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A REVIEW ON WATER QUALITY IN DOMESTIC DRINKING WATER RESERVOIRS

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ABSTRACT

This study investigates the variation in water quality parameters due to short term storage in reservoirs in northeast Nigeria. The objective of the study is to determine the water quality, testing selected vital parameters and determining the DWQI of the samples from selected water sources and their respective reservoirs. The World Health Organization (WHO), as well as the Canadian Council of Ministers of the Environment (CCME) standards of water quality test and drinking water quality indices, were adopted. Samples were collected at both source and reservoir from five different points in the same area. The quality of water was analyzed in order to determine the variation in water quality and drinking water quality indices when stored over time in a storage system. The result of the quality test revealed that the level of all the parameters were within the limit set by WHO except that of Iron and Manganese which were slightly above the standard limits. The correlated variables revealed that a very strong relationship exists between all the samples with the highest R2 as 0.99 and the lowest R2 as 0.94. The drinking water quality indices were found to be good for all samples with an index value of 88.45%. This study strongly recommends further investigation as well as regular monitoring of the drinking water quality in the area.

INTRODUCTION

The quality of drinking water has a huge impact on our health and hence, effective monitoring and assessment of drinking water systems are important to the protection of the wellbeing of the public [1]. Such monitoring allows the implementation of a preventive approach to manage drinking water quality [3-4]. The lack of enough good water will threaten our survival since only 0.6% of water exists as groundwater which is the only source of good water [1]. Water is highly essential to our health and economy as well as for the survival of all living organisms [2]. Freshwater is a significant need for human life thus, the quality of drinking water is a concern that is crucial since it is directly linked with public health [2]. Monitoring the quality of drinking water is an important component of water management as it will help in the identification of problems [3]. Health problems may occur due to poor quality of drinking water, therefore, drinking water quality should meet the standards and be free from chemical elements in high concentrations that affect health and also from pathogenic microorganisms [5]. Although parameters of drinking water quality may vary based on countries, most countries have zero

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tolerance for these parameters since the body needs pure water for drinking [6]. It will be of importance if regular water quality assessment will be carried out on both domestic and public water sources, supply channels and storage systems as that will provide water quality information for treatment and other necessary actions.

MATERIALS AND METHODS

Study Area

The study was conducted at Bolori area of Maiduguri, Nigeria situated along 110 51'N 130 08'E. It is a residential as well as a commercial area with most of the population as middle to low-class citizens with family sizes ranging between 5 and 15 individuals with groundwater as the main source of drinking water. Water storage in a reservoir is the most practiced among the people residing in the area due to frequent power shortage with an average of 5 days storage period in the reservoirs, with the sizes of reservoir ranging between 2000-5000 Liters.

Sample Collection and Analysis

A total of 10 samples were collected from 5 different locations. Samples were collected in clean, sterile containers from both sources and storage reservoirs. All the collected samples were stored in an icebox with proper aseptic technique and transported to the laboratory immediately for the experimental analysis. The level of total coliform, pH, Zinc, Iron, Manganese and Lead were determined.

REALIZATION OF NEED FOR CONSERVATION

Living creatures of the universe are made of five basic elements, viz., Earth, Water, Fire, Air and Sky, Obviously, water is one of the most important elements and no creature can survive without it.

Despite having a great regard for water , we seem to have failed to address this sector seriously.

Human being could not save and conserve water and its sources, probably because of its availability in abundance.

But this irresponsible attitude resulted in deterioration of water bodies with respect to quantity and quality both.

Now, situation has arrived when even a single drop of water matters.

However, "better late than never", we have now realized the seriousness of this issue and initiated efforts to overcome those problems.

GENERAL COMMENT

Water is life blood of environment, a precious resource and important input to industrial and agricultural activities.

A recent survey indicates that nearly 1.4 billion of world's population lives in regions that would face severe water shortage.

Water resources have influence on almost every aspect of national economic strength.

USAGE OF SURFACE WATER

In many surface water systems, less than half, the water diverted from reservoirs actually benefit crops.

Much seepage occurs through unlined canals, while an additional amount runs off the land or percolates unused through soil because farmers apply water unevenly, excessively or at wrong times.

