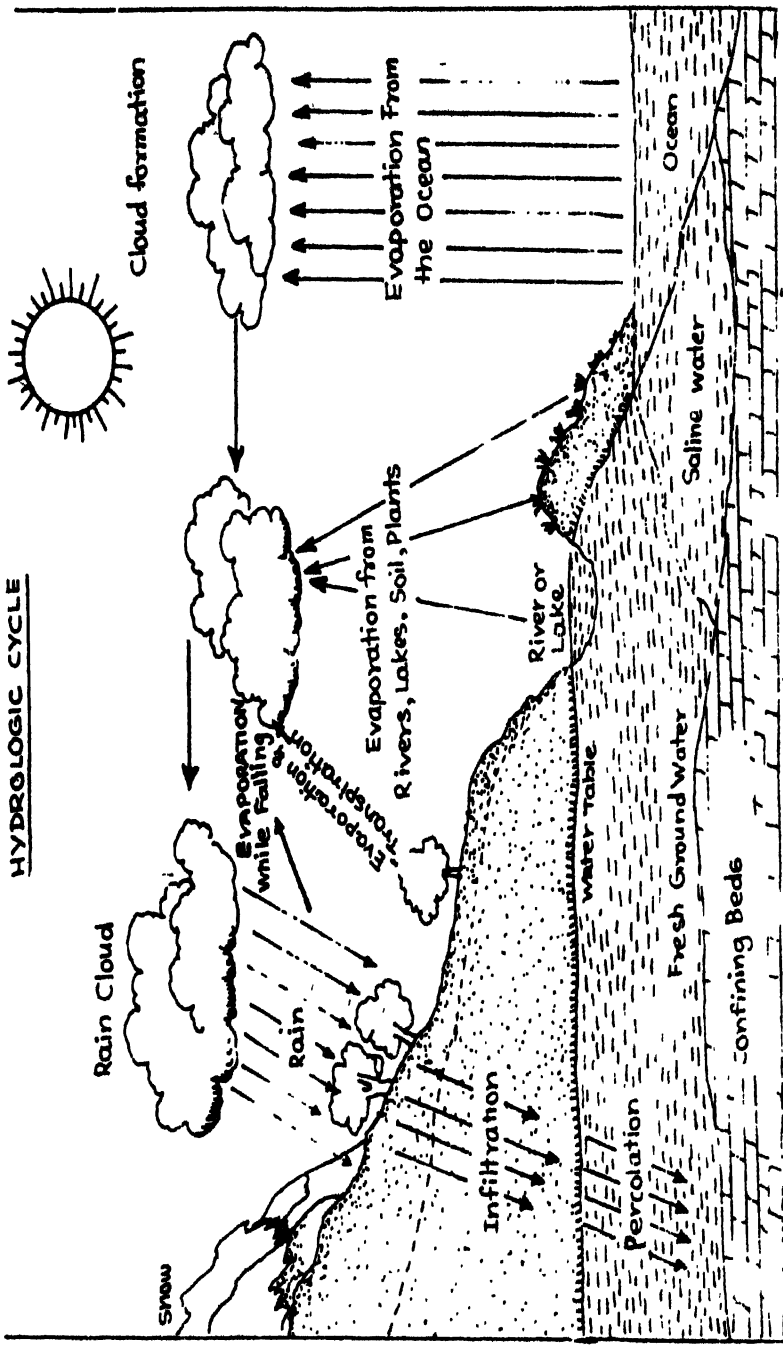


**OUR WATER**  
**OUR LIFE**

HYDROLOGIC CYCLE



# 1. WATER CYCLE

Water may be in the form of water vapour, ice or liquid. The heat of the sun evaporates water from oceans, seas, rivers and lakes. The heat also evaporates water from the land and from plants and animals. Heat converts liquid water into water vapour, water vapour rises and forms clouds in the air. When the clouds come near a mountain they are forced to rise, as the clouds rise they are cooled, this causes more and more water vapour to condense. This means they change from vapour to liquid. The tiny liquid drops of water in the clouds get bigger and bigger until they are heavy enough to fall to the earth as rain. If it is too cold, it falls as snow. Some rain water which falls on earth is again evaporated by sun's heat. Some of the rain sinks (infiltrates) into the soil. Some part of the rain water is used by thirsty plants, animals and human being. Plants give away water through leaves. Without water there can be no life on the earth.

Most of the remaining part of water runs off on the surface into the lakes, rivers, swamps, seas, oceans. The heat of the sun evaporates water from the oceans, seas, rivers, and lakes. This process continues all over again. This endless cycle is known as water cycle.

Water which infiltrates through soil layers is available to us in the form of dug well, borewell, and spring.

## **FRESH WATER IS TOO LESS**

About 97% water is in the form of sea water. It is salty. About 3% is fresh water. Of the 3 per cent more than 2 per cent is frozen in ice caps and glaciers, only 0.65 per cent is liquid. Even of the 0.65 per cent, almost all of it is in ground water (99 per cent), a tiny amount is surface water (1.3 per cent of fresh liquid water) and other minute amounts are in the atmosphere or contained in plants, animals and people. This is the distribution of earth's water resources. Therefore water is a precious thing.

