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A Review on Traditional Water Purification Methods Used in Rural Area

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A safe and convenient water supply plays a vital role in public health and well being of the society. There are numerous conventional water treatment technologies available in rural areas of developing countries. The rural communities have adopted some simple rudimentary water treatment technique that can serve individual household. Basically all such techniques aim to remove suspended impurities from water. There are also some traditional household techniques to remove specific water pollutant. Traditional water purification methods include boiling, filtration, sedimentation and solar radiation. Water borne diseases are more common in rural community where potable water supply coverage is very low. The boiling method was the most efficient giving 100 % decontamination after three minutes of boiling. Boiling and solar methods were found to be suitable for purifying domestic water in the rural areas. However, solar method being simple, practicable and cheap is, therefore, recommended for use in the rural communities. This paper contains traditional and household techniques that are widely used in rural areas.

KEYWORD

Traditional, Purification, Impurities.

INTRODUCTION

Clean water is vital for the villager's health and economy. Human society is facing a tremendous crunch in rising demands of potable water. Rivers are among the most vulnerable water bodies to pollution because of their role in carrying municipal and industrial wastes and run-offs from agricultural lands in their vast drainage basins. Freshwater supply is decreasing due to population growth and extended droughts, decline in water quality particularly of groundwater due to increasing water pollution. The water from each source may contain sediments and other solids. In villages, water is drawn from the nearby borewell, pond or lake for drinking, cooking and cleaning purpose. Treatment of water is required for the removal of impurities. Different processes are used to obtain the safe drinking water in villages, that is aeration, boiling, filtration, sedimentation and solar radiation. This paper evaluates the economic feasibility for providing water treatment technologies in rural areas of developing countries, alongwith social and economical factors.

The main sources of potable water supply are handpump, traditional wells. Seasonal streams and ponds were used to supplement the existing sources. During the summer seasons it does not have any kind of water supply source, therefore, majority of inhabitants have to travel long distances in search of water. In most cases traditional bore well and ponds are preferred sources. Water from these sources is of poor quality and in most cases highly turbid that obliges women to clarify domestic water using locally available methods, such as boiling, filtration, sedimentation and chlorination. In all process filtration is more common in village and used by more than 80% villagers because it does not require skilled person and expense. Impurities, such as plant debris, mud, sand

Table 1. *Number of water deficient households* (www.yourarticlelibrary.com)

City	Number of water deficient household
Mumbai	17,35,756
Delhi	14,73,114
Kolkata	4,36,905
Ahmedabad	4,29,199
Hyderabad	4,13,881
Kanpur	3,29,714
Madurai	1,48,533

Table 2. *Demand, supply and deficiency of water in selected cities of India, in million L/day (MLD)* (www.yourarticlelibrary.com)

City	Demand	Supply	Deficiency, %
Mumbai	4,300	3,600	43.3
Delhi	3,830	2,950 >	29.8
Kolkata	2,258	1,568	44.0
Chennai	3,000	1,950	53.8
Hyderabad	956	770	24.2 (least deficient)
Indore	318	184	72.8
Bangalore	1,200	860	39.5
Lucknow	560	440	27.3
Jabalpur	239	144.5	65.4
Vaizag	305	159	91.8 (most deficient)

or coarse particles, insects from raw water can be removed by filtration. According to 2001 census figures, 77.9 % of India's population had access to safe drinking water. Number of water deficient households in different cities is given on table 1.

The southern cities are most water deficient. Chennai and Bangalore suffer from 53.8 and 39.5 % deficiency, respectively. Andhra Pradesh has too extremes: Deficiency is a moderate 24.2 % in Hyderabad, an alarming 91.8 % in Vaizag. In the north, Delhi records 29.8 % water deficiency and Lucknow, 27.3 %. Table 2 is showing demand, supply and deficiency of water in selected cities. Central India is more water-deficient than the north with wide regional variations. For example Bhopal is 26.4 % water-deficient while Indore and Jabalpur record rates of 72.8 and 65.4 %, respectively. Mumbai in the west, with deficiency rate of 43.3 %, is similarly situated to Kolkata which clocks at 44 %. Nearly 40 % of water demand in urban India is met by ground water. So ground water tables in most cities are falling at alarming rate of 2-3 m per year. Another factor is water leakage. Delhi loses atleast 30 % of its water due to leakages in its 83.0 km long pipeline network. Mumbai loses about 20 % of its water due to leakage.

