

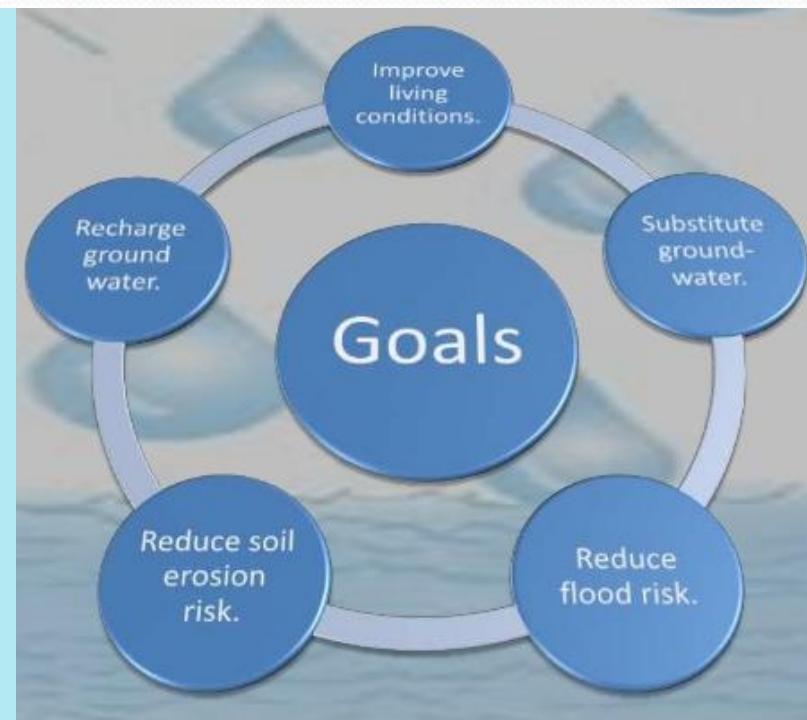
**Rainwater harvesting :process of collecting, conveying & storing water from rainfall in an area for beneficial use.**

**Storage – in tanks, reservoirs, underground**

Harvesting rainwater has several functions:

## Objective

- Providing water to people and livestock
- Providing water for food and cash crops
- Increasing groundwater recharge
- Reducing storm water discharges, urban floods and overloading of sewage treatment plants
- Reducing seawater ingress in coastal areas

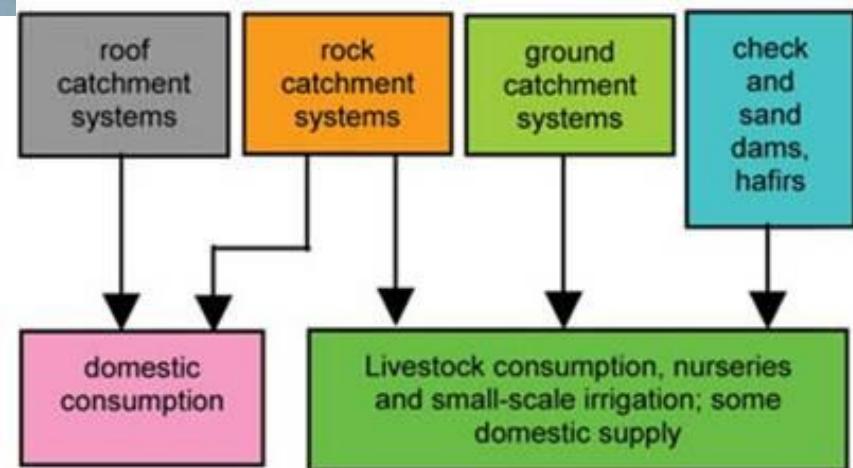
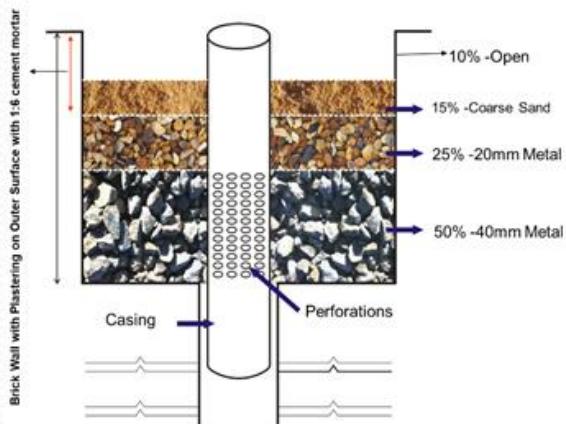