## **2. WATER IS NOT ALWAYS SAFE**

As rain begins to fall from the clouds, it is pure and safe. However, as water falls through the air it dissolves some of the gases (oxygen, carbon dioxide etc.) in the air. It also collects dust and germs (microbes) that are floating in the air. When the rain reaches the ground, it begins to pick up more dust and dirt. Many kinds of elements and minerals substances (potash, calcium, iron, phosphates, nitrogen, fluorides, salts etc.) dissolve in water. Substances like sand, algae and mud etc. are not soluble in water. Certain substances like calcium compounds make the water hard. Excess of salts make the water salty. Excess of iron makes the water red. Gases like hydrogen sulphide give foul smell to water. Dissolved (gases, minerals) and undissolved/suspended substances (germs, algae, sand etc.) in water are known as impurities. The impure water is not safe for domestic and drinking purposes. Unsafe water can cause various diseases—acute diarrhoeal diseases—cholera, gastroenteritis, dysentery; worm infection, typhoid fever, viral hepatitis (jaundice), polio etc. Excess of fluorides in water can damage the bones.

Water becomes impure due to industrial wastes, domestic and biological wastes. We call it as polluted or contaminated water.

We must remove impure substances present in the water to make it safe and potable for domestic and drinking purposes. The methods of removing impurities is known as purification.

# SAFE WATER?

## What is Safe Water?

Safe water is one that cannot harm the consumer, even when taken for long period. Safe water can be used for domestic and drinking purposes.

## What is Drinking Water?

Water which is safe, wholesome and acceptable is called drinking water.

<i>Safe, potable and wholesome</i>	<i>Water should not have</i>
1 Pleasant to taste or tasteless	1 Unpleasant or bad taste
2 Colourless or crystal clear	2 Cloudy or turbid appearance
3 Odourless	3 Foul smelling
4 Free from harmful chemicals	4 Harmful chemicals
5 Free from harmful germs.	5 Harmful germs.

## FISH, AS AN INDICATOR OF SAFETY

If a fish can live in the water, the water may be free from harmful chemicals. Fish do not tolerate harmful chemicals. They may die in a day or few days depending upon the toxicity of the chemicals. Salt water fish also can be affected by toxic chemicals.



**How Pollution of Water  
takes place ?**

## **4.HOW WATER GETS CONTAMINATED**

- (1) Harmful bacteria from human intestine-night soil get mixed up with water.**
- (2) Urination by human beings and animals in water source.**
- (3) Bathing, washing and cleansing activities in the water source.**
- (4) Sewage is passed in the water source without treatment (without removing harmful substances from it.)**
- (5) Industrial waste—chemicals are passed directly into the water source without treatment i.e. without removing harmful elements from the waste.**
- (6) Nuclear waste—Waste from atomic thermal plants or other nuclear based industries may go directly into water source which causes nuclear pollution.**
- (7) Dead bodies (animal or human) thrown in the water.**
- (8) Dead plants enter in water.**
- (9) The water gets polluted due to soil. In the absence of green cover over the soil, the rain disintegrates the soil structure. The soil gets mixed with water. The water gets more and more turbid. We call it "Muddy water". It is common experience to get muddy water in rainy season. The problem is ever increasing because more and more green cover of the soil is being lost and more and more soil erosion is taking place. In this process minerals which are useful get washed off.**
- (10) The ground water gets polluted due to chemicals, sew-**

age, bacteria and nuclear waste etc.

- (11) The rain water gets polluted due to gases which are thrown out in the air from chemical industries, thermal power stations and exhaust of vehicles. The harmful gases like sulphur dioxide, nitrogen oxide, carbon monoxide etc. get mixed with rain water, called as "acid rain". Acid rain damages the plants, forests, crops, soil and pollutes water which is unsafe for domestic and drinking purposes.
- (12) Mines-Minerals from mines pollute water.



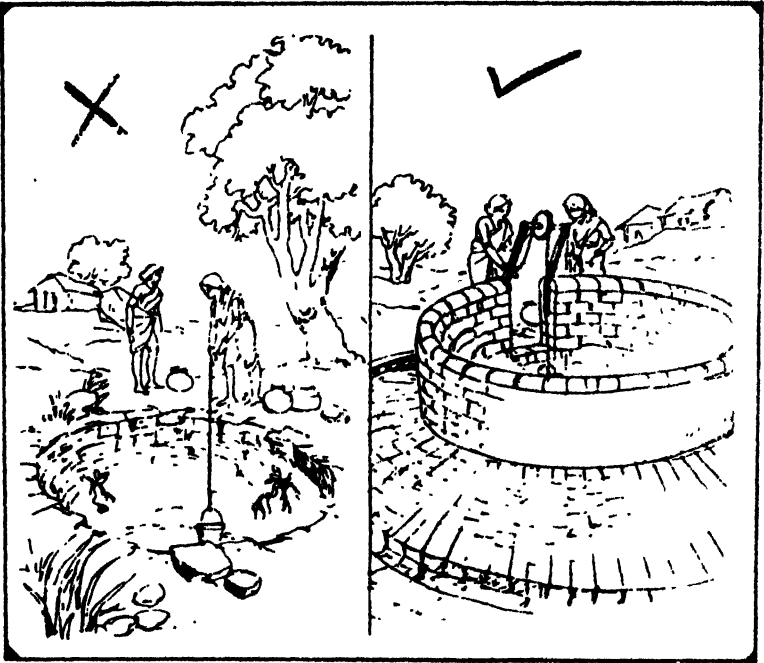
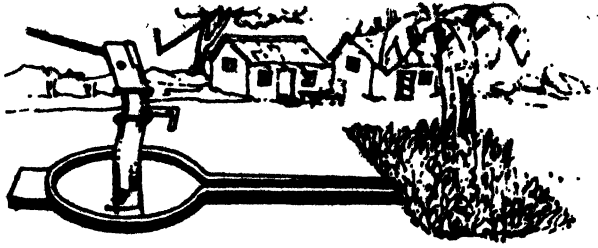
## 5. USES OF WATER

*We need water for various purposes—*

- 5.1 **Domestic Use:** Drinking, cooking, washing, bathing and sanitation.
- 5.2 **Public purposes:** Public latrines, hospitals, schools, fire extinguishing, construction of public buildings etc.
- 5.3 **Industrial Purposes:** All industries require large amounts of water for their production of goods.
- 5.4 **Agricultural :** Water is a must for agriculture, rainfed or irrigated. More water is necessary for hybrid or high yielding varieties of crops, fruits trees. Agrobased industries like dairy, require large amount of water. Cross breed animals give more milk and consume more water.
- 5.5 **Energy:** Water is necessary to produce energy-electricity.
- 5.6 Water for fun and pleasure.
- 5.7 Water is required for navigation.

