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Study on low cost water treatment for rural area

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ABSTRACT: Over 3 million people, including 1.3 million children's below six die every year from drinking infected water. According to UNICEF and the World Health Organization One in eight people worldwide lack access to safe, clean potable drinking water, and Many people has no choice but to drink water they know is contaminated with potentially life-threatening bacteria. In poor developing countries people, obtain up to 5 gallon (Appox.19-20 litter) of safe, clean water each day.
In ancient ages of human civilization boiling water over a wood fire is one of commonly cheaper clean method for water solution, but it is still hazards in poor ventilation kitchen and what's more it fuels deforestation.

I. INTRODUCTION:

Approximately 80% of all illnesses in developing countries are caused by poor water and sanitation condition. It is normal for women and young girls to need to walk a few kilometers consistently to bring water for their families. When filled, water containers can weigh as much as 20 kg (44 lbs). In the last century, water use has greatly outpaced the rate of population growth: people are using more water than ever before. By 2025, up to 1.8 billion individuals could face water scarcity. By 052- EVH-17 2025, up to 1.8 billion people could face water scarcity Water scarcity can take two forms: physical water scarcity, or low quantity of water, and economic water scarcity, or low quality of water. Physical water scarcity term typically applies to dry, arid regions where fresh water naturally occurs in low quantities. This is in effect incredibly exacerbated by anthropogenic exercises that take surface and ground water quicker than the earth can recharge it. Locales most influenced by this kind of water lack are Mexico, Northern and Southern Africa, the Middle East, India, and Northern China. Economic water scarcity applies to ranges or societies that fail to offer the monetary assets and/or human ability to put resources into water sources and take care of the local demand. Water is often only available to those who can pay for it or those in political power; leaving millions of the world's poorest without access. The regions most affected by this type of scarcity are portions of Central and South America, Central Africa, India, and South East Asia. India's water crisis is established in three reasons. The primary is insufficient water per person as a consequence of population growth. The second cause is poor water quality coming about because of inadequate and postponed investment in urban water-treatment offices. The third issue is waning groundwater supplies because of over-extraction by agriculturists. This is on account of groundwater is an open-access asset and anybody can pump water from under his or her own particular area. India has 16 per cent of the world's population and four per cent of its fresh water resources. Around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year. Providing safe drinking water to all in rural India is a challenging task. The user should be made aware of the importance of preventing contamination of water and user's accountability should also 052- EVH-17 realize their individual responsibility in maintaining the quality of water. Researcher point out the various low cost water treatment method suitable in rural area as Bamboo charcoal (Activated carbon) Solar sterilization, distillation, Chlorine filters, Bone ,Everything-but-the-sink portable filter ,Slow sand filtration ,and Emergency homemade filter.

II. LITERATURE REVIEW:

1) A. D. Mande, B. R. Kavathekar, A. S. Langade, N. G. Lasankute, S. H. Patle(2018) performed a study on **" Low cost Household water treatment systems: A Review".**

This review paper did the detailed study on low cost household water treatment methods. In this review paper there are various low cost households water treatment methods are there like ceramic candle filter, silver impregnated pot filter and bio sand filter. In this there are various media

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used in this treatment methods like resin, activated carbon etc.

2) Abhishek Kumar Singh , Lokesh Kumar Gupta , Vivek Kumar Singh (2015) performed a study on **"A review of low cost alternative of water treatment in rural area".**

This paper is an attempt to examine and review the published research that has been carried out so far with various low cost water treatment method suitable in rural area as Bamboo charcoal (Activated carbon) Solar sterilization, distillation, Chlorine filters, Bone ,Everything-but-the-sink portable filter , Slow sand filtration ,and Emergency homemade filter. These low cost water treatment sustainable tool options for rural infrastructures.