# Rain water harvesting

Rainwater harvesting can be undertaken through a variety of ways:

## Types

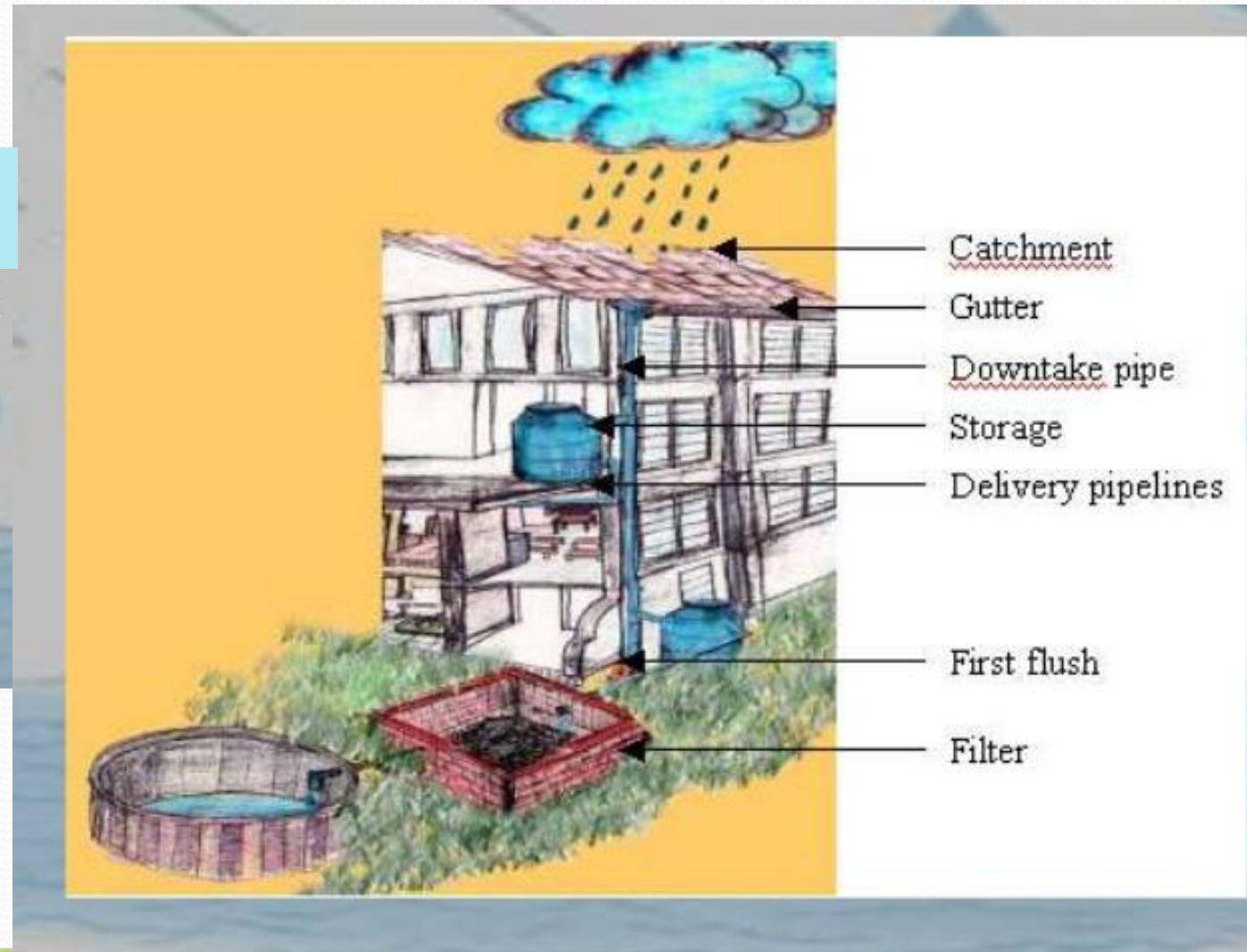
- Directly from roof tops and stored in tanks.
- Monsoon run off and water in swollen streams during the monsoon and storing it in underground tanks.
- Water from flooded rivers can be stored in small ponds.
- Collection and transfer of rainwater into percolation tanks so as to facilitate discharge into ground.
- capturing run-off from local catchments
- capturing seasonal floodwater from local streams
- conserving water through watershed management



# Urban model of RWH

The components of urban models are:

- a) Roof catchment
- b) Gutters
- c) Down pipe
- d) First flush pipe
- e) Filter unit
- f) Storage tank
- g) Collection pit.