### **Waste Water :**

All uses of water produce unsafe waste water. If such waste water mixes with water source water gets polluted.



**Are our water sources safe?**

## **6. ARE OUR WATER SOURCES SAFE?**

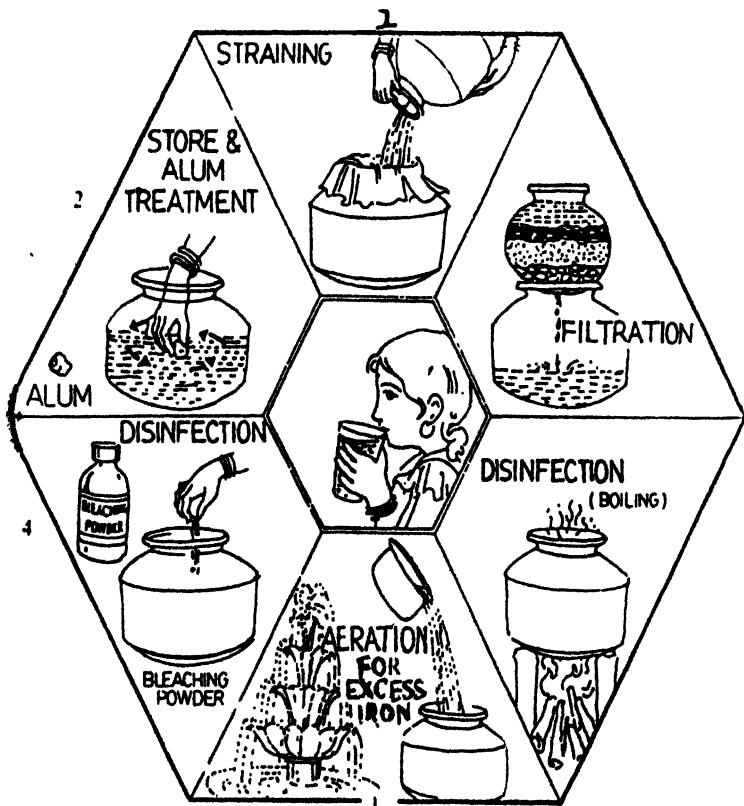
We get water from various sources like streams, rivers, canals, ponds, wells, handpumps etc. In urban areas water is supplied through pipe water scheme. Water from all these sources get polluted due to human activities.

In summer when there is a scarcity of water, it is supplied by water tanks, many times it is not a safe water.

- 6.1 Most of the times dug wells are not properly constructed, sanitation is not properly maintained. This leads to incoming of waste water in the well and therefore the water become unsafe.
- 6.2 People have bad habits—defecation and urination in the open-around or near a water source—canal, rivers pond. This also pollutes the water sources.
- 6.3 The handpumps are not properly constructed, not maintained properly, environmental sanitation is not observed. This makes handpump water unsafe.
- 6.4 Most of the times pipe water schemes in our country are not well designed (pipe water supply do not have filtration unit, usually there is no chlorination). The pipes have faulty connections, leakage takes place. Waste water from outside enters in the pipe. This makes water unsafe.
- 6.5 Spring water also gets contaminated if they are not protected properly.

In conclusion we can say—our water sources are not safe, and are unhygienic. Therefore, we get unsafe water.

We must keep our water sources clean. We must maintain environmental sanitation. We do not do this and therefore we suffer from illness.



# Water Purification

## **7. SAFE DRINKING WATER**

### **How to get Safe Drinking Water?**

Purification of water and environmental sanitation will give us safe water.

#### **7.1 How to purify our water?**

*We have to observe following important stages—*

- 7.1.1 Straining
- 7.1.2 Storage/Sedimentation
- 7.1.3 Filtration
- 7.1.4 Disinfection
- 7.1.5 Maintenance.

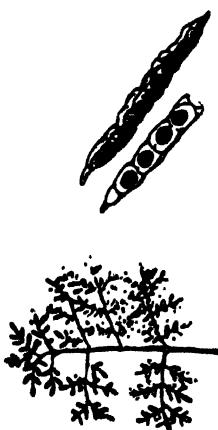
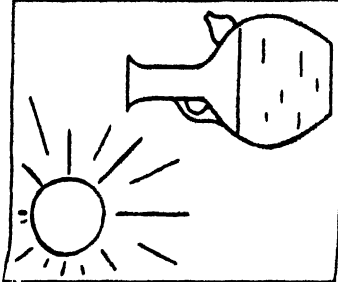
#### **7.1.1 STRAINING**

Strain the water through a piece of cloth. This will remove some visible impurities like leaves or some bigger particles etc.

#### **7.1.2 STORAGE**

Suspended impurities in the water get settled by storage. If muddy water is kept undisturbed for 24 hrs. soil particles settle down. Sometimes fine dust particles do not settle down only by storage, for this alum treatment is necessary. Take a piece of alum and agitate in water through a circuitous path for several times. This will settle down fine particles within few hours, water becomes much more clearer than before.