Traditional purification methods used in village

All over the world, rural communities have adopted simple and rudimentary treatment techniques that mainly aim to filtering out the visible impurities from the water collected from local sources. Though these traditional methods are expedient and can remove certain types of particles in water, they do not provide water necessarily of what would be considered under the present day situation as drinking quality. These methods provide water of quality, that is acceptable to rural communities and in most of the cases, with a further simple step of disinfection, they could yield water free from pathogens.

Boiling

Boiling is a traditional method of treating water. If done properly it can provide safe water to a population that has no alternatives. Boiling has positive and negative aspects. Boiling will kill all germs that cause disease. Boiling water is something people can do themselves it takes 1kg of firewood to boil 1L of water for 1 min. Boiling should not be promoted in areas where wood is scarce and no other heating options are available. Boiling destroys water borne disease causing agents present in water, that is spores, cysts, ova and bacteria and it is equally effective whether

the water is cloudy or clear, pure or contaminated with organic matter. It is a satisfactory method for rural areas. Container which is used to boil water in the same it is to be cooled and stored, for no other purpose to use this container. Pouring from one into another container is not a good habit, as it makes for a serious risk of recontamination in handling. Boiling alters the taste of water because it drives out dissolved gases, such as carbon dioxide.

Filtration

Filtration of water is an important first step that, if done correctly, will improve the effectiveness of all the methods purring muddy or dirty looking water through a piece of fine, clean cotton cloth is used to remove a certain amount of the suspended solids and insect larvae contained in the water. A cotton cloth works best. On the other hand, the cloth should not be so thick that it takes a very long time to filter the water. Filtration alone is unlikely to make water from a contaminated source completely safe to drink. But it makes household water treatment easier. Cotton cloth filtration is not suitable for high turbid water. It is most suitable for well water filtration. Cloth filtration technique is more common in village. Some time sieve is used for filtration to remove wind borne pollutants, such as leaves and coarse particles; this type of filter is economical and widely used. Filtration depends on the pore size of sieve and flow of water through a sieve, on which the insoluble particles are retained. If water is clear but possibly contaminated, it must be disinfected by boiling, solar and chemical disinfection.

Sedimentation

Sedimentation mainly reduction in turbidity and the efficiency of sedimentation depend on the nature of suspended particle size and allowed settling time. Before the use of this type of treatment process, it is necessary to study the nature and characteristics of the suspended matter present in the raw water. To assist the process of sedimentation the use of chemical would not be feasible under rural conditions as it would require expenses and skills which are usually beyond the areas resources. Sedimentation is useful for the removal of the turbidity and pathogenic bacteria.

Solar disinfection

Exposing water to sunlight will destroy most germs that cause disease. This is even more effective at higher temperature (although the temperature of the water does not need to raise much above 50°C). One easy method of treating the water is to expose plastic or glass bottles of water to the sun. In tropical regions, a safe exposure period is about 5 hr, centers around midday. The amount of time the bottle is exposed to the sun will need to be doubled (2 days instead of one) when the water is cloudy. The exposure time should also be increased if there is not sunny weather (rainy season).This method, also known as the SODIS system, uses clear plastic or glass bottles to increase the temperature of the water by placing it direct sunlight. For greater effectiveness place the bottle on a corrugated-iron roof. The water can also be held in a clean and clear plastic bag if a bottle is not available. Solar disinfection has positive and negative aspects. Solar disinfection will kill most germs that cause disease if exposed to the sun long enough. Solar disinfection is something people can do themselves with widely available materials (clear bottles or clear plastic bags). Solar disinfection has no residual effect, so improper storage can lead to re-contamination. Water treated by this method should be stored safely and used within a few days. Solar disinfection takes more time than other methods and requires sunny weather.

