

# Water Education - a manual





*" Value-based education can be an important agent for behavioral and attitude changes of key actors in the urban scene, particularly in dealing with issues that affect everyday life in our cities."*

Anna Kajumula Tibaijuka  
Executive Director  
UN-HABITAT

Education helps in conserving water and managing it in a wise manner so that future generations will not suffer from our mistakes of today. The value-based water education is an innovative approach to water education that seeks to bring out and stress desirable human qualities, which therefore help us in making informed & wise choices in water resources management. Nurturing values such as honesty, integrity, tolerance, responsibility, sharing and caring, etc., particularly in children during their formative years, will result in caring and responsible adults in the future. They, in turn will lay the groundwork for character development of generations following after them. The broad aim of value-based water education is to facilitate changes in attitude and behavior and personal attitudes among water consumers and to promote better understanding of the environment in the context of water. Everybody talks about the problems regarding water crisis and unhygienic sanitation but let us be the first, to take initiative and implement, Human Values & Value-based Water Education and Simple Water Optimizing Techniques in the schools & the communities and let it be an example to the rest to follow.

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## I. Our Initiative

Rapid population growth, combined with industrialization, urbanization and water-intensive lifestyles is resulting in a water crisis. Unavailability of safe and adequate drinking water, conversion of rivers into open sewer drain due to inadequate sanitation, and groundwater depletion are common problems of urban centers. Country needs huge investment to solve these problems which is not affordable for the country like Nepal.



For example, Nepal is investing 464 million US dollars out of which 60 percent is a loan simply to serve water for 1.16 million people in the Kathmandu Valley which is only 6 % of total national population. Yet, sanitation part is not addressed adequately even in this big investment. In addition, due to poor drinking water quality and polluted water bodies, water borne diseases are common in the cities seriously affecting the urban dwellers.

Therefore, one approach in solving the problem is to develop action plan to pursue Human Values and Value-based Water Education to the school children and communities. The value-based approach in water education seeks to bring out and stress desirable human qualities, which therefore help us make inform and wise choices in water resources management. Nurturing values such as honesty, integrity, tolerance, responsibility, sharing and caring, etc., particularly in children during their formative years, will result in caring and responsible adults in the future. They, in turn will lay the groundwork for character development of generations following after them. The broad aim of this education is to facilitate changes in attitude and behavior and personal attitudes among water consumers and to promote better understanding of the environment in the context of water. Everybody talks about the problems regarding water crisis and unhygienic sanitation but let us be the first, to take initiative and implement, value-based water education in the schools and the communities and be, an example to the rest to follow.

## A. Conserve Water Individually

It is now time to act to make the best use of the little water we have. People need to think how water can be saved and recycled.

For practicing water conservation at the household level, it is necessary to first understand the amount of water being used for different purposes. table 1 shows an example of quantities and different uses of drinking water in a fully plumbed house. It indicates that of total water consumption, only 2% is used as drinking water, the rest 98 percent serves the purpose of cleaning and hygiene. About 45 liters (33%) of high quality drinking water is poured into the toilet each day, although for this purpose use of lowest quality water is sufficient.

*Table 1: Quantities and different uses of drinking water for fully plumbed house*

Liter per person /day	Purpose of use	Quality requirement
3	drinking and cooking	highest quality
10	dishwashing	high quality
57	bathing, showering	high quality
20	laundry	high quality
7	cleaning	low quality
3	garden	low quality
45	toilet flushing	lowest quality

It is our responsibility as citizens, to take initiative for the best utilization of water at household level. Let's come together and take part in implementing these simple methods of water management and conservation at household level described in this manual and observe how much difference we can make.

## **II. Water Optimization and Management Techniques**

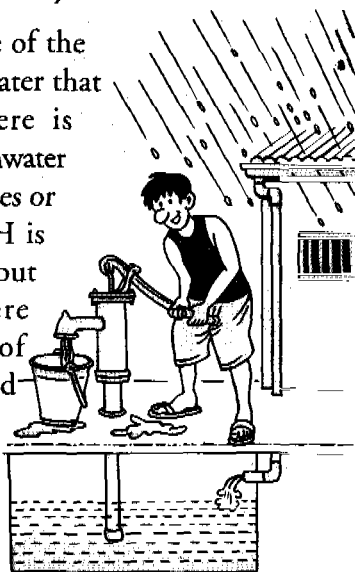
There are several water optimization and conservation tools. Rainwater harvesting, ECOSAN Toilet, Constructed Wetlands and Household Composting are some of the major techniques which have the following advantages:

1. These systems can co-exist with and provide a good supplement to other water sources and utility systems, thus relieving pressure on other water sources
2. Provides a water supply buffer for use in times of emergency or breakdown of the public water supply systems, particularly during natural disasters
3. Rainwater harvesting can also reduce storm drainage load and flooding in city streets
4. ECOSAN toilets and Constructed Wetlands provide on-site sanitation alternatives thus, cuts down the cost of a sewerage system and requirement of a large volume of piped water supply
5. On-site disposal, dealing with excreta and kitchen wastes where it is deposited, can provide a hygienic and satisfactory solution
6. Users of rainwater and treated wastewater are usually the owners who operate and manage the system, hence, they are more likely to exercise water conservation because they know how much water is in storage tank from drying up
7. These technologies are flexible and can be built to meet almost any requirements. Construction, operation, and maintenance are not labor intensive.



