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Rainwater Harvesting in Flouride Affected Area in Jamui, Bihar

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ABSTRACT

Many people use to drink rainwater, even in areas where clean municipal water is available. Domestic rainwater is defined here as any water collected from building roof tops subsequent to rainfall events and stored by households for later use. Rain water may easily become contaminated on storage unless correct procedures for collection and storage are made. Rainwater may provide the best source of domestic water in areas affected by salinity, high fluoride or areas affected by pollution from various sources. Fluorides are widely distributed in nature and it is estimated to constitute about 0.32% of the earth's crust. Water forms the most important component of eco-system therefore any imbalance either in term of its amount or presence of added impurities to it can harm the whole eco-system (Ranjana, 2009) Nearly 12 million tons of fluoride deposits on the earth's crust are found in India. These fluoride deposits are the reason for fluorosis in 17 states of India (UNICEF, 1999). Rainwater has been found in some cases to contain bacteria, or trace metals, or both. the public to limit rainwater use to outdoor purposes, and to laundry and toilet flushing. In our study, over 12 months, rainwater samples were collected around tested for E. coli and total coliforms. Of many samples tested, more than 50% contained E. coli. The health guideline for E. coli is 0/100 mL for drinking water. A survey on household drinking water choice was undertaken across the metropolitan area. The aim was to determine drinking water choices and to understand the driving forces behind drinking potentially contaminated rainwater in a city where clean municipal water is supplied. The investigation concluded that a higher proportion of households use rainwater as their primary source of drinking water. It was found that a higher proportion of households are using domestic filtration systems to improve municipal water quality. Opposition to municipal water fluoridation was reported, drinking water preferences.

KEYWORDS: *Rainwater, Storage tank, Drinking water, Household, Ground water recharge, Fluoride, Chlorination*

INTRODUCTION

Fluorides are widely distributed in nature and it is estimated to constitute about 0.32% of the earth's crust (fluorine in the form of fluoride) (WHO environmental health , Geneva. (1984). Fluoride could be found in a number of minerals, of which fluorspar, cryolyte and fluorapatite are the most common (WHO,1993). Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions.

Bihar is the 12th largest state in the country and is abundant in natural resources, rivers and fertile land. However, water in most habitations is contaminated by chemicals like arsenic, fluoride, iron and nitrate. This contamination has resulted in water borne problems like arsenic poisoning, melanosis and fluorosis, which make it necessary for the Government of Bihar to provide safe drinking water to its people. While hand pumps are the main source of water for a majority of the rural population in Bihar, some also depend on mini piped-water supply schemes. To monitor the quality of water supplied to the habitations via hand pumps, piped schemes and other sources, Fluoride contamination in the groundwater has got great attention in last few decades due to their toxicity, persistent capacity and accumulation in human body. There are several sources of fluoride in the environment and different pathways to enter in the drinking water resources, which is responsible for potential effect on human health. Presence of high concentration of fluoride ion in groundwater is a major issue and it makes the water unsuitable for drinking purpose. Availability of fluoride in groundwater indicates various geochemical processes and subsurface contamination of a particular area in nawada and jamui. Rainwater may easily become contaminated on storage unless correct procedures for collection and storage are made. Rainwater may provide the best source of domestic water in areas affected by salinity, high fluoride or areas affected by pollution from various sources. The chemical and isotopic composition of the rain may be used as a tracer to identify the recharge pathways, it may be possible to quantify recharge efficiencies.

Rainwater harvesting most common technique is small-scale rooftop rainwater harvesting: rainwater is collected on the roof and transported with gutters to a storage reservoir, where it provides water at the point of consumption. Rainwater harvesting for agricultural use see also bunds, field trenches, planting pits, micro-basins, retention basins, sand dams, conjunctive use, gully plug, controlled drainage or fog drip. High fluoride waters have traditionally been treated by a range of techniques including precipitation or flocculation, adsorption or ion exchange, use of alum adding Ca through gypsum this technique is known as Nalgonda technique, calcite, calcium chloride, activated alumina, activated carbon, ion-exchange resins, clay pots, crushed bone, bone char. However most methods designed for village-scale fluoride removal have drawbacks in terms of removal efficiency, cost, ethical issues, local availability of materials, chemistry of resultant treated water and disposal of treatment chemicals as well as monitoring the process. The harvesting of rainwater, either directly in cisterns, tanks or by careful collection via small recharge dams, offers a potentially safe and attractive alternative solution in endemic areas.

LOCATION AREA

The Jamui was separated from Munger district as a district on 21 February 1991. Jamui district is one of the thirty-eight districts of Bihar state. Jamui town is the administrative headquarters of this district. The area of the district is 3098 km sq. It lies between 24023'15" and 25008'30" North Latitude and 85049'30" and 86038'00" East Longitude, and fall on Survey of India Degree Sheet No. 72/ G, H, K and L. The district is bounded in the north by Sheikhpura, Lakhisarai and Munger district, in the west by Nawada district, in the east by Banka district and in the south by Jharkhand state boundary. The district comprises 10 administrative blocks, namely Jamui, Khaira, Gidhour, Jhajha, Sono, Chakai, Barhat, Laxmipur, Sikandra, Aliganj. Jamui township is the headquarters of the district.

