

## 6.11 Rainwater harvesting

### *Water quality and health risk*

Rainwater is relatively free from impurities except those picked up by rain from the atmosphere, but the quality of rainwater may deteriorate during harvesting, storage and household use. Wind-blown dirt, leaves, faecal droppings from birds and animals, insects and contaminated litter on the catchment areas can be sources of contamination of rainwater, leading to health risks from the consumption of contaminated water from storage tanks. Poor hygiene in storing water in and abstracting water from tanks or at the point of use can also represent a health concern. However, risks from these hazards can be minimized by good design and practice. Well designed rainwater harvesting systems with clean catchments and storage tanks supported by good hygiene at point of use can offer drinking-water with very low health risk, whereas a poorly designed and managed system can pose high health risks.

Microbial contamination of collected rainwater indicated by *E. coli* (or, alternatively, thermotolerants coliforms) is quite common, particularly in samples collected shortly after rainfall. Pathogens such as *Cryptosporidium*, *Giardia*, *Campylobacter*, *Vibrio*, *Salmonella*, *Shigella* and *Pseudomonas* have also been detected in rainwater. However, the occurrence of pathogens is generally lower in rainwater than in unprotected surface waters, and the presence of non-bacterial pathogens, in particular, can be minimized. Higher microbial concentrations are generally found in the first flush of rainwater, and the level of contamination reduces as the rain continues. A significant reduction of microbial contamination can be found in rainy seasons when catchments are frequently washed with fresh rainwater. Storage tanks can present breeding sites for mosquitoes, including species that transmit dengue virus (see section 8.5.5).

Rainwater is slightly acidic and very low in dissolved minerals; as such, it is relatively aggressive. Rainwater can dissolve heavy metals and other impurities from materials of the catchment and storage tank. In most cases, chemical concentrations in rainwater are within acceptable limits; however, elevated levels of zinc and lead have sometimes been reported. This could be from leaching from metallic roofs and storage tanks or from atmospheric pollution.

Rainwater lacks minerals, but some minerals, such as calcium, magnesium, iron and fluoride, in appropriate concentrations are considered very essential for health. Although most essential nutrients are derived from food, the lack of minerals, including calcium and magnesium, in rainwater may represent a concern for those on a mineral-deficient diet. In this circumstance, the implications of using rainwater as the primary source of drinking-water should be considered. The absence of minerals also means that rainwater has a particular taste or lack of taste that may not be acceptable to people used to drinking other mineral-rich natural waters.

Water quality should be managed through development and application of WSPs that should deal with all components from catchment areas to point of supply.

### *System risk assessment*

Important factors in collecting and maintaining good quality rainwater include proper design and installation/construction of rainwater harvesting systems. Materials used in

the catchment and storage tank should be suitable for use in contact with drinking-water and should be non-toxic to humans.

Rainwater can be harvested using roof and other above-ground catchments and stored in tanks for use. The roof catchment is connected with a gutter and down-pipe system to deliver rainwater to the storage tank. The quality of rainwater is directly related to the cleanliness of catchments, gutters and storage tanks. Rooftop catchment surfaces collect dust, organic matter, leaves and bird and animal droppings, which can contaminate the stored water and cause sediment buildup in the tank. Care should also be taken to avoid materials or coatings that may cause adverse taste or odour, and some metals can dissolve to give high concentrations in water. Regular cleaning of catchment surfaces and gutters should be undertaken to minimize the accumulation of debris. Wire meshes or inlet filters should be placed over the top of down-pipes to prevent leaves and other debris from entering storages. These meshes and filters should be cleaned regularly to prevent clogging.

The first flush of rainwater carries most contaminants into storages. A system is, therefore, necessary to divert the contaminated first flow of rainwater from roof surfaces. Some devices and good practices are available to divert the first foul flush of rainwater. Automatic devices that prevent the first 20–25 litres of runoff from being collected in storages are recommended. If diverters are not available, a detachable down-pipe can be used manually to provide the same result. Even with these measures in place, storages will require periodic cleaning to remove sediment.

Storages without covers or with unprotected openings will encourage mosquito breeding, and sunlight reaching the water will promote algal growth. Covers should be fitted, and openings need to be protected by mosquito-proof mesh. Cracks in the tank and withdrawing of water using contaminated pots can contaminate stored water. Storages should preferably be fitted with a mechanism such as a tap or outlet pipe that enables hygienic abstraction of water. Some households incorporate cartridge filters or other treatments at the point of consumption to ensure better quality of drinking-water and reduce health risk.

### ***Operational monitoring***

Sanitary inspections should be a focus of operational monitoring. This should include checking the cleanliness of the catchment area and storage, the structural integrity of the system and the physical quality of rainwater (turbidity, colour and smell). The level of pH should be monitored frequently in case of new concrete, ferrocement or masonry storage tanks.

### ***Verification***

Microbial quality of rainwater needs to be monitored as part of verification. Rainwater, like all water supplies, should be tested for *E. coli* or thermotolerant coliforms. The levels of lead, zinc or other heavy metals in rainwater should also be measured occasionally when it is in contact with metallic surfaces during collection or storage.

### ***Management***

Management plans should document all procedures applied during normal operation as well as actions in the event of failures. In the case of rainwater harvesting, remedial

actions will generally involve physical repair of faults and cleaning of catchment areas, filters or storage systems. Disinfection of rainwater should be practised when microbial contamination is detected or sanitary inspections indicate a likelihood of contamination. Disinfection with chlorine can make rainwater safe for drinking.

### *Surveillance*

Independent surveillance is desirable for ensuring the quality, safety and acceptability of water supply based on rainwater. The principal focus of surveillance apart from verification of compliance should be geared more towards evaluation of hygienic practices in collection, storage and use of rainwater and needs for development and refinement for improving water safety by the use of a WSP.