## A. Rain Water Harvesting (RWH)

Falling rain can provide some of the cleanest naturally occurring water that is available anywhere. There is considerable scope to collect rainwater when it falls, before it evaporates or becomes contaminated. RWH is not only a useful technology but also a good choice where groundwater is too deep of inaccessible due to hard ground condition, or where it is too silty, acidic, contaminated with arsenic, fluoride or otherwise unpleasant or unfit to drink.



### How to harvest rain water?

The system is very simple; water drains from the roof into a drainpipe, which feeds into a storage tank fitted with a tap. The water is then safely stored right next to the house ready for use whenever needed or recharge groundwater aquifers. RWH systems are comprised of six basic components:

1. Catchments area upon which the rain falls
2. Gutters transport from catchments surface to storage
3. Screening bucket that removes debris

4. First-flush device to ensure that the runoff from the first spell of rain does not enter the system
5. Cisterns or Storage Tanks
6. Delivery system for the treated rainwater, either by gravity or pump

### **How much water can be harvested?**

The amount of rainfall that can be effectively harvested is called the water harvesting potential. 25.4 mm (1 inch) of rainfall precipitation on one square foot of catchments surface can be calculated as 2.36 liters of water. However, in practice, this volume can never be achieved since a portion of the rainwater evaporates from the roof surface and a portion may be lost to the drainage system, including the first flush.

Therefore, we can only collect about 80% of the rainfall.

Water harvesting potential = Rainfall(mm) X collection efficiency

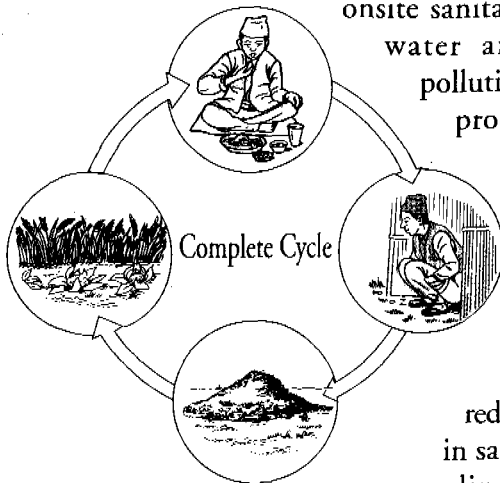
Volume of water harvested (cu.m) =  
area of catchment (sq.m) X amount of rainfall

### **Quality of harvested rainwater**

Collected rainwater is free of pollutants. However, it might be contaminated with air pollutants and surface contamination such as silt, dust etc. Biological contamination may occur if the rainwater catchment area is not cleaned. Flushing off the first 10-15 minutes of rainfall can prevent these contaminations.

## B. Ecological Sanitation (Ecosan)

ECOSAN is a sustainable and environment-friendly tool for onsite sanitation that conserves water and thus prevents pollution. It is a three-step



process : containment, sanitization and recycling of human excreta. The objective is to protect human health, the environment while

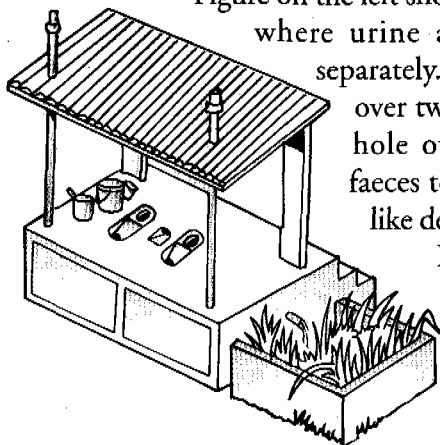
reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilizers in agriculture.

### How it works?

**Containment & Sanitization:** ECOSAN systems are designed in such a way that provides two ways to render safe disposal of human excreta through dehydration and decomposition.

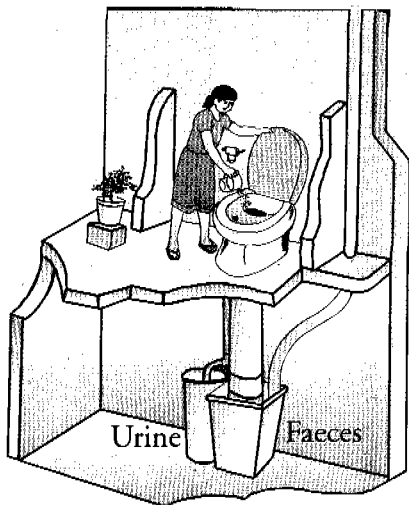
Dehydration is the chemical process of destroying pathogens by eliminating moisture. Some drying materials like wood ash, lime and soil are added to cover fresh deposit of faeces. Ash and lime increase pH which acts as an additional toxic factor to pathogens if the pH can be raised to over 9.5. To minimize the moisture content in faeces, urine is diverted.

