



19th WEDC Conference

ACCRA, Ghana 1993

WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

Rural water supply - choice of technology

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Introduction

Rural water supply in Ghana dates back to the 1920s when hand dug wells and henderson boxes were the main technology used. During the 1950s drilled wells equipped with either the expensive Godwin handpumps or motorized reciprocating pumps were used. Rain harvesting was practiced basically for government buildings. From 1960 to 1985, the Governemnt of Ghana (GOG) used considerable bilateral funding to drill over 7000 wells equipped with handpumps (cheaper versions). This has been followed by NGO inputs with 2000 drilled wells equipped with handpumps. Meanwhile 1960 to date earth dams have been constructed expecially in Northern Ghana.

All these systems have not been sustained satisfactorily. Serious lapses in continuous operation and maintenance have eroded user confidence in these systems. The end result is that the supposed service has been limited and the projected benefits have not been derived.

There is a sense in which the choice of technology for rural water supplies impacts sustainable development critically.

Factors affecting sustainable rural water supplies

Some of the critical factors which determine ultimate sustainability of rural water supplies are:

- source of water
- choice of technology for development
- community involvement
- replicability of the systems
- monitoring and evaluation

It is important to get a right and balanced mix of factors to guarantee sustainable development.

Technology choice

Technology choice is discussed in this paper in relation to its effect on sustainability and interrelationships with other factors. In Ghana, the choice of technology is now undergoing rigorous assessment. For instance rain harvesting systems have been constructed with little or no regard to design elements such as demand forecasting and climatic variables such as, the extent of rainy season and dry season which determine the storage capacity required.

Rain harvested in the rainy season therefore does not last through the dry season. The rural folks go back to unwholesome traditional sources as a result.

The technology used in any circumstance should take into account, the following:

Source of water

- Whether surface water or groundwater. If surface water, is it rainfall, or perennial river or lake? If groundwater, does the water exist in soft formations (sand and gravel) or hard formations (fractured crystalline rocks or sandstones)? What quantities are involved? Is the water level shallow or deep, stable or does it suffer periodic decline? is the quality of water conducive for the particular type of technology?

Operation and maintenance

- Any technology chosen requires maintenance. The level of technology determines the nature of maintenance required, et a simple rope and bucket assembly requires periodic replacement of the rope and regular cleaning of the bucket. A handpump however requires mechanical skills to dismantle pump and replace say cupleathers and reassemble the pump.
- In the rural situation the long term sustainability of systems therefore depend on the choice of technology used - this must be compatible with the users ability to both afford maintenance and be capable of carrying out some basic maintneance at the community level.

Spare parts supply

- One of the major bottlenecks to effective maintenance of rural systems, is the lack of pump spare parts. Easy access to pump spare parts at the local level guarantees effective maintenance of systems at the village level.
- Technology chosen must be appropriate to village level and its spare parts need to be easily acquired and be inexpensive. Local manufacture of fast moving parts is an advantage.

Cost recovery and replicability of systems:

- The choice of technology, impacts the ability of a community to recover costs - both capital and recurrent. Additionally, the technology should be replicable at the village level.

- Technology should have long life and preferably of local manufacture to guarantee easy replacement. Additionally, if technology requires an energy source, other than manual, then it presents additional recurrent costs which may not be easily affordable at the village level.

Experiences

World Vision recounts the following experiences, which describe how technology choices were made on the current Ghana Rural Water Project.

Afram Plains District

Surface water resource

There is a woeful lack of springs in the Afram Plains district. The occurrence of a 4 to 6 month dry season on the Afram Plains leaves groundwater as the more viable option.

Groundwater resource

Fresh water exists in fractured sandstones. The aquifers occur at average depth 30m. The typical geologic section derived from boreholes drilled in the district is:

0-10 m	Overburden - lateritic and clayey. Small quantities of water which dry up in the dry season.
10-30 m	Hard sandstone - dry.
30-35 m	Hard sandstone - fractured and conglomerates. Water bearing.
35-50 m	Hard sandstones.

This hydrogeologic feature does not suit hand dug well technology. Wells can only be dug manually to about 15 m depth. Groundwater accessed will dry up in the dry season (February-March) every year. Attempts to deepen wells require using either explosives or compressors - which makes the cost of hand dug wells prohibitive and construction dangerous.

World Vision opted for drilled wells fitted with hand-pumps. Drilled wells require the use of drilling rigs and compressors and specialist manpower. These facilities are an imported input. Community members participate in clearing sites, contributing to a pump maintenance fund and training in pump maintenance skills.

A drilled well is completed within 2 days, and the well is equipped with a handpump within 2 weeks.

Kwahu South District (southern parts)

Water source : water exists in Birrimian greenstones and granites and a typical section is as follows:

0-30 m	Plastic clay - very little water.
30-40 m	Fractured greenstones. Very productive 200 l/m.

Hand dug well construction is dangerous because of possibility of caving of the plastic clay overburden. In the fractured zone, you need more than pick axes and shovels to deepen the well and access groundwater.

World Vision Ghana Rural Water Project opted for a drilled well using mud flush drilling technique for 0-30 m, cased the overburden and used DTH technique for beyond 30 m in fractured rocks.

These two examples indicate the importance of determining the source of water before choosing the technology for harnessing it for rural use. For large programmes this choice is determined on basis of regional water resources assessment.

World Vision Ghana Rural Water Project had to acquire a rig capable of drilling in the mud flush, DTH and air/foam flush modes, on the basis of regional and countrywide water resources assessments, carried out in 1984.

Pumping mechanism

- Once the drilled well had been chosen, the water lifting technologies are limited to hand pump or motorized pumping.
- In the rural environment, motorized pumping with attendant energy requirements, is not sustainable. Hand pumps was therefore chosen. A fairly simple hand pump capable of lifting water from depths averaging 30-40m, preferably without a gearing system, was the choice. The India MkII does, effective work and can be repaired at the village level.
- The pump is equipped with stainless steel rods and pipes to cope with aggressive water (quality considerations).

Community volunteers

- Community volunteers were trained at the rate of 2 per pump. A tool box for repairs is provided per 4 or 5 communities. These volunteers are operational and can handle repair work including replacement of cup leathers.

Conclusions

In the choice of technology, it is crucial to cater initially for naturally controlled factors. Human controlled factors can then be dealt with in turn.

The capacity of communities to manage water supply technologies depends on the extent of training given to them.