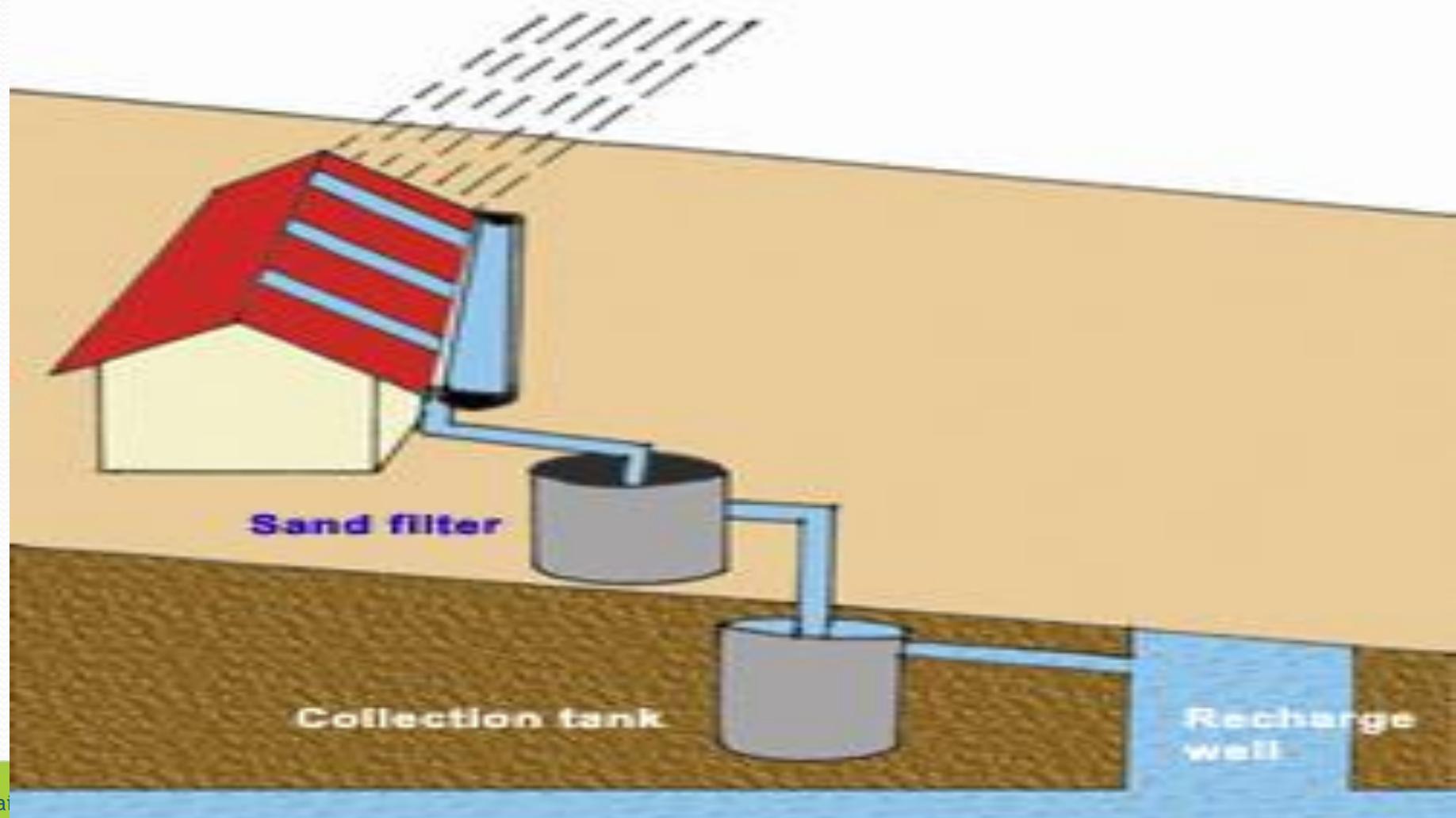
## 2. Roof catchment systems



Rooftop rainwater harvesting at school in Misore, India

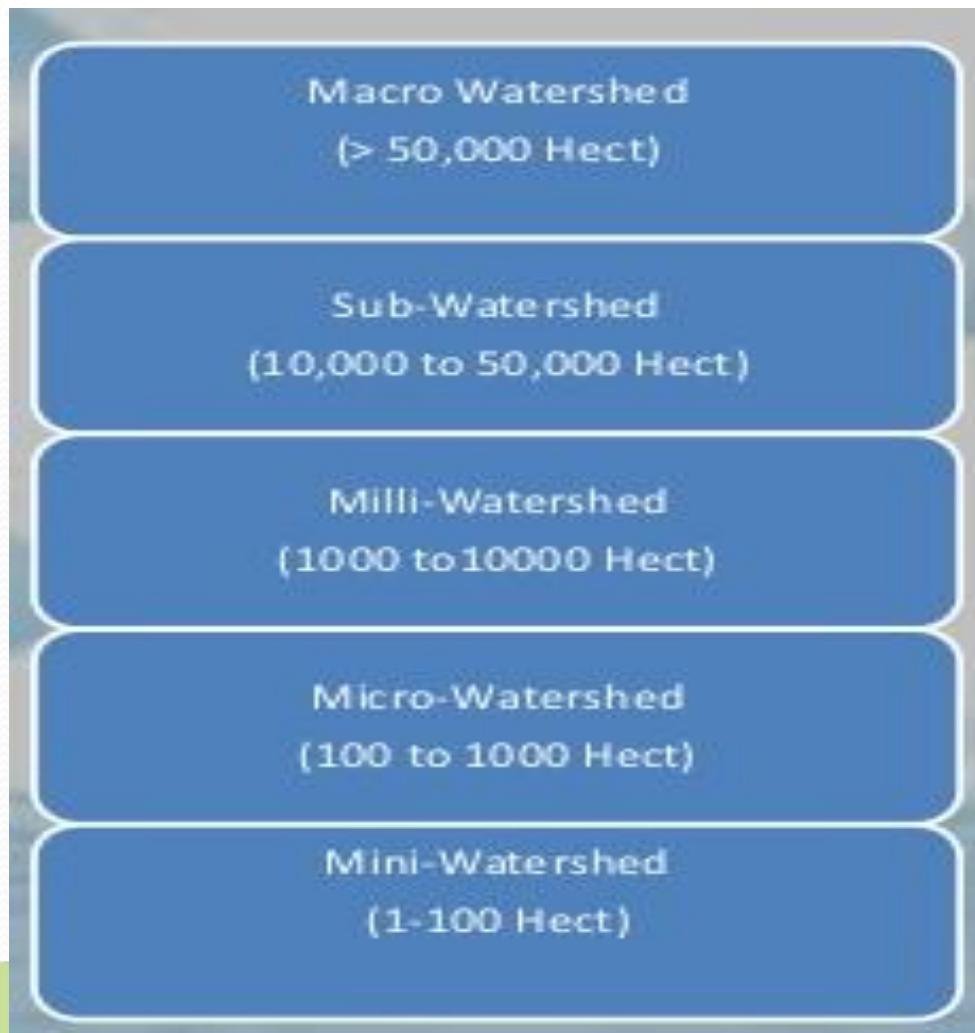
Source: M. Wafler

# Rainwater harvesting through recharge well



# WHAT IS WATERSHED

An area or ridge of land that separates water flowing to different rivers, basins, or seas is called watershed.



## Classification of watersheds

# Objective of watershed management

- To manage and utilize the runoff water for useful purpose.
- To check soil erosion and to reduce the effect of sediment yield on the watershed.
- To rehabilitate the deteriorating lands.
- To moderate the floods peaks at downstream areas.
- To increase infiltration of rainwater.
- To improve and increase the production of timbers, fodder and wild life resource.
- To enhance the ground water recharge, wherever applicable.