Figure on the left shows ECOSAN toilet pan where urine and faeces are stored separately. It consists of slab built over two vaults. The slab has a hole over each vault for the faeces to drop in and a funnel-like device to collect the urine.



It takes an average family 6 months to fill one of the vaults. Then second vault is used. The vault is emptied following an

additional 6 months of sanitization and the material is taken to a soil compost. Urine is never mixed in this system which is collected separately and can be applied as a fertilizer by diluting with water as necessary.

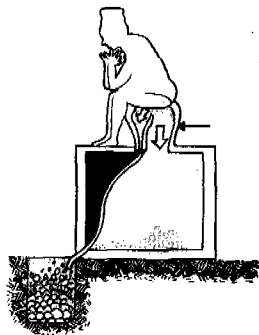


ECOSAN system for modern house where urine and faeces are separated.

**Recycling:** Recycling of nutrients in urine and faeces is one of the key benefits of ECOSAN.

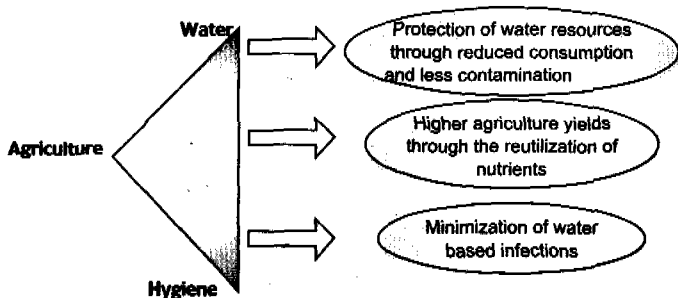
Urine consists of all kind of nutrients (nitrogen, potassium and phosphorus) required for the plant growth and it is mostly sterile. Whereas faeces contain large amount of diseases causing pathogens for example: 1 gram of faeces consists of 100 parasites

eggs, 1000 parasite cysts, 1,000,000 bacteria, and 10,000,000 virus. Such pathogens will be destroyed after 4 to 6 months of period due to raising of pH and removal of moisture. Finally faeces is converted into composted product 'humus', which is an excellent soil conditioner.



Therefore, ECOSAN toilet serves two purposes: it saves water and generates resource from the waste. It uses human excreta as a resource, not as waste. Thus, the saved water is never used to transport human excreta.

### ECOSAN Triple Win:



## C. Wastewater Treatment and Water Recycling using Constructed Wetland

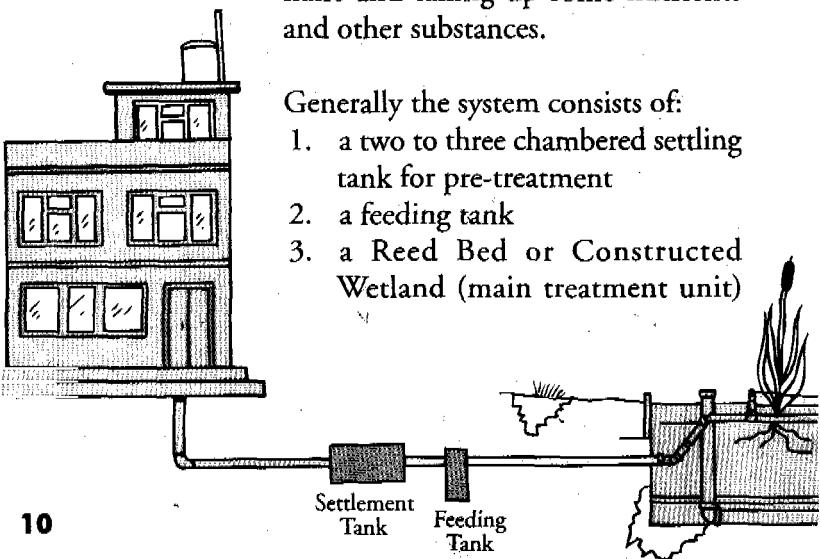
Constructed Wetland (CW) is engineered marshes that duplicate natural process to cleanse waste water. It is used to recycle household graywater and black-water. Graywater is defined as any domestic wastewater produced; such as, water from bathrooms, kitchen and laundry, excluding human excreta. Where as black-water includes human excreta.

### How it works?

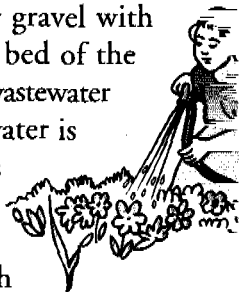
This system utilizes wetland plants, soil and their associated microorganisms to remove pollutants from wastewater. The plants assist in the cleaning process by transporting oxygen to the microorganisms in the bed through its root hairs and taking up some nutrients and other substances.

Generally the system consists of:

1. a two to three chambered settling tank for pre-treatment
2. a feeding tank
3. a Reed Bed or Constructed Wetland (main treatment unit)

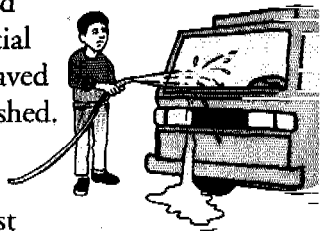


The basic features in CW or Reed Beds are that they have a bed of uniformly graded sand or gravel with plants such as reeds growing on it. The bed of the CW is lined with plastic or clay to prevent wastewater from leaching into groundwater. Wastewater is evenly distributed on the bed and flows through it either horizontally or vertically. As the wastewater flows through the bed of sand with reeds it gets treated through natural processes by mechanically filtering, chemically transforming and biologically consuming potential pollutants in the wastewater stream.



