

## Importance of Rainwater Harvesting in Human Health

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### ABSTRACT

Water used for drinking and other purposes may contain elements such as arsenic, cadmium or anions such as fluoride, and nitrates at toxic levels. Drinking of such contaminated/polluted water can cause considerable health problems. Arsenic in water causes many health problems collectively referred to as Arsenicosis. Cadmium in toxic levels cause Chronic Renal Failure. Excess fluoride in water cause dental and skeletal Fluorosis., and high levels of nitrates result in a condition called Methemoglobinemia. The facilities to purify water effectively are not adequate in most countries. . Hence, a large number of people in many countries have to drink unpurified water resulting in numerous diseases, some of which are incurable. Water obtained directly from rain ie. Rainwater harvesting is the best alternative to prevent occurrence of such diseases.

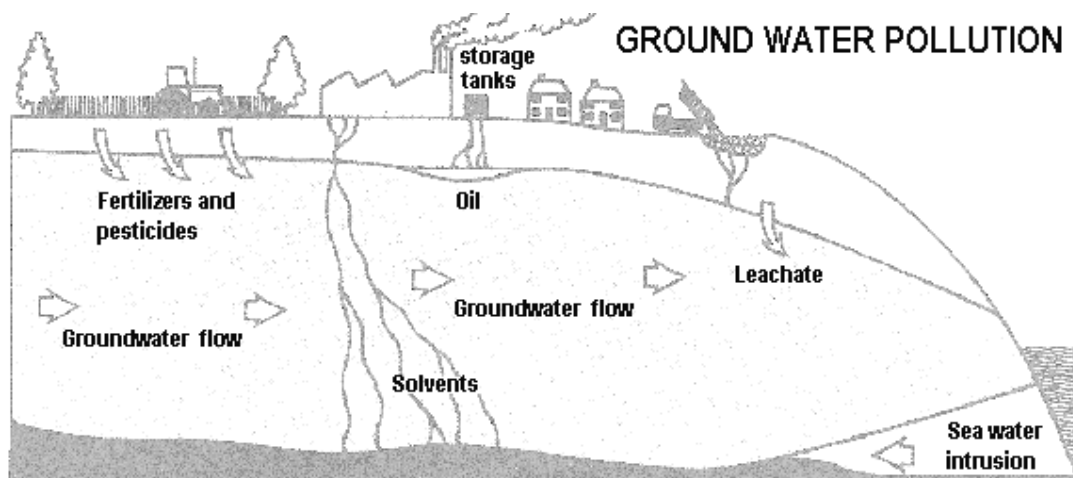
### KEYWORDS

arsenic; cadmium, fluorides; nitrates, rainwater harvesting

### INTRODUCTION

Rain is the main source of water in many parts of the world. However, the water used for drinking is obtained mostly from wells, reservoirs, rivers and lakes. Water obtained from these sources in many parts of the world are contaminated with various cations or anions. Among the cations commonly found in toxic levels in water are arsenic, and cadmium. Nitrates, and fluorides are among the common anions found at toxic levels in water. These toxic substances enter water bodies as a result of ground water pollution as illustrated in Figure 1.

Figure 1



## **ARSENIC**

Arsenic is one of the elements reported to be present in toxic levels in drinking water in some countries. Arsenic enters drinking water supplies mainly from natural deposits in the earth. In a survey reported by Khan (2000) that 50% of tube well water in 44 districts of Bangladesh, contains arsenic above the WHO maximum permissible limit of 0.05 mg per litre of water. The depth of contaminated tube wells ranged from 50 - 110 feet. In 59 districts of Bangladesh out of its 64 districts, arsenic has been found in groundwater at levels above 0.05 mg/l of water which is the WHO maximum permissible limit. (Das et al. 2000) High arsenic levels in water also has been reported in six districts of West Bengal covering an area of 34 000 km<sup>2</sup> with a population of 30 million. In addition to Bangladesh and West Bengal, high concentrations of arsenic in drinking-water are found in various parts of the world including China, and Taiwan, Cambodia, Lao People Democratic Republic, Pakistan, Myanmar, Vietnam, and Nepal. (Anonymous 2009).

Arsenic dissolved in water is acutely toxic and can lead to a number of health problems. Long-term exposure to arsenic in drinking-water causes increased risks of cancer in the skin, lungs, bladder and kidney. It also leads to other skin-related problems such as hyperkeratosis and changes in pigmentation. Consumption of arsenic also leads to disturbance of the cardiovascular and nervous system functions and eventually leads to death. Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been reported for consuming drinking-water with arsenic concentrations equal to or greater than 50 parts per billion (or microgram per liter). (Anonymous, 2009). These health effects – sometimes collectively referred to as arsenicosis – have been demonstrated in many studies. Among the 44 districts surveyed by Khan arsenicosis cases were identified in 26 districts. It has been estimated that more than 35 million people in Bangladesh are at risk of arsenic toxicity Khan (2000).

## **CADMIUM**

Cadmium has been reported to be present in high concentrations in water in five reservoirs of the North Central Province, located in the Dry Zone of Sri Lanka. (Bandara et al. 2008). The dissolved cadmium in the water samples ranged from 0.03-0.06 mg/l, 19 fold increase over maximum contaminant level set by WHO.

Chronic Renal Failure has been reported among 5,000 inhabitants in many parts of the Dry Zone of Sri Lanka (Atapattu, 2006). Athuraliya et al (2003) too reported that around 5% of the farming community in North central Province of Sri Lanka are affected by CRF. Bandara et al. (2008) carried out intensive studies and attributed high levels of cadmium in water to Chronic Renal Failure reported by Atapattu (2006) and Athuraliya et al. (2003).