A 10% improvement in irrigation efficiency would release a substantial volume of water for other uses.

Technologies exist to achieve these gains but there adoption has been slow mainly because of their cost and complexity.

NATIONAL COMMITMENT

As per the national water policy of Government of India, there is a commitment that no water should go waste and efforts must be made to conserve the water so as to meet all future demands.

Per capita availability of fresh water has fallen from 5200 cu.m. in year 1950 to 1860 cu.m. in year 2010 due to deteriorating quality of surface water and depletion of ground water.

It is imperative that conservation, recycle and reuse of precious water must be given due attention of sustainability.

Major users of water in our country: (i) Agriculture, (ii) Domestic, (iii) Industry, (iv) Power sectors.

Key areas where 'water needs" and "conservation practices" required to be assessed:

* Water requirement due to rapid urbanization
* Drought
* Floods
* Power requirements
* Waste water generation
* Food security
* Rural water supply
* Water use by industries

TRADITIONAL WATER HARVESTING SYSTEMS

System of collecting rain water and conserving for future needs has traditionally been practiced in India.

The traditional systems were time-tested wisdom of not only appropriate technology of Rainwater Harvesting, but also water management systems, where conservation of water was the prime concern.

Traditional water harvesting systems were bawaries, step wells, lakes, tanks etc.

These were the water storage bodies for domestic and irrigation demands.

People were themselves responsible for maintenance to water sources and optimal use of water that could fulfill their needs.

RAINWATER HARVESTING

It is a technique used for collecting, storing and using rainwater for landscape irrigation and other uses.

The rainwater is collected from various hard surfaces such as roof tops and / or other man made above ground hard surfaces.

- It is one of the most effective methods of water management and water conservation.
- It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface run off.
- The augmented resource can be harvested in the time of need.
- Artificial recharge to ground water is a process by which the ground water reservoir is augmented at a rate exceeding that under natural conditions of replenishment.
- This is a very useful method for a our country.

NEED

i. To overcome the inadequacy of surface water to meet our demands.
ii. To arrest decline in ground water levels.
iii. To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
iv. To increase infiltration of rain-water in the sub-soil. This has decreased drastically in urban areas due to paving of open area.
v. To improve ecology of the area by increase in vegetation cover.

ADVANTAGES

i. The cost of recharge to sub-surface reservoir is lower than surface reservoirs.
ii. The aquifer serves as distribution system also.
iii. No land is wasted for storage purpose and no population displacement is involved.
iv. Groundwater is not directly exposed to evaporation and pollution.
v. It increases the productivity of aquifer.
vi. It reduces flood hazards.
vii. Effects rise in groundwater levels.
viii. Mitigates effects of drought.

POTENTIAL AREAS

i. Where groundwater levels are declining on regular basis.
ii. Where substantial amount of aquifer has been de-saturated.
iii. Where availability of groundwater is inadequate in lean months.
iv. Where due to rapid urbanization, infiltration of rain-water into sub-soil has decreased drastically and recharging of groundwater has diminished.

TWO WAYS OF RAINWATER HARVESTING

1. *Surface run off harvesting*: In urban areas rain-water flows away as surface run-off. This run-off could be caught and used for recharging aquifer by adopting appropriate method.

2. *Roof top rain water harvesting*:

- ✓ It is a system of catching rain water where it falls.
- ✓ In roof top harvesting roof becomes the catchment and rain water is collected from roof of house / building.
- ✓ It can be stored in a tank or diverted to artificial recharge system.
- ✓ This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

COMPONENTS OF ROOF TOP HARVESTING

The system is mainly constituted of the following components:

1. *Catchment*
2. *Transportation*
3. *First flush*
4. *Filter*

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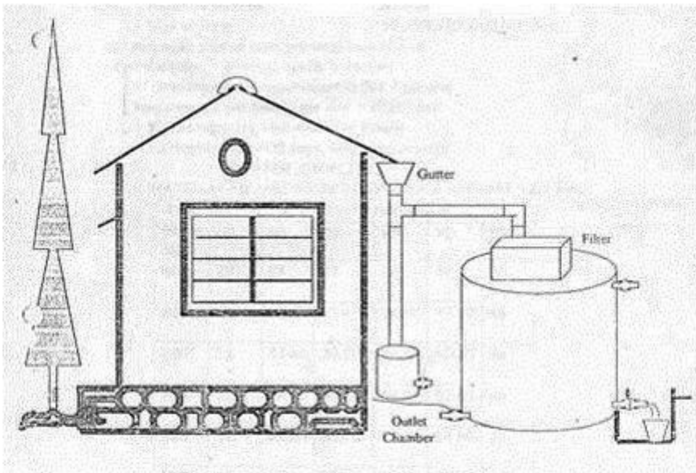