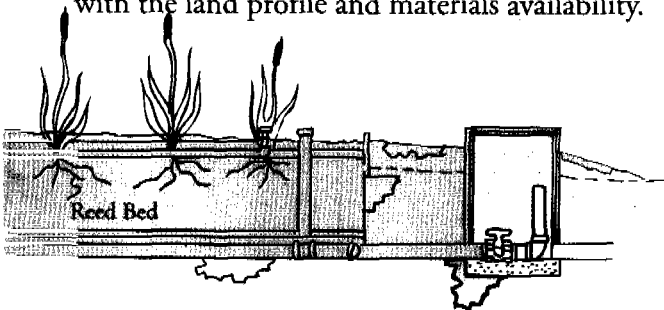
### **Quality of the treated wastewater**

Quality of treated water is good enough for toilet flushing, cleaning vehicles and watering the garden. Thus substantial amount of drinking water can be saved once this treatment system is established.



### **How much does it cost?**

For a single household, it may cost around Rs. 30,000 and in large scale the cost varies with the land profile and materials availability.



## **D.Composting of household organic waste**

### **Steps to adapt**

Composting bin can be made at home from old plastic buckets, barrels by poking holes on them for aeration or one can purchase the ready made composting bins.

All types of kitchen organic wastes can be dumped for composting into the bin.

Carbon and Nitrogen ratio should be 25:1 in degrading the waste. If the waste contains more Nitrogen than Carbon then it can be balanced by adding rice husk, ash, saw dust etc. Water content of the waste in composting bin should be about 50-60 %.

Aeration is another important factor to compost, therefore, the dumped waste in the bin needs to be stirred periodically (at least once a week). If there is not enough aeration then waste will start smelling.

To activate the composting process faster Effective Micro-organisms (E.M.) can be added. This process will produce the compost within one and a half to two months period.

This will give us free compost and help stop throwing the garbage out.

### **Availability**

The compost bin is available at CIUD and ENPHO offices.

### **Cost**

It costs Rs. 750 per bin and Rs. 200 for the accessories.





## E. Household Water Disinfection Techniques

### 1. Piyush

Piyush is a solution of 0.5 % chlorine, a patent product of Environment and Public Health Organization (ENPHO). This product was introduced in 1994, as it was felt that the public water is not safe for drinking in many places and there was an irregular system of chlorination in water supply reservoirs.

It is the most effective way of disinfecting the drinking water since one has to simply add prescribed quantity of the solution to the water prior to drinking.

#### How it works?

PIYUSH is used in drinking water in the ratio of 3 drops per liter of water. PIYUSH is then mixed and allowed to stand for 30 minutes. Normally, the FRC (Free Residual Chlorine) content after this reaction time is recorded to be between 0.2-0.5 mg/l, which is the standard value recommended by WHO. After this treatment one does not need to boil or treat the water further.



#### Availability

It is available in all the pharmaceutical stores and the major departmental stores through out the country.

#### Cost

It costs only Rs. 17 per bottle. One bottle of PIYUSH lasts for more than 2 months in a family of 6 members.

## **2. Solar Disinfection Techniques (SODIS)**

It is a simple water treatment method to eliminate disease-causing microorganisms in drinking water.

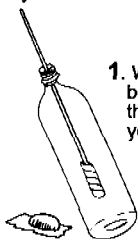
### **How it works?**

SODIS uses the Sun's ultra violet radiation to eliminate disease-causing microorganisms in the water.

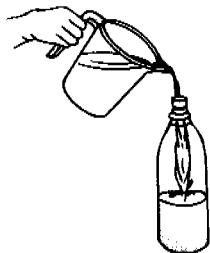
### **7 steps of application**

1. Collect PET bottles (transparent mineral water and cold drink bottles) of 1-2 liters size (preferably 2lt.). Make sure the lid of the bottle closes and the bottle does not leak
2. Clean the inside and outside of the bottles
3. In the morning, fill the 3/4 of the bottle with clear water to be treated
4. Shake the bottle for about 20 seconds. High levels of oxygen in presence of sunlight produces highly reactive forms of oxygen ( $O_3$  &  $H_2O_2$ ) which has high disinfectant properties.
5. Now fill up the bottle completely and screw the cap tightly
6. In the morning (before 10AM) place the bottles on a flat surface. Make sure that bottles will be in the Sun until 3 PM (i.e. not shaded)

7. In the evening, collect the bottles and use for drinking. In cloudy days (more than 50% cloud), expose the bottles for two days.



1. Wash the bottle well the first time you use it.



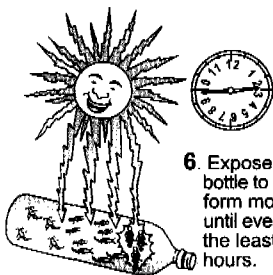
2. Fill the bottle 3/4 full with water.