3) Shams Ali Baig, Qaisar Mahmood, Bahadar Nawab, Mustafa Nawaz Shafqat, Arshid Pervez (2011) Performed a study on "**Improvement of drinking water quality by using plant biomass through household biosand filter – A decentralized approach"**

The removal of microbial and physico-chemical contaminants was investigated using an innovative biosand filter (BSF) containing three combinations of coniferous pinus bark biomass (CPBB), i.e. 1 cm (treatment 2), 2.5 cm (treatment 3) and 5 cm (treatment 4). The efficiency of BSF was assessed in batch mode experiments and the comparative reductions of contaminants were monitored over the control treatment (1) at temperature range of 1–15 ◦C for 90 days. Standard methods were used to analyze 9 operating, physico-chemicals and biological water quality parameters of pre-and post-water filtration samples after 15 days interval. The results showed mean 93 ± 2% and 95 ± 3% reductions of Eischerichia coli and total coliforms, respectively

4) Mr. Anil K. Rajvanshi and AmolDalvi performed a study on **"Low-cost solar water purifier for rural households" ,Nimbkar Agricultural Research Institute (NARI) Phaltan, Maharashtra, India.**

Author have discussed about technique of water purification with the help of solar energy. They used simple solar device to purify the water in their system. They started heating water using tubular solar collector. All the harmful deposits were eliminated by heating water using solar technique but they have to heat the water until the next morning to a desired temperature. Then they have to collect it next morning. As in this process the water purification method takes a lot of time. This method is also no useful for the rainy seasons or the season where there is low temperature. Therefore this time required is very much as if we want a purifier which has fast service. They also surveyed how many days there will be the temperature above 45 degree and analysis.

5) Jason Corey(2008) Performed a study on **performance evaluation of Bio Sand Filters, a method of Household Water Treatment.**

Field methods included microbial and turbidity water quality testing. The average filtration efficiency was found to be 98% for total coliforms, and 88% for turbidity. When water flows through the filter physical straining removes pathogens, iron, turbidity from drinking water. Biosand filter is proven technology which removes pathogens. And it is also somewhat effective for removal of E-coli Bio sand filter are suitable for the treatment of water at householdschool or community level.

6) Ratnoji and Singh(2014) performed a study on **A study of coconut shell - activated carbon for filtration and its comparison with sand filtration**

This work examined reduction and removal of iron, turbidity, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in river water by making different arrangements of CS-AC (Coconut Shell-Activated carbon) in the filtration unit. Also its comparison with sand filter, a conventional practice in water treatment plants in India was done to reduce these parameters. Finer grade activated carbon (AC-III) showed the maximum iron removal (95%). Turbidity was reduced to 1.7 NTU from 2.1 NTU.

7) Ranjan Pandhare1, Dr. Isha Khedikar performed a study on **Feasibility study of Domestic Water Purifier for Rural Areas**

The study focuses on feasibility of water purifiers for the rural areas which will protect children and other members of the family from water borne diseases. The water filter used in this study is designed by Bhabha Atomic Research Centre (BARC) along with the design inputs from IIT Bombay. The unique thing that makes this filter different from others is the use of Nano membrane technology in purification. This membrane filter makes it useful for long term use and economical. This study is done in four villages of remote and tribal areas of Gadchiroli where the problem of water borne diseases is in major amount.

8) Pankaj J. Edla, Neha Sonkar, Dr. Bhupendra Gupta Performed a study on **Solar Water Purifier For Indian Villages – A Review**

In this article a review has been done on different types of solar still. This article provides a detailed review of different studies on active solar distillation system over the years. This review would also throw light on the scope for further

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research and recommendations in active solar distillation system

Study on different types of filtration and carrying out test:

1) Bamboo charcoal

Members of the E4C Community researcher team fromBangalore, India propose to design and constructed a natural filter comprising of bamboo, gravel, pebble and other locally available natural adsorbents to carry out this purification. Properties of bamboo charcoal such as its high porosity, mineral constituents, absorption rate, existence of harmless microbes etc., make it perfect for its utilization in the purification of water.

During water purification processes, bamboo charcoal even dissolves its rich mineral contents into the water, so the purified water becomes mineral-rich. Apart from the use of bamboo, they also propose to use gravel and pebbles in various stages to aid particle sedimentation and thus further purification. By exposure to sunlight, UV rays also play their role in the filtering and purification with their capacity to kill pathogenic bacteria. Uniquely, the process they propose is indigenous, eco-friendly, low cost and entails minimum maintenance. It can purify 30 liters of water per hour by the application of batch process method under maximum sunlight

Bamboo charcoal is rich in a number of minerals including potassium, magnesium, sodium, and calcium. As it filters your water,Bamboo charcoal releases a type of electromagnetic waves, called Far Infrared Waves (FIR), at wavelengths ranging from 4 to 16 micrometers. It is absorbed by all organic material.

