



WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

Rainwater harvesting in Ghana - challenges

Dr E O Engmann



Introduction

Rainwater harvesting has been practised globally throughout history. In Ghana, collection of rainwater using rudimentary techniques is still widely practised both in the urban and rural environments. The type of technology employed is often determined by available resources and sometimes by what is socially and culturally desirable.

Rainfall distribution

The extreme south-western part of Ghana is the wettest part of the country receiving more than 1900 mm of rain a year. Annual rainfall amounts decrease from here northwards and eastwards. The driest area in the country is found in the south-east coastland plains where the mean annual rainfall is about 750 mm. Unexpected prolonged dry spells are common especially in areas of low rainfall. In recent years large fluctuations of up to +/- 70% from the long term mean annual rainfall have been recorded in some parts of Ghana. (Mote, et al 1991).

Rural water supply situation

More than 60% of Ghana's rural population of 9.7 million is without access to potable water supply (Krokobite Workshop, 1991). Even in communities where hand-pumps have been installed about 30% of them have broken down or inoperable. For the rural population, water service coverage is estimated to be about 30% (Government of Ghana, 1992). This is not surprising since there are only about 10,000 handpumps and approximately 100 small piped systems in the country (Government of Ghana, 1992). The majority of these systems are located in rural communities with populations between 100 and 5000. It is obvious that other technologies must be identified, researched into and developed specifically for the rural environment. One such technology is rainwater harvesting.

Rainwater harvesting

Traditional techniques for harvesting rain are still very much in use in the country although there seems to be a gradual shift towards hand dug wells and boreholes. Rain harvesting systems normally consist of three components, namely, the catchment, the conveyance system and the storage facility. The roof catchment is the most prevalent in Ghana. Ground catchments for harvesting rainwater for domestic use are not common although the potential for

their use exists in many parts of the country. Traditional facilities for storing rainwater have very limited holding capacities of less than 200 litres. Modern tanks constructed with ferrocement and concrete and having capacities of up to 20 cubic metres and more are gradually being introduced into the rural areas.

Costs

In rural areas the settlements are dispersed, hence unit costs for water supply systems involving distribution networks are usually high and prohibitive. The provision of individual rain harvesting tanks becomes a more attractive economic option in the rural context.

Rainwater harvesting from roofs for individual buildings normally requires no distribution and no or limited treatment. Mechanical lifting of the water can be avoided. Additionally, failure of an individual system does not affect the rest of the rural population.

Assuming a rural dweller uses on the average 30 litres of water a day, his total water requirement in a year will be 11 m³. If the total rainfall in a very dry year is taken to be 400mm, the roof area required to capture all the rain, accounting for the usual losses, will be about 35 m². Suppose the roof catchment is made of aluminium, the cost of storage tank alone could be between 60-90% of the cost of the rain harvesting system depending on the type of tank used. Again, suppose water is to be stored only for a normal dry period of six months to satisfy just cooking

Table 1
Comparison of costs for rainwater tanks

Type of tank	Volume m ³	Cost '000	Remarks
Ferrocement	20	1,800	
	5	500	estimated
Aluminium	4.5	380	2 tanks
Plastic	5	300	
Glass reinforced plastic	50	9,425	imported
	5	1,050	estimated
Cement block	20	1,100	
Reinforced cement block	20	1,100	
Concrete	5	750	
		₤ 650 = \$1.0	

and drinking requirements (assumed to be 6 litres/c/day), the corresponding shortage needed will be about 1.10 m³/per person.

A family of 5 will therefore have to store 5.5 m³ of water to last six months to meet basic drinking and cooking needs. Such a family will have to invest a minimum of about C300,000 for a storage tank (see Table 1). This is far beyond the means of the rural people. It is evident that the crucial issue is the development of low-cost tanks that are durable, affordable and backed by technologies that can easily be assimilated by the rural people.

Challenges

Rainfall amounts in rural Ghana are more than adequate to be harvested for domestic and other uses. It has already been noted that any rainwater harvesting system usually has three components, namely, the catchment, conveyance system (gutters etc) and storage facility.

The catchment for rainwater is either the roof of a building or the ground. For roof catchments a variety of suitable materials such as corrugated galvanised iron and aluminium sheets, tiles, slate are used. These materials are rust and corrosion free but expensive.

Straw or thatch roofs are most common in the rural areas but have a number of drawbacks. The harvested water from thatch roofs contains a high amount of suspended solids and is susceptible to biological contamination. Straw roofs experience relatively high rainfall losses. Also problems are encountered when installing roof gutters for round buildings. Researchers must investigate the possibility of coating the straw with a film of non-toxic substance that will protect the straw from rapid deterioration and at the same time act as a water repellent to increase catchment runoff. In some localities bamboo is used as an alternative low-cost roofing material but it is not very durable and is easily subject to leakage. In general the conveyance or gutter system is the least costly of the three components and not much attention is given to it in this paper.

The principal constraint to harvesting rain water economically from both roof and ground catchments is the cost of storage. Serious research needs to be focused on this issue with the aim of drastically cut down on the cost of water tanks so that they are affordable by the rural people. The technology for low-cost tanks made with bamboo reinforced cement, for example, is well known and is widely practised in countries like Indonesia, China and Malaysia. This technology is yet to be introduced in Ghana. A recent innovation in the country is the use of cane reinforced cement tanks for rainwater storage. (Acheampong and Owusu, 1987).

These issues must be tackled in two phases. The first phase is purely from a hydrological perspective. From hydrological considerations design methodologies must be developed for working out the basic dimensions of any rain harvesting system that is, area of catchment, dimensions

and slope of roof gutters and storage reservoir capacity based on factors such as:

Number of people to be served,
Water requirements,
Rainfall characteristics,
Level of reliability required,
Rationing pattern for water use,
Existence of alternative supplies etc.

This could lead to the standardization of tanks which may result in cost reduction where the same materials are used in construction of the system.

The second phase has been aptly described by the Ghana Water Resources Institute, Research Project Proposals Part III of 1985 which is summarized here. Traditional techniques and systems for harvesting rainwater must be identified and documented. (Acheampong and Owusu, 1987).

The next stage is the involvement of rural communities in the selection of the appropriate systems that need to be adapted and developed for their use. Research will then be conducted on the selected systems to satisfy the conditions of affordability, appropriateness and sustainability. The final step in this phase is the transfer of knowledge and skills to the rural communities so that they can operate, maintain and replicate the systems. The successful implementation of this phase calls for collaboration and resource allocation by government, NGOs, Research Institutions and the rural communities.

Conclusion

Rainwater harvesting is appropriate as a small-scale water supply system that can meet the basic water requirements of rural communities in developing countries. However, vigorous research must be focused on (i) improving the durability and effectiveness of local roofing materials such as straw and (ii) reducing the cost of storage tanks through the introduction of appropriate and innovative techniques in storage tank construction.

References

1. Acheampong, S Y, Owusu, 1987. Report on Field Survey of Water Conservation and Utilisation Techniques in the Rural Areas of Ghana. Water resources Research Institute (CSIR), Accra.
2. Government of Ghana, 1992. The Child Cannot Wait. A National Programme of Action on the Follow-up to the World Summit for Children.
3. Krokobite Workshop Recommendations on Rural Water Supply and Sanitation, 1991, Ghana Water and Sewerage Corporation.
4. Mote, F P, Wellens-Mensah, J, Nii Boi Ayibotele, 1991. Climate Variations and Change Studies in Ghana. NATO Advanced Workshop on Opportunities for Hydrological Data in Support of Climate Changes Lahnstein, Germany.