CATCHMENT

The surface that receives rainfall directly is the catchment of rain water harvesting system. It may be terrace, court yard, or paved / unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore catchment is the area, which actually contributes rain water to the harvesting system.

TRANSPORTATION

Rain water from roof top should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipes. At terrace, mouth of each drain should have wire mesh to restrict floating material.

FIRST FLUSH

It is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere as well as of the catchment roof. It will also help in cleaning the silt and other materials deposited on roof during dry seasons. Provision of first rain separators should be made at outlet of each drain pipe.

FILTER

After first flushing of rain fall, water should pass through filters. A gravel, sand and nylon mesh filter is designed and placed on roof of storage tank. It removes silt, dust, leaves and other organic matter from entering storage tank. The filter media should be cleaned daily after every rainfall event. Clogged filters prevent rainfall from easily entering the storage tank and the filter may overflow. The sand and gravel media should be taken out and washed before it is replaced

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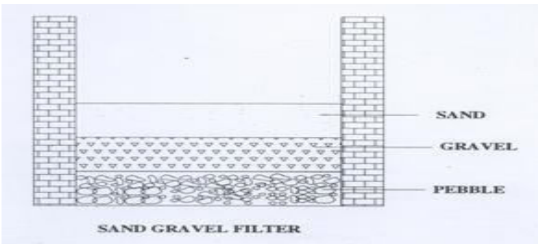
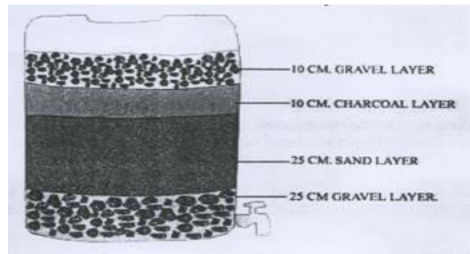
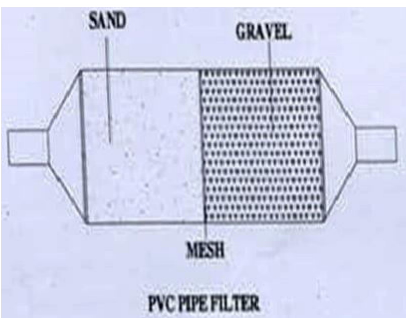
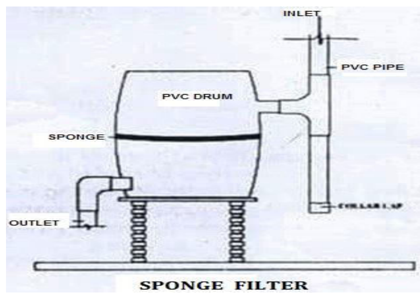
in the filter. Different types of Filters that are used in this purpose are: (i) Sand gravel filter, (ii) Charcoal filter, (iii) PVC-Pipe filter & (iv) Sponge filter.





CHARCOAL FILTER





Various methods of using roof top rain water harvested are:

A) Storage for direct use

B) Recharging ground water aquifers

CONCLUSION

The results obtained conclude that the groundwater used as the source of drinking water in Bolori area is of good physico-chemical quality. The obtained results of the samples were normal when compared to the recommended limits of World Health Organization Standards for physico-chemical, biological and metal analytical parameters. The result of the correlation indicates that a very strong relationship exists between all samples at the sources and reservoirs which show a slight variation. The drinking water quality index of all samples was good which is satisfactory. Therefore, there is a need for a further regular investigation to establish the actual factor responsible for the variation in the quality of drinking water. This will provide information on the actual problems that contributed to the variation in quality by the use of reservoirs to store drinking water.

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