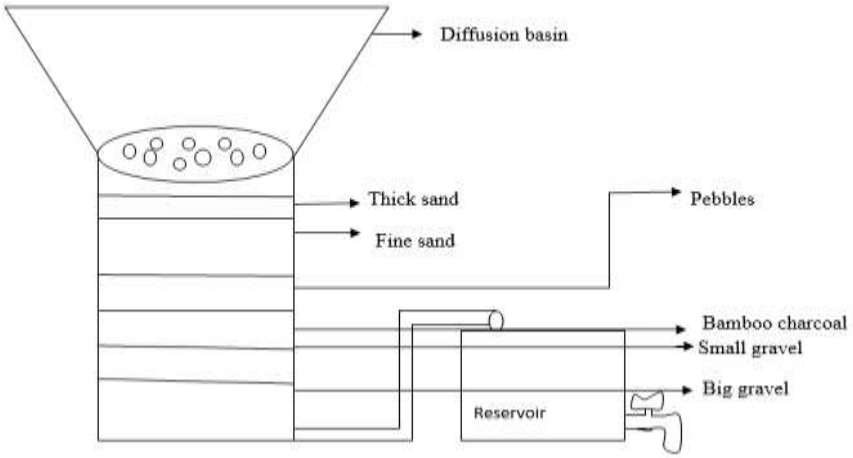

Fig (1) Primary design of the Bamboo charcoal filter

2) Ceramic filters

After the 2004 Indian Ocean tsunami, safe drinking water became a huge problem in Sri Lanka. Trucking or flying in bottled water was just a temporary fix. What the devastated communities needed was a cheap way to treat water at the point of use. The American Red Cross Society teamed up with the Sri Lanka Red Cross Society to bring clay water filters to tsunami affected communities. They submitted the design to Practical Action, which now makes the technical brief freely available. Clay and sandstone water filters have been used for over a thousand years. The Sri Lanka National Museum has one on display that is 1200 years old, and the design has not changed much. Each filter looks like a large clay flower pot. When water is poured into the filter, it slowly seeps through the clay material and drips into a storage container. The filter works like a sieve because the clay used to make it is porous. These tiny pores are large enough to allow water to seep through, but small enough to trap bacteria and other contaminants. Filters made by using the Red Cross design treat about 2 liters of water per hour, adding up to 40 liters per day. This is sufficient for most families.

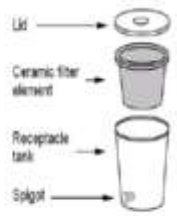

Figure 3 Parts of the Ceramic Water Purifier

3) Portable cheap water filter

Group of students at BITS-Pilani have developed one such water filter.This portable filter design proposed in response to a call for better

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water filtration at taps in India uses chlorine, silver beads, activated charcoal and sand.Flow rate: 10 liters per hour.