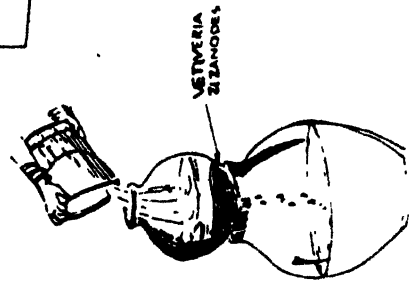
# Ancient & Modern Disinfection



**DRUMSTICKS**



**KATHAKA SEEDS**



**VETIVERIA ZIZANOIDES**

**Lotus like water-purifying aquatic plants**



**kolattamara-malyalam**

### **7.1.3 FILTRATION**

Filtration means passing the water through layers of fine sand. Due to filtration very fine impurities get removed from the water. This is a very important process. This process can eliminate bacteria and viruses also.

#### **7.1.3.1 How to make water filter at home**

Every home can do this. A group of houses/communities can also work out jointly.

##### **Practical—1**

Take a pitcher of about 40 to 50 litre capacity. (The height of which is about 40 to 50 cms). Pitcher can be a aluminium, steel, copper or earthen pot. Pitcher is filled with large gravel (Sand particles of Peanut size) upto 7 to 10 cms height.

On the top of the gravel put fine sand to make a column of 15-20 cms. Above that make a gravel layer of 3 to 5 cms. Now, fill the remaining space with water (about 15 cms). A tap will be necessary which should be at the height about 5 cms from bottom. We get a very clean, crystal clear water.

##### **Practical—2**

This may be useful for group of houses or community.

Take a barrel of earthen pitcher of about 200 litre capacity and having 1 metre height. Adjust a cock at a 10 cms height from bottom.

Place the gravel at bottom of pitcher to prepare a layer of 15 cms. Fill the column with clean sand to form a layer of 30 cms and again place gravel on it to form 15 cms top layer.

Fill the remaining space (40 cms) with water. Water will

pass through layers of sand. We get crystal clear water.

### **Practical—3 Two Stage Filter**

Two pitchers are used in this process. An alternate filter medium. i.e. coconut husk is used in one pot and burnt rice husk in the second. Water is passed through both the pitchers and collected in lower vessel. (Instead of coconut husk and burnt rice husk one can use the gravel in first pitcher and fine sand in second pitcher in a two stage filter.)

### **Ceramic Filters**

These commercially manufactured filters are useful for purification of water. The filter consists of a "Candle" made of porcelain. Water filters through candle. The candle often gets clogged with dirt, dust and bacteria and needs to be scrubbed with a hard brush under running water. The candle must be boiled for 30 minutes once in a month to disinfect the candle.

### **Limitations of Home Filters**

By and large all filters described above will give a good quality crystal clear water. Many times water may be bacteria free, but it may not be virus free. If filters are not properly maintained water may not be pure.

One should do disinfection after filtration.

### **7.1.4 Disinfection of Water**

Disinfection is a process by which the micro-organisms in the water are killed. Before disinfection water should be stored, and filtered. It means water should be crystal clear for disinfection. If water is not clear or is muddy disinfection will not take place properly and adequately.



## **TWO PROCEDURES OF DISINFECTION**

### **7.1.4.1 Boiling of Water**

If water is boiled for 20 to 25 minutes all micro-organisms in the water are killed and water becomes disinfected. But such water after boiling should be well stored. If dirty fingers or dirty utensil is dipped in such disinfected water, it will again get contaminated with harmful micro-organisms.

Water should be well stored and long handled single utensil should be used to draw water.

### **7.1.4.2 Disinfection by Chlorination**

Bleaching powder is used as a chlorinating agent. Almost all micro-organisms are killed by bleaching powder. For one litre of water we require 5 mg. of good quality bleaching powder. For a common household pitcher (of about 15 litre) we require 75 mg. bleaching powder (a pinch of two fingers).

Good quality bleaching powder can be identified by its irritating smell. Bleaching Powder should be well stored in cool, dry place and away from sunlight to maintain its chlorine content. In market 100 gm. of packet of bleaching powder costs about Rs 3/- only. This means, per day cost is 5 paise only.

Bleaching powder will act within half an hour and after this one can use the water for drinking purposes.

### **Bleaching Powder Solution**

Bleaching powder solution can be prepared and kept for ready use of community or group of houses. How to make bleaching powder solution at home? 10% mother solution of bleaching powder.

Take 10 gms of good quality bleaching powder. Add 100 ml of clear water. Shake well. Allow excess powder to

settle down. Take upper clear solution in other bottle. This is 10% mother solution. For 10 litres of water add 3 to 4 drops of mother solution. Wait for half an hour, the water is germ free and ready to use for drinking.

## **7.2 Traditional methods of water purification**

### **7.2.1 Seeds as a purifying agent**

- I. Kataka Seeds (*Strychnos potatorum*) can be used as effective coagulant. Make a thick paste of crushed seeds and take extract of same. 1.5 mg extract will be required for one litre of water. Then the water is treated with alum (10 to 15 mg per litre) keep it for 2 hours. Muddy water becomes clear water.
- II. Drum stick (*Moringa olifera*) Seeds are also useful. After the coat and wings of the seeds are removed, the white kernel is crushed in a mortar and powder mixed with a small amount of already purified water in a glass and stirred fast with a spoon for about five minutes. The suspension is then poured through a tea strainer into the turbid water and slowly stirred by a wooden twirling stick for ten minutes (the dose for jar of 40 Litres—30 seeds.) After keeping some time, impurities will settle down to give clear water.
- III. In southern Kerala, wiry roots of rhizome from the "Vamachham" (Malayalam) (*Vetiveris zizancides*) are laid in a clay jar which has a few tiny holes in its bottom. Water filtered through this layer of roots is not only clearer but also has a pleasant smell.
- IV. Coagulation with mucilagenous material and thick paste in central India *strychnos potatorum* seeds or seeds of *semacarnus anacardium* (Hindi Bhela) are rubbed on a stone and made into a thick paste which is immersed in turbid water to give clear water after sometime.