Chemical disinfection

There are many chemicals capable of disinfecting water. These chemicals often vary in their effectiveness and safety. The International Federation most commonly uses

chlorine tablets for household water disinfection in emergencies. Chemical disinfection has positive and negative aspects. These products are easy and safe to use. There is a residual effect of disinfection, which gives some protection against contamination after treatment. These products must be brought from outside the community; it is not something they can do with local resources. Chemical disinfection will not get rid of all germs that cause disease. Water should be strained prior to use of chemical disinfection in order to ensure all risks are eliminated. If water is muddy, giving it time to settle or adding chemicals can cause the dirt to fall to the bottom of the container and make the water clear. Straining the water through a cloth can make this process more efficient.

Three pot method

The 3 pot method reduces dirt and germs that cause disease by storing water in containers, allowing dirt to settle and moving cleaner water to different containers over time. Pour water collected from the source into pot 1.Strain through a cloth if possible. Allow the water to settle for a day and then repeat the process. Only drink water from pot 3. This water has been stored for atleast 2 days and the quality has improved. Periodically this pot will be washed out and may be sterilized by scalding with boiling water. Using a flexible tube to siphon water from one pot to another disturbs the water less than pouring. The 3 pot method has positive and negative aspects. The 3 pot system greatly reduces dirt and disease causing germs in water. This method is low cost, easy to use and is something people can do themselves with local resources. This method reduces, but does not totally remove, disease causing germs. Boiling, chemical or solar disinfection is still needed to completely remove all risk of disease.

CONVENTIONAL TREATMENT METHOD

Aeration

Process of aeration the water should come into maximum contact with the air so that it becomes fully saturated with oxygen. Under rural conditions it would be possible and normally uneconomical. The process can be accomplished by letting the water fall by spraying it from nozzles into the air and channelize it back into a storage tank in thin sheets over a concrete apron or by letting it fall through several perforated trays placed vertically one below the other. Aeration mainly control taste and odour, water dissolved gases, such as hydrogen sulphide is responsible for tastes and odours. Aeration also increases the requirement of oxygen content of waters which are not already saturated with it and in so doing, helps to remove the flat taste of water. Aeration also may be useful in the removal of CO_2 which escapes into the air.

Chlorination

Turbid water can be filtered first and when clear it can be successfully chlorinated. Highly polluted water containing large quantities of organic matter or cloudy water, is not suited for chlorination. Chlorine is a useful disinfectant for drinking-water and is effective against the bacteria commonly associated with water-borne disease. Sometime usual doses are not effective against certain cysts and ova, or against organisms embedded in solid particle. Sufficient chlorine must be added to satisfy the 'chlorine demand' of water in addition to the amount required for bactericidal action. Chlorine is easiest to apply in the form of a solution. Bleaching powder or chlorinated lime, is a white powder which contains about 30% available chlorine when freshly prepared. However, the strength of this powder rapidly vanishes after the can is opened, it is best to use the whole can at once, immediately after opening. Chlorine solutions should be kept in brown or green bottles and stored in dark places. Chlorine can be secured in tablet form. Some commercial tablets available those are known as halazone, chlor-dechlor and hydrochlonazone. Directions given on the package should be followed carefully, for example

Table 3. *Economic comparison of treatment processes*

Treatment type	Treatment process	Construction cost	Operation cost	Worker
Boiling	It alters the taste of water	Medium	Low	Unskilled
Filtration	Barrier for plants debris, coarse particles, filtration depends on the pore size of sieve	Low	Low	Unskilled
Sedimentation	Turbidity reduction	High	Medium	Skilled
Solar disinfection	Sunlight will destroy most germs that cause disease	Medium	Low	Unskilled
Three pot method	Greatly reduces dirt and disease causing germs in water	Medium	Low	Unskilled
Aeration	Gases expulsion and uneconomical	High	Medium	Skilled
Chlorination	Disinfection	Medium	Medium	Skilled

chlor-dechlor has a double action. Economical comparison of different treatment process is given in table 3.

CONCLUSION

Local traditional water treatment knowledge has evolved and propagated water supply sources among rural populations. Filtration is the only convenient method used by rural people. Encourage people to ALWAYS wash their hands prior to handling drinking water. Distributions of household water treatment chemicals present a perfect opportunity to distribute soap and give hygiene messages.

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