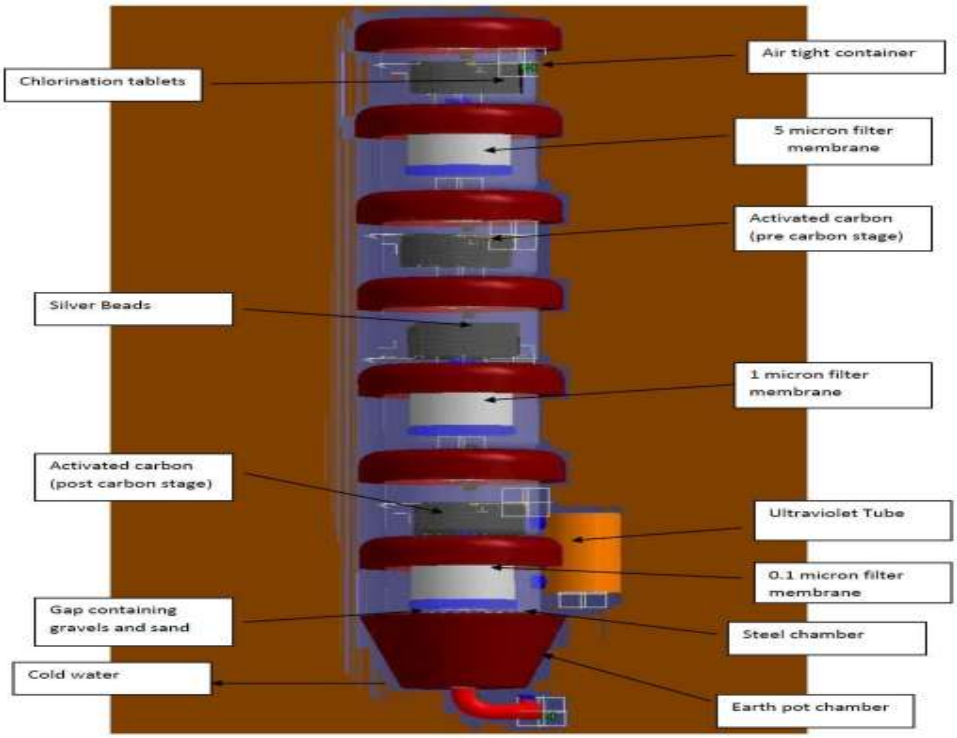

Fig.3. Portable cheap water filter

4) Bio sand filter

The household biosand filter was proposed by Dr. David Manz in the late 1980s at the University of Calgary, Canada.The system was developed from the slow sand filter, a technology that has been used for drinking water purification since the 1800s. Initial lab and field tests were conducted in 1991; the system was patented in 1993 and was implemented in the field in Nicaragua. The Canadian non-profit company Center for Affordable Water and Sanitation Technology (CAWST) was co-founded in 2001 by David Manz and Camille Dow Baker to promote education and training in water purification and sanitation including using this technology, and to continue developing it. A privately owned company, Hydraid Biosand Water Filter produces and distributes plans for filters.

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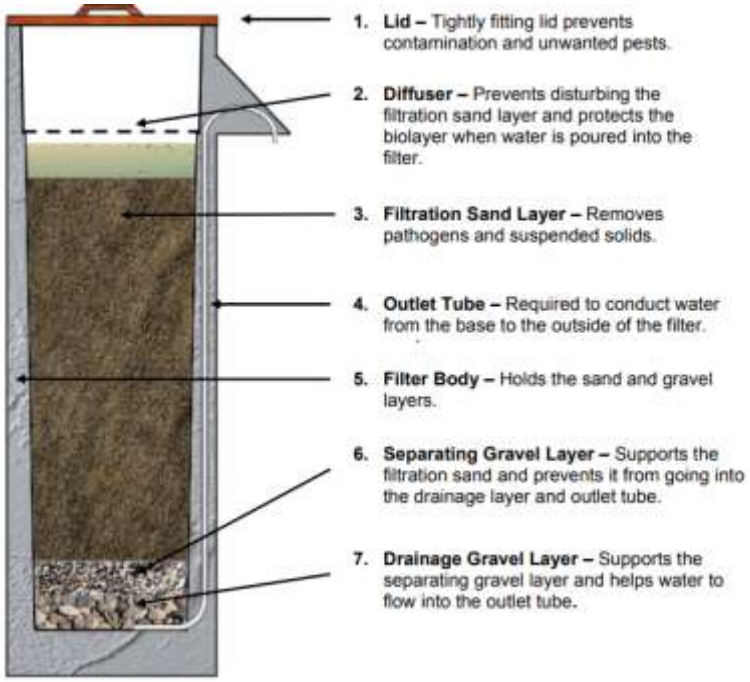

5) Bone char filtration

Bone char is a permeable, dark, granular material delivered by scorching creature bones. Its piece differs relying upon how it's made, in any case it comprises principally of tricalcium phosphate (or hydroxylapatite) 57-80%, calcium carbonate 6-10% and initiated carbon 7-10%. It is fundamentally utilized for filtration and decolourisation. [11]

Fig.5 Bone char filtration

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Water sample Test results.