# Watershed management

## 1. Contour trenches



**Contour trenches** trap rain water, enable it to percolate to underground aquifers and break the speed of fast moving water

Source: WOTR n.y.

# Watershed management

## 1. Contour trenches



**Stone bunds** across the slope to arrest the flow of water and control erosion in areas where soil work is not possible

## Watershed management

### 2. Gully Control



- Gully control - Gully plugs help to control the flow of water, sedimentation and recharge ground water aquifers.

### 3. Afforestation & field bunds



Green carpeting



Afforestation and pasture development on barren wastelands (top) and field bunds (bottom)

# Artificial Recharge Techniques

## □ Direct surface techniques

- Flooding
- Basins or percolation tanks
- Stream augmentation
- Ditch and furrow system
- Over irrigation



## □ Direct sub surface techniques

- Injection wells or recharge wells
- Recharge pits and shafts
- Dug well recharge
- Bore hole flooding
- Natural openings, cavity fillings.

## □ Combination surface – sub-surface techniques

- Basin or percolation tanks with pit shaft or wells.

## □ Indirect Techniques

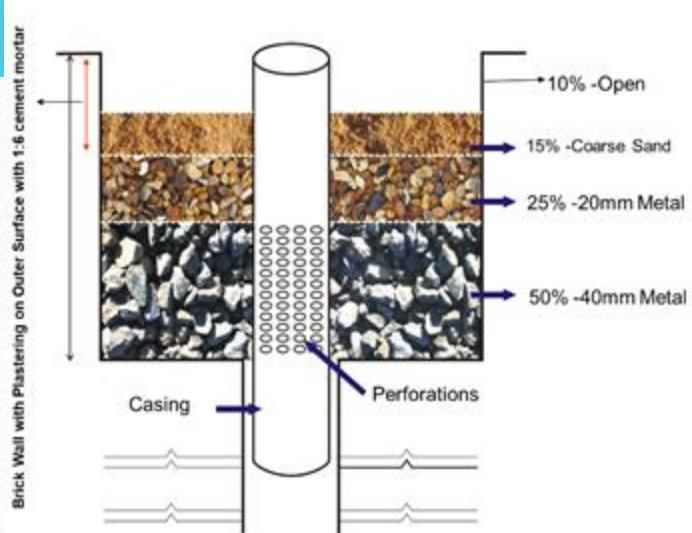
- Induced recharge from surface water source.
- Aquifer modification.



<http://periotech.in/aquaculture/>

## Stream augmentation

- ▶ Seepage from natural stream or river is artificially increased by putting some series of check dams across the river or stream.
- ▶ The placing of check dams spread the water in a larger area which eventually increases groundwater recharge.
- ▶ The sites for the check dams should be selected in such a way that sufficient thickness of permeable bed or weathered bed is



# Rainwater Harvesting - Advantages

- Provides self-sufficiency to water supply
- Reduces the cost for pumping of groundwater
- Provides high quality water, soft and low in minerals
- Improves the quality of ground water through dilution when recharged to groundwater
- Reduces soil erosion in urban areas
- Rainwater harvesting systems are simple which can be adopted by individuals
- Rooftop rain water harvesting systems are easy to construct, operate and maintain. Less expensive

# How much water can be harvested?

## Urban scenario

Water harvesting potential = Rainfall (mm) x Collection efficiency

- Area of plot = 100 sq. m. (120 square yards)
- Height of the rainfall = 0.6 m (600 mm or 24 inches)
- Volume of rainfall over the plot = Area of plot x height of rainfall  
( $100 \times 0.6 = 60 \text{ m}^3 = 60000 \text{ liter}$ )
- Assuming that only 60 per cent of the total rainfall is effectively harvested
- Volume of water harvested = 36,000 liters ( $60,000 \text{ liters} \times 60/100$ )

This volume is about twice the annual drinking water requirement of a 5-member family. The average daily drinking water requirement per person is 10 liters.

## Some Facts

- Tamil Nadu is the first & only state in India which has made roof top rainwater harvesting structure compulsory to all the houses across the state. There are legal provisions to punish the defaulters.
- At present, in Pune (in Maharashtra), rainwater harvesting is compulsory for any new society to be registered.



**THANK YOU**