#### **V. Coagulant dusted on water surface**

Dusting is mainly carried out with plant ashes, soil from termite hills, paddy husks or crushed seed coats from elaichi (Hindi), Elettaria Cardamum (southern India) Stirring improves the clarity of water.

- VI. Introduction of higher aquatic plants. In north Kerala lotus like aquatic plants called "Kolattamara" in malayalam (Nelumbium) are introduced into ponds and wells polluted with animal wastes. Water drawn from such a sources is considered to be clearer than before and to have lost its bad smell and taste. Similar practice is found in Tamilnadu.

#### **Limitations of water purifying seeds**

One can use water purifying seeds to purify water at home. But the question of disinfection will remain. Do chlorination before using it for drinking.

#### **7.2.2 Keep the Water in Sunlight**

Take water in a plastic or glass jar and keep in sunlight from 11 a.m. to 5 p.m. almost all micro-organisms in water will die due to ultra-violet rays from sunlight. We get safe water.

#### **7.2.3 To Store Water in a Copper Vessel**

In old days copper vessels were used to store water. If we store in a copper vessel for 72 hours, almost all bacteria in the water die and we get safe drinking water. One can use three copper vessels to get safe water every day.

**LET US RESOLVE TODAY—  
WE WILL PURIFY OUR WATER BEFORE WE DRINK**

## **7.3 Purification methods for certain chemicals such as fluorides, Iron and Salts**

### **7.3.1 Removal of excess of fluorides in drinking water**

The optimum level of fluorides in drinking water is 1mg/litre. Excess of fluorides in water can damage teeth and bones. Problems of excess fluorides is in many states like Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Orissa, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and Delhi. Teeth damage is seen in children and bone deformity in adults.

One can test the water sample to find out the percentage of fluorides in water. If it is excess than 1 mg/litre, one should do defluoridation (removal of excess fluorides in water).

**How to remove fluorides at home:**

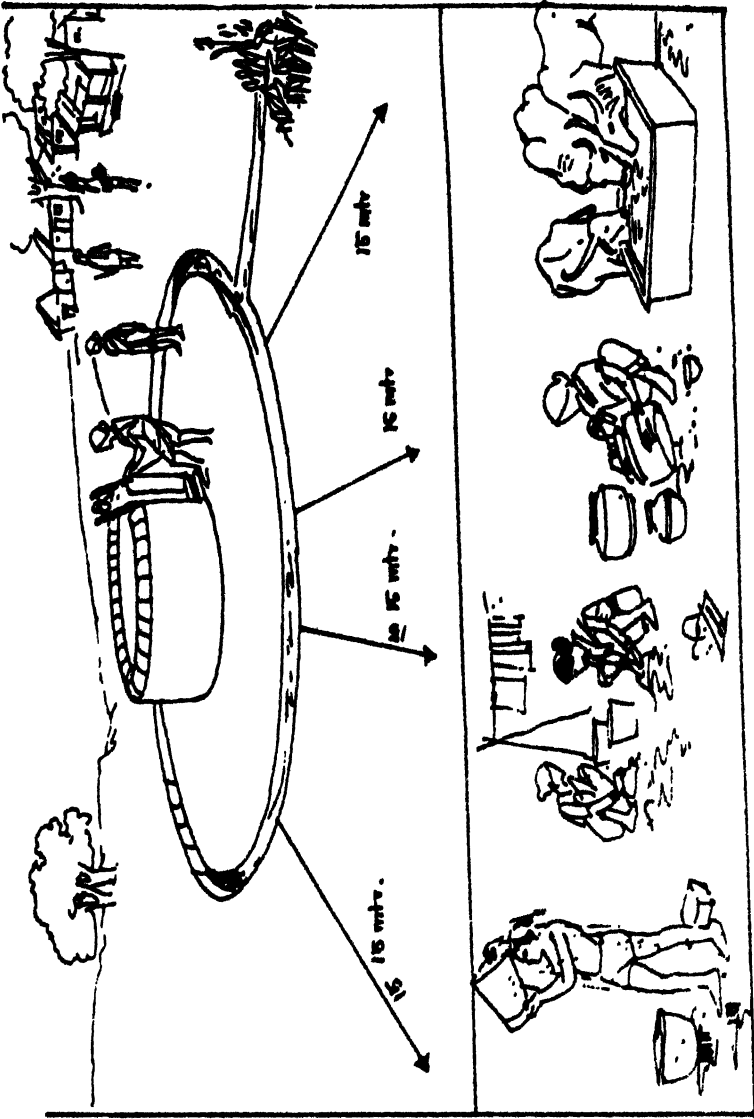
**Practical :** Take one litre of water. Add 30 mg. lime powder. Mix it well. Then add 500 mg. Alum powder and mix it well. Stir the water for about 15 minutes. Keep the water undisturbed for atleast four hours. The excess fluorides settle down at the bottom. Then the upper water is taken in another vessel which is free from fluorides.