7. The water is now ready for drinking



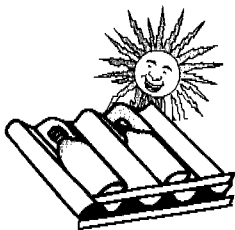
3. Shake the bottle for 20 seconds.



6. Expose the bottle to the sun from morning until evening for the least six hours.



4. Now fill up the bottle fully and close lid.

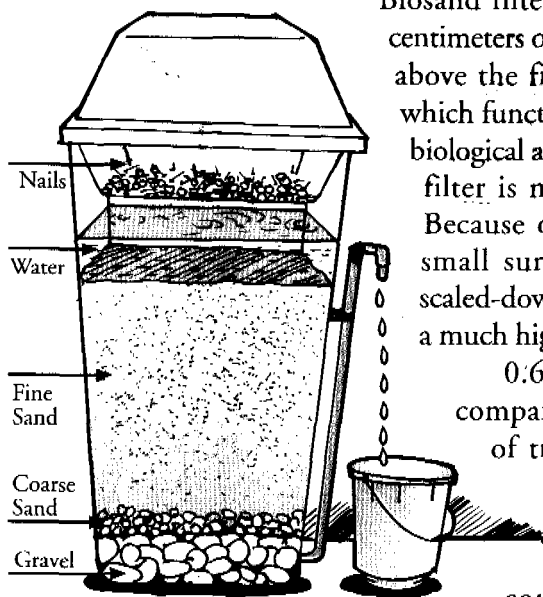


5. Place the bottle under the Sun.

### 3. Bio-Sand Filter

Bio-Sand filter is originally designed by Dr. David Manz, from the University of Calgary, Canada. Water is simply poured into the filter and microbial contamination will be removed as it flows through sand media and the schmutzdecke (Biological layer) that forms at the sand-water interface (just as it does in continuous slow sand filtration). This innovative intermittent design, called the

Biosand filter, contains five centimeters of standing water above the fine sand media which functions to preserve biological activity when the filter is not being used. Because of its relatively small surface area, this scaled-down filter also has a much higher flow rate of 0.6 m/h (30 l/hr) compared to 0.1 m/h



Much like its continuous counterpart, the Biosand filter requires no chemical additives with its primary materials consisting of sand and concrete (which can be found anywhere). Filter cleaning is simple and only necessary

when the flow rate drops below a desirable level. Simply breaking up the biofilm present in the top ~5cm of sand by stirring gently and replacing the highly turbid water with relatively clean water will resume adequate flow of the Biosand filter, and thus there are no costs associated with filter cleaning or maintenance. This cleaning allows for the maintenance of a high bacterial population and minimally affects performance.

Biosand filter is most efficient in removal of turbidity, iron and pathogens. By realizing its efficiency in removing physico-chemical and bacterial quality, researchers from MIT, Boston and ENPHO has come up with new idea for removal of arsenic from this filter with minor modifications.

A newly improved bio-sand filter has a tray above the biological layer where 5 kilograms of iron nails are kept. This filter uses the process of aeration, adsorption and filtration. The system removes iron, turbidity and arsenic without using any chemicals.

### **Availability**

It is available at ENPHO office.

### **Cost**

It costs only Rs.1850 per filter unit.

## F. Basic Water Quality Parameters and its Testing



World Health Organization (WHO) has recommended drinking water quality guideline value for more than 120 parameters, which is not practical to general consumers. In practice, the quality of water resource is determined by various

measurements of physical, chemical and biological characteristics.

For the determination of such parameters it can be either tested in the laboratory or tested by simple test kits. For example to know the water contamination by sewer it is sufficient to test for chloride, ammonia, nitrate and coliform bacteria.

There are several types of imported test kits in the market which is still expensive and not easily available. Recently, ENPHO has developed such field test kit to measure some of the important water quality parameters such as turbidity, pH, chloride, hardness, dissolved oxygen, iron, ammonia, nitrate, phosphate, fluoride, arsenic and  $H_2S$  test for microbial presence. A non technical person can easily perform the tests by reading the operation manual provided with the kit.

Following parameters are more than enough in the context of Nepal to confirm whether the water is safe to drink or not.

## Temperature

Cool temperature is generally more palatable. Temperature is basically important for its effect on other properties e.g. speeding up of chemical reaction, reduction in solubility of gases, amplification of tastes and odors etc.

Sudden increase in temperature in the water is a indicator of pollution. Temperature does not have any guideline values, however it should be at acceptable level.

## Turbidity

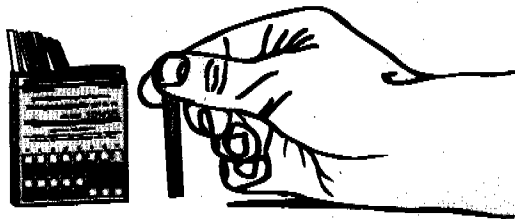
Turbidity is an indicator of suspended solids in the water. These suspended solids can be in the form of silt, clay, sand industrial wastes, sewage, organic matter, phytoplankton and other microscopic organisms.