CLIMATE AND RAINFALL

The average annual rainfall of district is 1107.3 mm. About 80% of the rainfall is received during June to September by south-west monsoon. The climate of Jamui district represents a transition between dry and extreme climates of the northern India and warm and humid of West Bengal. In the summer season the diurnal temperature rises up to 42 degree C, while in winter season it drops to as low as 20 degree C.

GROUND WATER SCENARIO

Chemical analysis of phreatic aquifer reveals pH value varying from 8.15 to 8.69 and EC from 390 to 1760 micro Seimens/cm. As per the concentration of chemical constituents given in Table 5, the ground water is by and large suitable for drinking and irrigation purposes. In some villages of Jamui and Lachhmipur block, viz., Nabinagar and Majhwe, higher concentration of fluoride above the permissible limit (1.5 ppm) has been observed. Fluoride concentration in Majhwe village has been detected in the fractures at a depth of 172.40 m bgl in granite rock. At some places in phreatic aquifers also the fluoride concentration is above the permissible limit. The fluoride contaminated water should be treated before its use for drinking purposes.

The major part of the district being occupied by hard rock, most of the rain water goes as runoff without recharging the aquifers of this area which leads to water scarcity in non-monsoon lean period. In general, the chemical quality of ground water is potable and suitable for irrigation purposes. Fluoride contamination has been found in some villages. People affected with fluorosis are present in Majhwe and Nabinagar villages. In these villages potable water should be supplied either from adjacent villages or through setting up of defluorination plant for treatment of contaminated water.

METHODOLOGY AND RESULTS OF WATER HARVESTING

Materials and construction related factor.

1. **Roof material** – The chemical characteristics, roughness, surface coating, weather ability need to be considered as suitable for collection. Rough surfaces are more prone to contamination.
2. **Roof location** – the avoidance of trees, proximity to any emissions from domestic or contaminant sources need to be considered in siting structures.
3. **Deposited matter** (mineral, organic, biological) on the roof. The roof is likely to be collector for dead insects, birds as well as vegetation. Avoidance of the initial rains and fitting of first flush devices such as leaf slides.
4. Anaerobic decomposition may take place in down pipes or small storage tanks unless avoided as in above. Problems can be avoided by proper siting, use of large tanks or use of a settling tank.

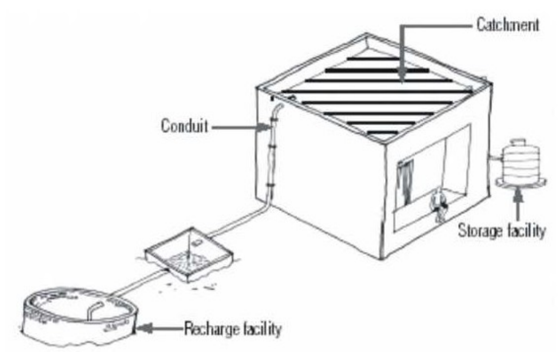
RAINWATER HARVESTING SYSTEM IN JAMUI

Chemical and Microbial quality related factor

5. Research report variously in developed country - bacterial diarrhoeas, bacterial pneumonia, botulism, protozoal diarrhea, Giardia and Cryptosporidium. Dry heat will however kill most organisms.
6. Studies show that faecal coliforms, total coliforms, faecal streptococci decline rapidly on storage, especially if larger tanks are used, although certain strains Pseudomonas and Aeromonas can still grow during storage.
7. Open storage system in hot countries may become attractive for mosquitos and other insects and a protective mesh or seal must be used.
8. Natural rain water may be acidic but pH usually rises during storage especially if cements used in construction. Some acidity may also be produced on breakdown of organic matter Remnant acidity may mobilise metals (Zn, Cd and Pb) from roof materials.
9. Trace organics – PAH (polycyclic aromatic hydrocarbons) are frequently adsorbed with clay tiles in urban areas – probably the by products of fuel burning. Pesticides are also found in roof runoff in some rural areas.
10. There may be problems in public perception and water quality, especially if communities are used to more mineralised groundwater for example. At household level the main problems will be the presence of leaves

and other solids, presence of mosquitos and other insects as well as residual colour or taste.

Elements of a typical water harvesting system



CONCLUSIONS

Rainwater collected and stored can offer an additional high quality resource at household and small community level. Understanding the various factors affecting quality can help to maintain purity of the resource. Rainwater chemistry will vary from place to place and be influenced by proximity to the sea, dust and aerosols derived from human activities such as fuel and forest fires. Attention to roof and other collecting surfaces, suitable collection and storage procedures will minimise contamination from pathogens, excess organic material as well as organic chemicals; discarding the first flush is recommended. Rainwater capture by check dams and other small system leads to the infiltration of generally high quality water which may create a seasonal freshwater above the regional water table. This water undergoes water-rock interaction in the same way as natural recharge and becomes slightly mineralised, according to the geology. This freshwater may become an important domestic resource along with roof water harvesting in areas affected by high salinity or high fluoride groundwater. The harvested rainwater acts as a means of raising regional water tables. The chemical and isotopic signatures in the water may be used to measure recharge pathways and in favourable circumstances to quantify recharge.

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