**7.3.2 Removal of excess iron from drinking water :** Excess iron in water causes discolouration, water is reddish or brown in appearance, turbid, it has a metallic or bitter taste. Excess iron may affect our blood. Excess iron in water spoils clothes. Iron above 1mg/litre causes bad odour, taste etc.

**How to remove excess iron :** Water is subjected to aeration (aeration is a process by which water is exposed to air). It helps to remove iron as well as bad odour. If the water is a surface water, iron can be removed by storing only—suspended iron particles settle down. Upper water is free from iron. If the water is from a dug well or hand pump, the iron

is in a dissolved form. Then we have to do aeration, this makes iron particles to change into suspended form and then water can be stored, upper water is taken which is free from iron. Aeration is done by passing the water through cascades or making a fountain. The problem of excess iron is in Assam, Meghalaya, Tripura, West Bengal, Orissa, Bihar, Uttar Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, and Kerala.

**7.3.3 Removal of excess of salt: (Brackishness) :** When salts are in excess, the water has a bad salty taste. Brackish water is found in Punjab, Uttar Pradesh, Rajasthan, Gujarat, Andhra Pradesh, Maharashtra, Orissa, Tamil Nadu, West Bengal, A & N Islands, Lakshadweep. Brackish water or salinity problem exists in coastal regions. In these regions soil contents have more sodium. Increase pollution—due to chemical fertilizers, pesticides, sea water intrusion in coastal areas leads to more brackishness. Water can be made potable or drinkable by distillation—evaporation and condensation method. Solar units at domestic level can also be used.



**Environmental Sanitation of Water Source**

## 8. ENVIRONMENTAL SANITATION

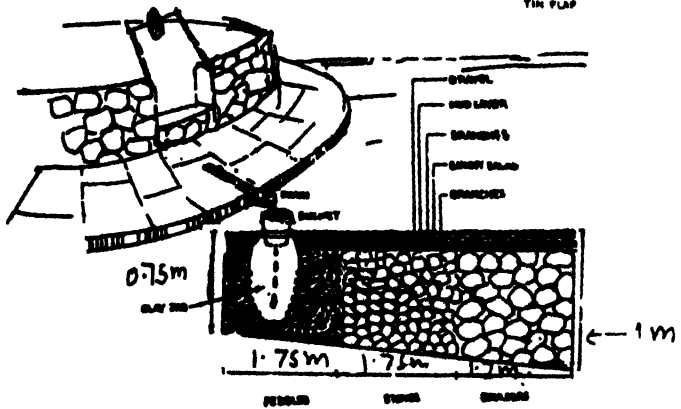
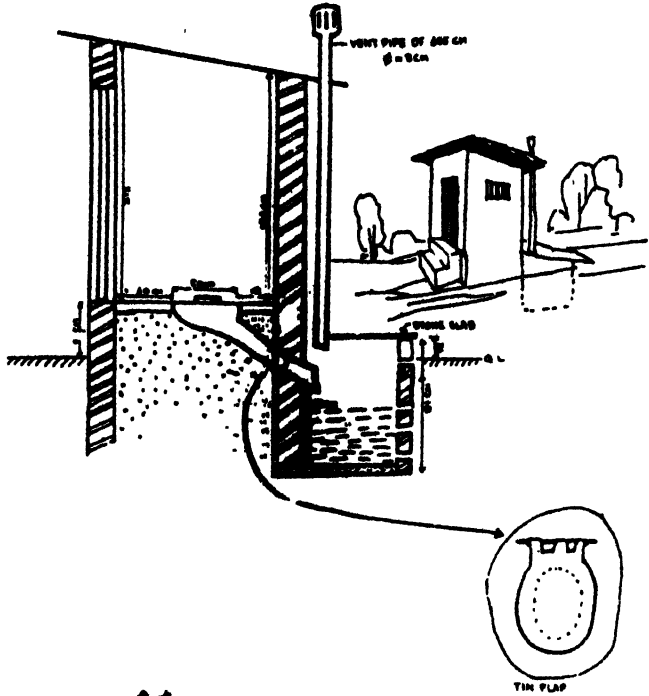
Environmental sanitation will maintain the water quality. "Sanitation is a way of life." It is expressed in terms of clean surroundings, clean home, clean farm, clean business, clean neighbourhood and the clean community. We have to take care of our food also. Food should not be allowed to get contaminated by our bad habits, flies etc.

*Environmental sanitation includes following points:*

- 8.1 Personal, family and community hygiene.
- 8.2 Environmental sanitation of water sources.
  - 8.1.1 Personal hygiene—deals with our body-dental care, washing hands with soap or ash, use of latrines, clean clothes etc.
  - 8.1.2 Family hygiene includes clean home, clean surrounding. Food is not allowed to get contaminated by flies, food is always covered with lid, etc.
  - 8.1.3 Community hygiene:
    - \* Use of Garbage pit and soakpit.
    - \* Prevention of flies and mosquitoes.
    - \* To avoid open urination and open defaecation.
    - \* To maintain public taps properly etc.

**Methods of Environmental Sanitation** —Latrines, Urinals, Biogas, Smokeless chullah, Kitchen garden, etc. Organise the waste in such a way that it does not contaminate

**SOPA TOILET**



**SQAQ PIT**

**Environmental Sanitation**



water sources. Biodegradable waste—human, animal and plants is converted into manure, fertilizer. Other waste like plastics, iron, glass, chemicals etc. is disposed by separate collection and dumping them at proper planned places.