WHO guideline value for Turbidity : 5 NTU

## pH

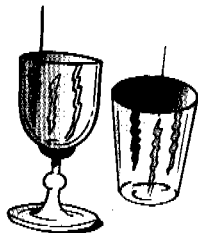
pH is the indicator of acidic and alkaline nature of water. Low pH can cause corrosion in the distribution system of water supply. pH above 8.0 decreases chlorination efficiency.

WHO guideline value for pH : 6.5-8.5



## Hardness

Hardness is caused basically by calcium and magnesium salts and is expressed in terms of equivalent quantities of Calcium Carbonate.



Depending on other factor such as pH and alkalinity water with hardness above approximately 200mg/l may cause scale deposit in the distribution system and results in excessive soap consumption. Again soft water with hardness less than 100mg/l may cause corrosion. The guideline value of hardness is

based on taste and household use consideration.  
WHO guideline value for Hardness : 500mg/l as  $\text{CaCO}_3$

## Chloride

Chloride may get into surface water from several sources including; rocks containing chlorides, agricultural runoff, wastewater from industries, oil well wastes and effluents from wastewater treatment plants.

Chlorides can corrode metals and affect the taste of food products. Chlorides can contaminate freshwater streams and lakes. Fish and aquatic communities cannot survive in high levels of chlorides.

WHO guideline value for Chloride : 250mg/l



## Ammonia

Ammonia is an indicator of water pollution caused due to human activities and natural decay processes. Sewage contains large amount of ammonia due to bacterial decay of nitrogenous organic wastes. Hence, surface water showing a sudden increase in ammonia content may indicate pollution from sewage, effluent from industries like dairies, tanneries or chemical plants. Groundwater often contains some ammonia due to natural reduction of nitrate by bacteria, but sudden change in ammonia content may be due to seepage of wastewater.

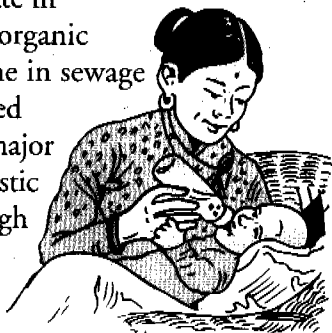
WHO guideline value for Ammonia : 1.5 mg/l

## Nitrate

The most important source of nitrate in water is the biological oxidation of organic nitrogenous substances, which come in sewage and industrial wastes or are produced indigenously in water. Some of the major sources of nitrate pollution are domestic sewage, fertilizers, and manure. High amount of nitrates are generally indicative of organic pollution.

Ingestion of high nitrate content water may cause death in infants by cyanosis (Methaemoglobinaemia) also known as blue baby syndrome. Investigation indicates that nitrate content higher than 200mg/l increase the risk of stomach cancer.

WHO guideline value for Nitrate: 50mg/l



## Phosphorous

Phosphorous is found in natural rocks, domestic sewage and decaying vegetable matter. Phosphorous as phosphate is an essential element for life as a nutrient and as a key element in the metabolic processes of all living organisms. In case of excess phosphate, it stimulates or promotes algal bloom. It may lead to rapid eutrophication especially in lakes, reservoirs and ponds. Phosphorous as such is not harmful to the human but its analysis is useful for pollution study.

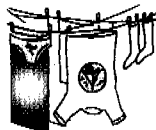
## Iron

Since iron is present in rocks and soil, almost all natural waters contain some dissolved iron, often only in traces but sometimes up to 50mg/l. The problems created by high iron concentrations are mainly aesthetic which may seem very serious to the consumer. Clothes develop rust stains when washed in water containing iron, bathtubs and lavatories get red stains, pots turn red inside, water tastes metallic. It also leads to corrosion of pipes, pumps etc. and may lead to deposition of Ferric hydroxide.

WHO guideline value for Iron : 0.3 mg/l

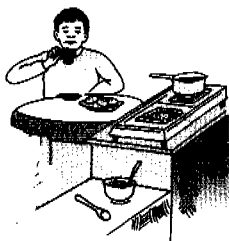


## Manganese



Manganese dissolves into water when it passes through underground layers containing manganese. High content of manganese in the water will get black stains in wash-lavatory, bathtub and toilet pan. More brownish water contains manganese and iron. Blackish water

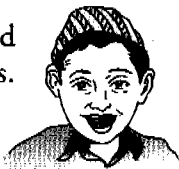
is rather rare, but it occurs due to managaese. It causes coffee and tea taste bitter, pots turn black/brown inside, white clothes turn brownish when washed and after a long period without water consumption, the tapped water turns black.



WHO guideline value for Manganese: 0.1 mg/ l

## Fluoride

Fluoride passes into water from rocks and minerals or through industrial discharges. The concentration of fluoride in drinking water is critical when considering the strength of growing teeth and bones. Low level of fluoride in the range 0.6 to 1.2 mg/l have been found to be effective in providing protection to tooth enamel. Staining of teeth, brittle bones and crippling in old people may occur if the level of fluoride is higher than about 2 mg/l.