## **NITRATE**

Nitrate is one of the most common groundwater contaminants in rural areas. The high nitrate content in groundwater is mainly from irrigation run-off from agricultural fields where chemical fertilizers have been used indiscriminately. Nitrate in groundwater originates primarily from fertilizers, septic systems, and manure storage or spreading operations. Fertilizer nitrogen that is not taken up by plants, volatilized, or carried away by surface runoff leaches to the groundwater in the form of nitrate. This not only makes the nitrogen unavailable to crops, but also can elevate the concentration of nitrates in groundwater above the levels acceptable for drinking water quality. Melvani (2004) and Liyanage et al (2000) reported that the ground water in Kalpitiya in Sri Lanka contains nitrate levels above 10mg per liter which is the WHO standards for drinking water.

Short-term exposure to drinking water with a nitrate level at or just above the health standard of 10 mg/l nitrate-N is a potential health problem primarily for infants. Babies consume large quantities

of water relative to their body weight, especially if water is used to mix powdered or concentrated formulas or juices. Also, their immature digestive systems are more likely than adult digestive tracts to allow the reduction of nitrate to nitrite. In particular, the presence of nitrite in the digestive tract of newborns can lead to a disease called Methemoglobinemia, which is the most significant health problem associated with nitrate in drinking water. Blood contains an iron-based compound called hemoglobin, which carries oxygen. When nitrite is present, hemoglobin can be converted to methemoglobin, which cannot carry oxygen. In the blood of adults, enzymes continually convert methemoglobin back to hemoglobin, but newborn infants have lower levels of these enzymes, and their methemoglobin level is usually 1 to 2 percent. Anything above that level is considered methemoglobinemia. (McCasland et.al. ) Few clear cut symptoms are associated with methemoglobin levels between 1 and 10 percent. At higher levels, symptoms of cyanosis usually appear. Babies with this condition have bluish mucous membranes and may also have digestive and respiratory problems. At methemoglobin levels above 20 to 30 percent, the primary effects result from the blood's severely reduced oxygen-carrying capacity and are referred to as anoxia. At methemoglobin levels around 50 to 70 percent, brain damage or death can occur.(McCasland et.al.

## **FLUORIDE**

In a number of small villages in Sicily, Turkey and India there is naturally occurring fluoride in the water ranging from 0.7 to 5.4 ppm. (Yiamouyiannis, J (1993) Fluoride concentration of ranging from 6-8 mg/liter in drinking water has been reported in some parts of the Dry Zone of Sri Lanka. (Padmasiri and Wickramasingha (2004), Ileperum, et.al (2004) reported that water in dug wells in some parts of Anuradhapura District has a fluoride content of 1.0-4.0 ppm. High fluoride levels in potable water has been reported from China and India. many countries (Fawell et. al. 2006). High fluoride levels in potable water causes children to have brown decaying teeth; young adults often have none. Young men are bent over and crippled with pain in their joints and hips. There is premature hardening of the arteries, and loss of appetite. (Yiamouyiannis, J (1993). Fluoride at high levels can cause severe skeletal fluorosis including pains in bones and joints , reduced appetite backache, osteoarthritis As fluoride builds up in different parts of the body over decades it can disrupt the actions of many key enzymes. (Fawell et. al. 2006).

Facilities to purify water effectively are not adequate in most countries. . Hence, a large number of people in many countries have to drink unpurified water. In such situations water obtained directly from rain ie. Rainwater harvesting is the best alternative. Das et. Al. (2000) and . Ahmed (2000) have proposed that rainwater harvesting is used to prevent arsenic poisoning in Bangladesh.

## **RAINWATER HARVESTING**

Rainwater harvesting is collecting the run-off from a structure or other impervious surface to be stored for later use. Traditionally, this involves harvesting the rain from a roof. The rain will collect in gutters that channel the water into downspouts and then into a storage vessel. Rainwater collection systems can be as simple as collecting rain in a rain barrel or as elaborate as harvesting rainwater into large tanks.

Rainwater is relatively the most pure form of water. Some factors such as pollution by extraneous matter (eg. bird faecal matter etc.) on roof surface may affect the quality of rainwater collected. The quality of the rainwater can vary depending on the atmospheric pollution, harvesting method and storage. While the quality of collected rainwater may vary, on the whole, harvested quality is found to be equal to that of the regular treated water supplied through the public mains. Heyworth (2001) showed that in Adelaide, under-fives in rainwater supplied, rural households were at no greater risk to diarrhea than those who drank the treated piped water. Evans et al. ( 2007) in a study conducted in Eastern Australia indicated that roof harvested rainwater was satisfactory , and Ariyananda (1999, 2007) have shown that rainwater harvesting could be effectively practiced, and

has many benefits. Ahmed (1999) and Das et. al (2000) have shown that rainwater harvesting is an effective practice to overcome arsenic poisoning.

Rainwater harvesting is becoming increasingly popular as the availability of good quality water decreases. Rainwater harvesting is acknowledged as a sustainable source of water that has less impact on the environment. In 2004, 17% of households in Australia had rainwater as a source of water. In rural Western Australia 62% of the households owned rainwater tanks and 53% had rainwater as their main drinking source. (Australian Bureau of Statistics 2004) .

## CONCLUSION

Rainwater is a good alternative for drinking water in those areas where ground water contains a high concentrations of toxic materials such as arsenic/cadmium/nitrates/fluorides. Hence, rainwater harvesting need to be popularised in areas where water available for drinking contains high levels of such toxic ions.

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