	parameters	Results	Maximum acceptable limits in(mg/L)	Maximum permissible limits in mg/L	Test method
Water sample	Colour, hazen units	<5	5	15	IS:3025/part 4
	Odou	Agreeable	Agreeable	Agreeable	IS:3025/part 5
	pH value	6.0	6.5-8.5	No relaxation	IS:3025/part 11
	Turbidity,NTU	1.1	1	5	IS:3025/part 10
	Total Dissolved solids,mg/L	1252.0	500	2000	IS:3025/part 16
	Total hardness as caco3	700.0	200	600	IS:3025/part 21
	Calcium as ca	172.3	75	200	IS:3025/part 40
	Magnesium as Mg	65.6	30	100	IS:3025/part 46
	Chloride as Cl	370	250	1000	IS:3025/part 32
	Total alkalinity	420	200	600	IS:3025/part 23
	Total acidity	38	-	-	IS:3025/part 22
	Residual free chlorine	<0.1	0.2	1	IS:3025/part 26
	Sodium as Na	59	-	-	IS:3025/part 45
	Ammonia as total ammonia	<0.1	0.5	No relaxation	IS:3025/part 34
	E coli,MPN/100ml	Not detected			IS 1622-1981
Method	parameters	Results	Maximum acceptable limits in(mg/L)	Maximum permissible limits in mg/L	Test method`
Biosand Filter	Colour, hazen units	<5	5	15	IS:3025/part 4
	odour	Agreeable	Agreeable	Agreeable	IS:3025/part 5
	pH value	5.5	6.5-8.5	No relaxation	IS:3025/part 11
	Turbidity,NTU	0.8	1	5	IS:3025/part 10
	Total Dissolved solids,mg/L	1150.0	500	2000	IS:3025/part 16
	Total hardness as caco3	220.0	200	600	IS:3025/part 21
	Calcium as ca	140.3	75	200	IS:3025/part 40
	Magnesium as Mg	45.4	30	100	IS:3025/part 46
	Chloride as Cl	230	250	1000	IS:3025/part 32
	Total alkalinity	350	200	600	IS:3025/part 23
	Total acidity	32	-	-	IS:3025/part 22
	Residual free chlorine	<0.1	0.2	1	IS:3025/part 26
	Sodium as Na	50	-	-	IS:3025/part 45
	Ammonia as total ammonia	<0.1	0.5	No relaxation	IS:3025/part 34
	E coli,MPN/100ml	Not detected			IS 1622-1981

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Method	parameters	Results	Maximum acceptable limits in(mg/L)	Maximum permissible limits in mg/L	Test method
Bone char filtration	Colour, hazen units	<5	5	15	IS:3025/part 4
	odour	Agreeable	Agreeable	Agreeable	IS:3025/part 5
	pH value	6.0	6.5-8.5	No relaxation	IS:3025/part 11
	Turbidity,NTU	1.1	1	5	IS:3025/part 10
	Total Dissolved solids,mg/L	1252.0	500	2000	IS:3025/part 16
	Total hardness as caco3	650.0	200	600	IS:3025/part 21
	Calcium as ca	172.3	75	200	IS:3025/part 40
	Magnesium as Mg	65.6	30	100	IS:3025/part 46
	Chloride as Cl	370	250	1000	IS:3025/part 32
	Total alkalinity	420	200	600	IS:3025/part 23
	Total acidity	38	-	-	IS:3025/part 22
	Residual free chlorine	<0.1	0.2	1	IS:3025/part 26
	Sodium as Na	59	-	-	IS:3025/part 45
	Ammonia as total ammonia	<0.1	0.5	No relaxation	IS:3025/part 34
	E coli,MPN/100ml	Not detected			IS 1622-1981

Method	parameters	Results	Maximum acceptable limits in(mg/L)	Maximum permissible limits in mg/L	Test method
Bamboo charcoal	Colour, hazen units	<5	5	15	IS:3025/part 4
	odour	Agreeable	Agreeable	Agreeable	IS:3025/part 5
	pH value	6.0	6.5-8.5	No relaxation	IS:3025/part 11
	Turbidity,NTU	1.1	1	5	IS:3025/part 10
	Total Dissolved solids,mg/L	1252.0	500	2000	IS:3025/part 16
	Total hardness as caco3	680.0	200	600	IS:3025/part 21
	Calcium as ca	172.3	75	200	IS:3025/part 40
	Magnesium as Mg	60.6	30	100	IS:3025/part 46
	Chloride as Cl	370	250	1000	IS:3025/part 32
	Total alkalinity	320	200	600	IS:3025/part 23
	Total acidity	38	-	-	IS:3025/part 22
	Residual free chlorine	<0.1	0.2	1	IS:3025/part 26
	Sodium as Na	59	-	-	IS:3025/part 45
	Ammonia as total ammonia	<0.1	0.5	No relaxation	IS:3025/part 34
	E coli,MPN/100ml	Not detected			IS 1622-1981

III. CONCLUSION:

Based on the test results usage of biosand filters is suggested for the rural areas.

Research needs:

As many people can't afford water purifiers, study has been carried out so that many people can utilize the benefits out of it and consume treated water for the consumption.

ACKNOWLEDGEMENT:

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