WHO guideline value for Fluoride: 1.5mg/l

## Arsenic

Arsenic is a metalloid element present normally in the earth's crust that may exist in groundwater. It is recognized as

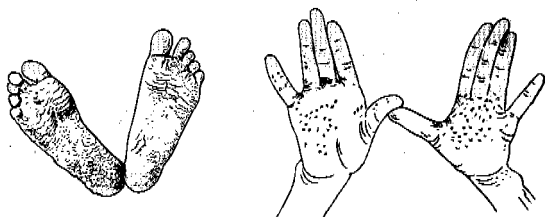
a potent human toxin. Prolong and continuous consumption of water having abnormally high arsenic content causes adverse effect in human health. The arsenic poisoning is cumulative and the development of arsenic toxicity is very slow and insidious. It takes about 2 to



10 years of continuous ingestion of arsenic contaminated water to develop symptoms of arsenicosis. Final symptoms of arsenicosis lead to fatal type of cancer of skin, lungs, liver, bladder, kidney and colon.

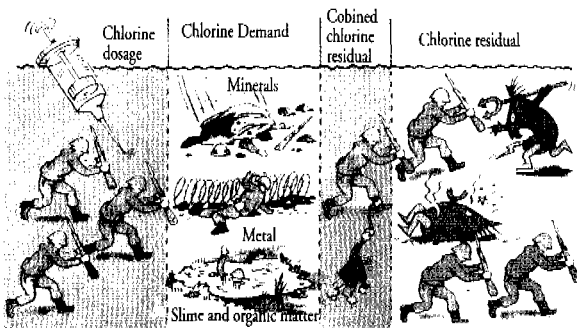
WHO guideline value for Arsenic : 0.010 mg/l

Nepal's Interim standard: 0.05 mg/l



## Free Residual Chlorine

Chlorine is added to water at the water distribution center to kill the germs and bacteria that could be present in the water. Only very little chlorine is needed to kill bacteria whereas a little larger amount is necessary to kill virus. For effective disinfection, dose of chlorine, optimum contact period and residual chlorine are required to be known. When chlorine is added into the water, it is initially consumed by the metal, minerals, slime and organic matter in the water. Chlorine thus "used up" in this manner is called "chlorine demand". Some of the added chlorine will combine with the ammonia present in the water, which will hamper the bacteria destroying action. This is called "combined chlorine residual". The chlorine left free is called "Free Residual Chlorine" (FRC). The FRC is approximately 20 times more effective in destroying bacteria than the combined chlorine residual. Therefore FRC should be measured to check if added chlorine is sufficient or not. FRC should be at the range of 0.2 to 0.5 mg/l for complete water disinfection



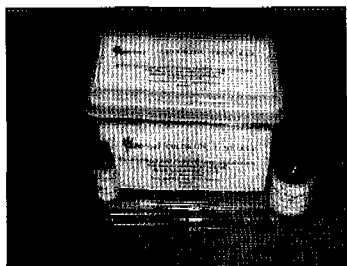
Process during the Chlorination

## Microbiological Quality

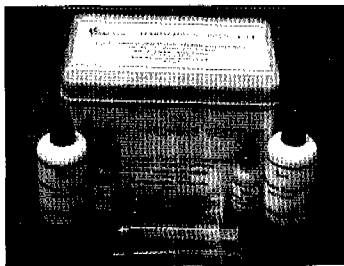
Water may contain disease-causing pathogens if it is contaminated with human or warm blooded animal excreta. Sources of such pathogens include septic tank, pet wastes, urban runoffs, sewage etc. The disease-causing organisms are accompanied by other common types of non-pathogenic bacteria found in animal intestines such as faecal coliform bacteria, *enterococci* bacteria and *Escherichia coli* (E.Coli) bacteria. Presence of these organisms in water means there is chance of having disease-causing organisms, hence these organisms are considered as indicator organisms. To see the microbiological quality of water, normally these indicator organisms is assessed in the water.

WHO guideline value for Faecal Coliform : 0 colony / 100 ml of water.