## **8.2 Environmental Sanitation of Water Sources**

### **8.2.1 River**

All the rivers are highly polluted. To prevent the pollution, we should not allow the waste to enter in the water unless it is made safe. The industrial effluent water should also be made safe before it enters into river. People should not defecate near the river. People should not throw dead bodies in the river.

### **8.2.2 Tanks, Ponds, Lakes, Canals**

Animals and human beings should not be permitted to enter into these sources.

### **8.2.3 How to keep surface water sources (River, Lake, Ponds, Tanks and Canals) safe?**

- \* Biological water food chain should be established for natural purification.
- \* In the catchment area there should be no pollution of chemicals, pesticides etc.
- \* There should be adequate grass, bush, tree cover over the soil (in the absence of green cover, silting takes place).
- \* Harmful human and animal activity should be prevented.
- \* To protect water sources people's awareness, education and involvement is necessary.

### **8.2.4 Well**

There are two types of wells, shallow and deep. Shallow well is one which taps the water from above the first impervious layer in the ground. The shallow has nothing to do with the depth of the well. A deep well is one which penetrates the first impervious layer in the ground and taps the water lying beneath the second impervious layer, most of the wells are shallow and therefore they are health hazards to the community. (The pollution from neighbouring sources of contamination such as latrines, urinals, drains, manures, can take place.)

#### **What is an Ideal Sanitary Well?**

Sanitary well which is correctly located, well constructed and protected against contamination with a view to yield safe water.

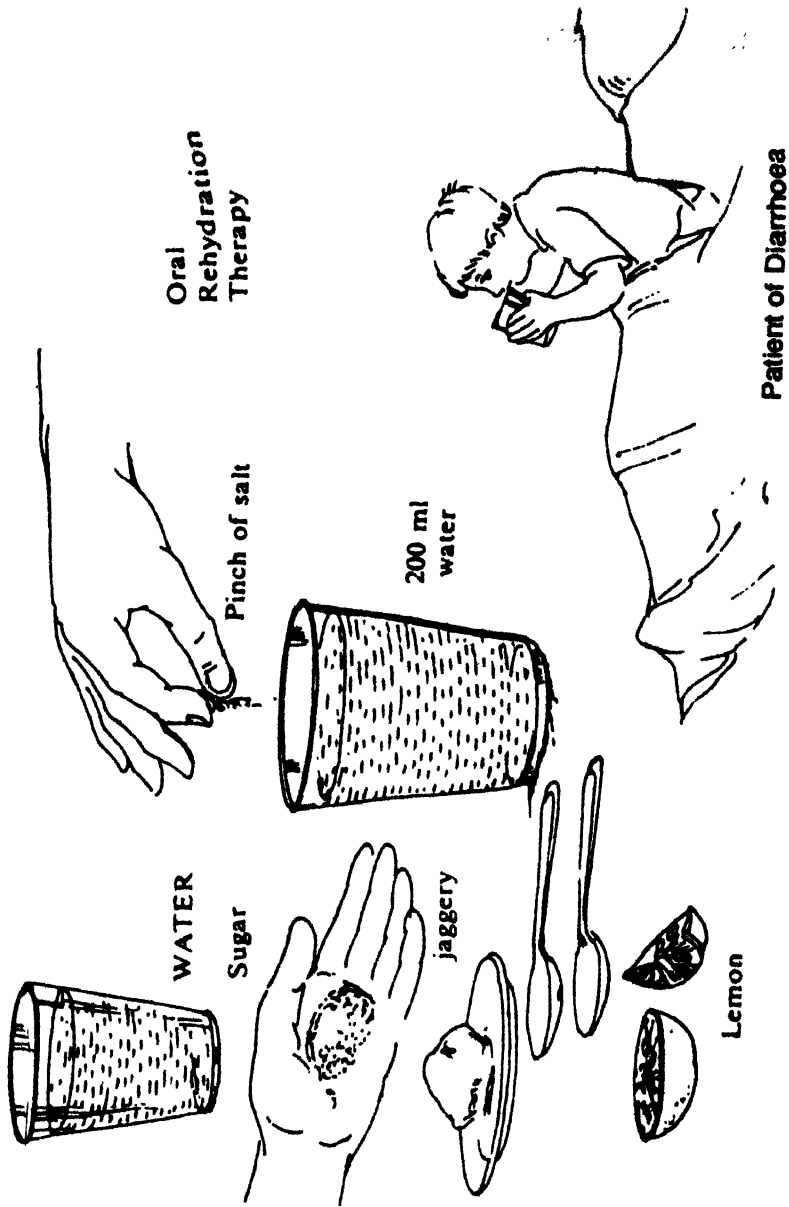
### **8.2.5 Hand Pumps**

There are two types of hand pumps—shallow handpumps and deep handpumps. Shallow handpump has capacity to suck water upto 7 metres and therefore they are health hazards. Deep handpumps draw water from 40 to 90 metre depth. Deep handpumps are safe.

Main points of hand pumps to be observed are—proper installation, maintenance of the handpump and keeping the surrounding clean—either by soakpit or by kitchen garden. UNICEF India Mark-II and Mark-III are very good handpumps.

### **8.2.6 Springs**

There are shallow and deep springs. Shallow springs are like shallow wells. Springs are protected by way of making a box which covers the spring.



## **9. WATER BORNE DISEASES**

**When we are not able to observe environmental sanitation and water purification, we suffer from various water borne diseases.**

**The important water borne diseases are as follows:**

**Acute diarrhoeal diseases—cholera, acute dysentries, gastroenteritis, fevers like typhoid, ineffective hepatitis (jaundice), polio, malaria. These diseases are caused by polluted water. Where there is a water scarcity people suffer from scabies (skin disease) and trachoma(eye disease).**

**We can prevent water borne diseases by maintaining environmental sanitation. Flies, mosquitoes are controlled by clean and healthy surroundings, and water purification is observed.**

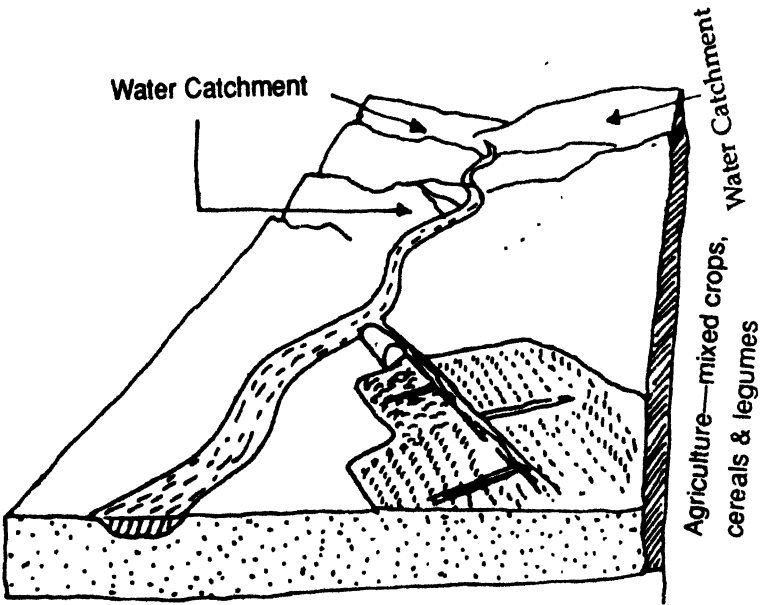
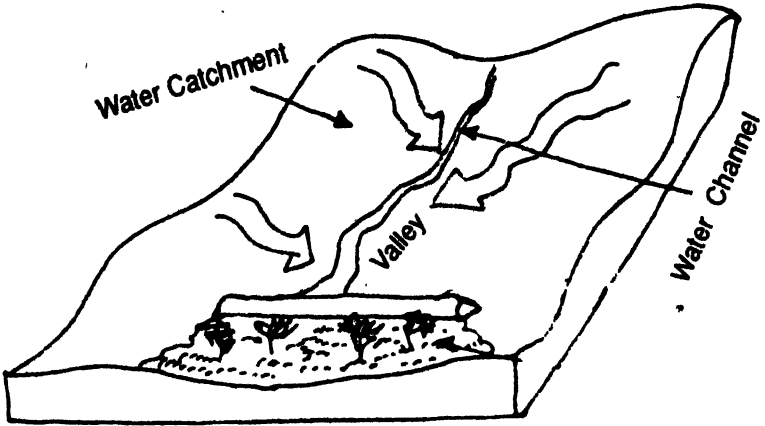
## 10. WE REQUIRE PLENTY OF WATER

*We require about 150 litre of water per day—for drinking purposes about 5 litre and 145 litre are needed for bathing, washing, cleaning of utensils etc. Our domestic animals also need plenty of water, a cow requires 30 - 75 litre of water per day.*

We require lot of water for agricultural purposes. When the agriculture is rainfed, water is free of cost, but when we irrigate the crops, water is costly. The river water which is lifted for agricultural purposes is also costly. The hybrid varieties of seeds require more water in comparison with local seeds. The cash crops (sugarcane etc.) require much more water than food crops.

Agro-based industries and other industries like paper, cement, steel, aluminium require large amounts of water. Demand for water is ever increasing. Our fastly growing population is putting more pressure on our water resources. We are facing a dilemma—at one end we need more and more water for development and at other we are suffering from floods, droughts and desertification. These situations are caused by environmental degradation.

Now we want sustainable development without damaging our ecosystems. We must unite, we must work together. We must learn to live with peaceful co-existence. Harmonious living will only solve our problems. Holistic approach is a must.



## Land, Water & Energy Management

# 11. PLANNING OF WATER MANAGEMENT

Planning of water management has become vital. One will have to think at individual, community, village and national level.

*All of us should do—*

- 1) Water conservation measures.
- 2) Misuse or over use of water is avoided.
- 3) Use of appropriate technology for rain water harvesting and watershed development.

## 11.4.1 Rain water harvesting

Individual houses can collect rain water from roof. Making of small pond near a house. Community can plan rain water harvesting structures—such ponds are existing in our country for hundreds of years.

## 11.4.2 Watershed Development

Watershed development is a process by which soil, water and energy conservation and development takes place. It can generate more income to people. Watershed will prevent floods and droughts. It will give more crops, fruits and grass production. This can be planned by people and people can implement themselves. This calls for united community action. This action will include mapping, channeling, terracing, bunding, reclamation of ill-drained lands, check dams, tree plantation, mix and integrated cropping patterns, development of agro-based industries etc. The watershed can be small as 2.5 ha. It can be of 1000 ha. also.

We can reuse the water by doing sewage farming, fish ponds etc.

## 12. WATER LEGISLATION

There is a water legislation of 1984 in our country. The law does not allow water pollution. Those who are responsible for water pollution can be punished—imprisonment and fine, under this law. Each citizen should be aware of this prevention of water pollution act. If one finds such incidence one should report to pollution control board of the state.

## 13. WATER CAN BE TESTED



The water which we use for domestic purpose or for agriculture purpose can be tested in a laboratory. Water testing will inform us about the quality of water. Water testing facility is available at District level, and/or State level. You can send your water sample to the local laboratory.