## ENPHO Water Testing Kits

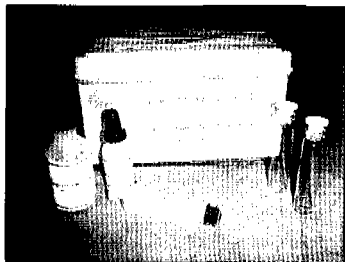


Chloride Test Kit

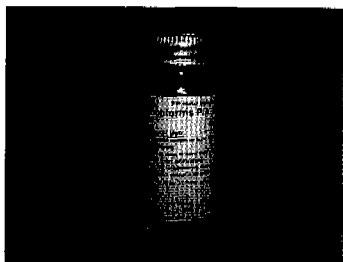


Hardness Test Kit

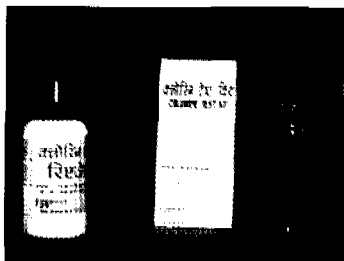
# ENPHO Water Testing Kits



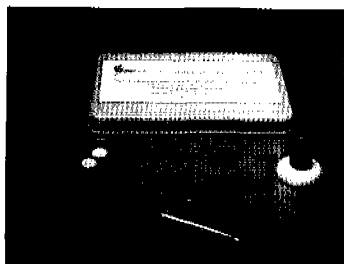
Phosphorous Test Kit



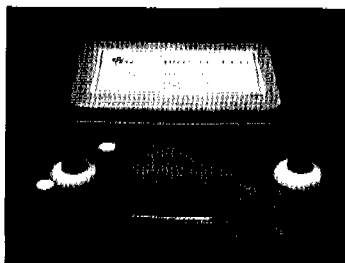
Coliform P/A Test Kit



FRC Test Kit



Flouride Test Kit



Iron Test Kit

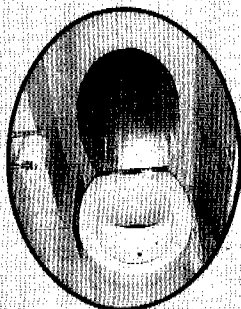
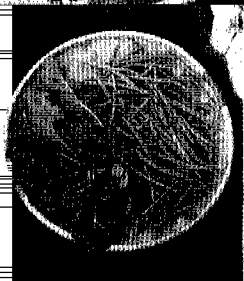


Arsenic Test Kit

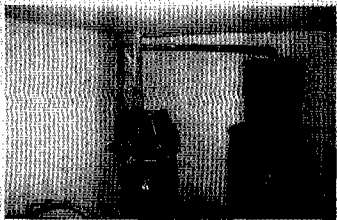
**Vegetables & Fruits  
grown by using urine  
and composted faeces**



**SODIS**



**Morden ECOSAN Toilet**



**Urine & Faeces collection**



**Compost out of faeces**



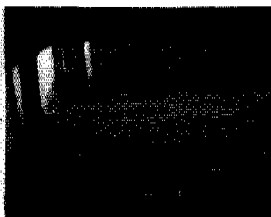
A Modern House  
with all the water conservation  
and optimization tools  
described in this manual



# ECO Home



Compost Bin for  
Kitchen waste.



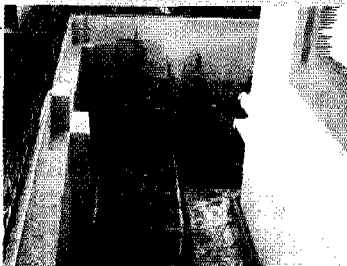
RWH catchment area



Rain water flushing  
device & storage



Terrace Garden uses urine



Constructed Wetland for  
graywater treatment

## Bibliography

1. WHO,1997 Guidelines for Drinking Water Quality, Vol. 1, Geneva
2. GROUNDFOSS, Domestic Water Supply,1988 International Education Centre, Denmark
3. SIDA, 1998, ECOLOGICAL SANITATION Swedish International Development Agency, Stockholm
4. Shrestha R.R. 1999 Application of Constructed Wetland for Wastewater Treatment in Nepal, Ph.D. Dissertation, University of Agricultural Sciences, Vienna, Austria
5. UNEP/IETC 2001, Rain Water Harvesting and Utilization- an environmentally sound approach for sustainable urban water management
6. SACOSAN, 2003 Country Paper on Sanitation in Nepal, South Asian Conference on Sanitation, 21-23 October 2003, Dhaka, Bangladesh
7. Shrestha R.R., 2003, Rural Water Supply and Water Quality Status in Nepal, ENPHO Magazine, March 2003
8. Tuladhar B.,2003 Home Compost Bin, ENPHO Magazine , March 2003
9. ENPHO, 2003, A Report on Measuring Effectiveness of SODIS in Nepal, ENPHO
10. Ngai T. and Walewisk S. 2003. Design of Appropriate Household Drinking Water Filter for Rural Nepal. MIT/ENPHO/RWSSP
11. ENPHO, Test Kit Operational Manual
12. Human Values in Water Education Creating a New Water-use Ethic in African Cities, UN-Habitat

# Saving Water at Home

Activity	Method practiced	Qty. used Ltr.	Method to be adopted	Qty. required Ltr.	Qty. saved Ltr.
Brushing Teeth	Running tap for 5 min.	45	Tumbler or Glass	0.5	44.5
Washing Hands	Running tap for 2 min.	18	Half filled wash basin	2.0	16.0
Shaving	Running tap for 2 min.	18	Shaving mug	0.25	17.75
Shower	Letting shower run while soaping Staying under shower too long	90	Wet down, tap off, soap up, rinse off	20.00	70.00
Flushing Toilet	Using old fashioned large capacity cistern	13.5 or more	Dual System short flush liquidwaste	4.5	4.5 or more
Watering Plants	Running hose for 5 minutes	120	Water can	9.0	115.00
Washing Floor	Running hose for 10 minutes	200	Mop and bucket	18.0	182.00
Washing Car	Running hose for 10 minutes	400	Buckets (Two)	18.0	382.00

*Please Use Water With Care!*

This manual demonstrates Value-based Water Education in a practical way. It provides information about "conserving water" as well as acquiring safe drinking water. It also provides simple and effective ways of testing quality of water as well as managing household organic wastes including illustration of "Simple Water Optimizing Techniques" and "Hygienic Eco-friendly Sanitation".

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