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REACHING THE UNREACHED: CHALLENGES FOR THE 21ST CENTURY

Rain water harvesting

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WATER, FOOD, CLOTHING and shelter are the basic needs of every human being. The two main sources of water supply are surface water and ground water.

Water audit of India

India has been blessed with 113 rivers (14 major, 44 medium and 55 minor rivers.) Lengthwise, these rivers cover 45,000 kilometers. Three of the major rivers are international and the remaining 11 are national. Together, they contribute approximately 80 percent of India's total water.

The average annual rainfall of India works out to about 1.2 meters, (against 0.86 by the entire world). Out of 400 M.ha-m of total precipitation, 115 M.ha-m has been estimated as true run-off.

Surface Run-off		115 M.ha-m
Evaporation		70
Percolation— Base		
flow for rivers	45	
Ground water table	50	
Soil moisture	120	215
Total		400 M.ha-m.

In addition to this precipitation of 400 M.ha-m, 10 M.ha-m of run-off comes from outside India, thus producing a total run-off or stream flow in India = 115+45+10 = 170 M.ha-m. Out of this only 31 M.ha-m is utilized through pumping and storage in dams, lakes etc., and 139 M.ha-m goes waste to join the seas. With proper planning and development of infrastructual facilities, a further 45 M.ha-m of water can be easily utilized.

State welfare measures

After Independence the Government moved very slowly in the matter of providing water to the rural masses. It was only in the Third Five Year Plan (1961-1966), that the Central Government laid considerable stress on the need for carrying out surveys in the States.

The surveys were aimed at providing a realistic assessment of the existing state of rural water supply, so that a concrete programme of action could be prepared. Subsequently, Rural Water Supply schemes were taken up in the States under the programmes of community development, local development works, welfare of backward classes, etc. Over the years, several schemes have been formulated and initiated, but unfortunately, have failed because of lack of a suitable water source.

Author's experience and observations

The second author had an opportunity to work in the State PHE (Public Health Engineering) Department (MWSSB) during 1971-76. He supervised three water supply projects during a 2 year posting at the works site.

Mulaj rural water supply scheme

Mulaj,a village with a population of about 2000,is famous for betel leaf production. With a local stream as a source,the project at Mulaj had all the usual features of a rural water supply scheme. After the work was completed and the project handed over, it was noticed that the distribution system was faulty. Non-pressure R.C.C. pipes were laid at shallower depths in the distribution system, as against pressure pipes at reasonable depths in accordance with specifications in the tender.

Consequently, once the project was commisioned, leakages sprang up at different places. The entire distribution system was replaced with A.C. Pipes laid at appropriate depth. The yield from the jackwell was not adequate and provision of infiltration gallery and inspection well had to be made in a revised estimate to augment the yield. The matter was raised in the Legislative Assembly and has made headlines several times in newspapers.

Murum urban water supply scheme

The source of this scheme, designed to cater to a population of about 12,000, was a local river called Benitura, where a jackwell was constructed. The project was complete except for installation pumps, commissioning of pumps and R.C.C. reservoir etc. The completion work was done at a snail's space and the project was handed over to the Municipal Council without a drop of water in the jackwell.

Killari rural water supply scheme

The source of this scheme was a local river known as Terana —a source which had the capacity to meet the needs of the people. The construction of jackwell, infiltration gallery, inspection well, rising main, RCC reservoir up to 1st stage with raft foundation and distribution system were completed under the author's supervision during a period of 1 year, 5 months.*(The reservoir, incidentally, withstood the shock of the killer earthquake that hit the region on September 30, 1993.)*

Initially, the locals were not very happy with the scheme and regarded it is as wasteful expenditure by the Government. But they soon realised its value. A famine occured in the area and the local population had to rely on the scheme for all their needs. Even the local sugar factory had to make temporary arrangements to draw water for drinking purposes, as well as for construction, from the scheme.

Inferences

Looking back on 5 years in the State PHE Deptt., 2 years on site and 3 years in the Circle Office, the author feels proud of fellow engineers who trudge to rural areas and execute work under conditions that are often far from ideal. Unfortunately, their efforts are seldom lauded as they fail to supply water during times of crisis— a failure which results from improper and inadequate selection of the water source. The source must yield a minimum quantum of water during the dry season of May and June.

Rain water harvesting

The collection and storage of rain from run-off areas such as roofs and other surfaces has been practiced since ancient times. It is particularly useful where water supply is inadequate. If collection and storage are designed carefully,it is possible for a family to live for a year in areas with rainfall as little as 100mm per year. Several observations made in Zimbabwe, Botswana and Israel show that between 80 to 85 per cent of all measurable rain can be collected and stored from outside catchment areas. This includes light drizzle and dew condensation which occurs in many parts of the country during the drier months.

The run-off from a catchment area can be worked out by the simple formula,

$$Q = C \times I \times A$$

Where, Q = discharge in cu.m.
C = co-efficient of run-off
I = Total rainfall per annum, m
A = Catchment area, sq.m.

The co-efficient of run-off depends upon the shape, size, soil conditions, temperature, geological conditions of the area of the catchment. However, on the basis of average annual rainfall in the area the co-efficient an be assumed.

Dry tracts with annual rainfall	350 to 750 mm	– 15 to 20 per cent
Intermediate Zones rain	750 to 1500 mm	– 20 to 30 per cent
Higher Zone with rainfall above	1500 mm	– 30 to 55 per cent
Roof and paved areas		80 to 90 per cent

As an example, if the rainfall is 635 mm per year the run-off from a suitable catchment area will be about 500 mm, and an area covering 1 hectare may yield 50,00,000 litres of water per year — enough for 500 heads of cattle for six months. *One millimeter of rain falling on one sq. m. of area will yield approximately one litre of water.* The requirement for solely domestic purposes may be 15 to 20 litres per head per day. For a family of of 5 persons, the daily requirement would be 100 litres. If we assume that the longest period without rain would be 6 months, the volume of water required to last throughout the dry season would be 180 x 10 = 18,000 litres.

All harvester surfaces, being exposed to the atmosphere throughout the year, are subject to contamination by dust, insects and birds. Harvester surfaces at ground level, however, can be fenced and kept clean. Storage tanks may be built below or above ground. The tanks should be fully enclosed to prevent evaporation. All apertures should be screened to prevent the access of mosquitoes, rodents, lizards, etc. The first flush of the new rains should be allowed to run waste. Sometimes water is passed through a sand filter before it is consumed for drinking.

Artificial harvesters

If water is required where there is no roof or rocky outcrop suitable for collection, the construction of an impervious surface can be undertaken on the ground itself. Reinforced concrete can be used to make the surface; chicken wire reinforcing should be used to prevent cracking of the floor. An alternative technique is to lay a large piece of plastic sheeting in a hollowed out and levelled area of ground. A layer of sand is laid over the bottom of the excavated area and raked flat. The sheet of plastic is laid out over the layer of sand and the edges raised up against the side walls of the excavation.

A drainage system is now laid in the form of a slotted PVC pipe which drains away in the reservoir used for storage. Finally, a layer of gravel or very coarse washed river sand is laid on the bed. The edges of the area should be raised with a rim of concrete work. No part of the plastic sheet should be exposed to the sun or it will perish within a year. The area should be fenced off to prevent access to animals. The construction of the reservoir is the costliest. It may be either in stone masonry or R.C.C. and constructed either below or above ground. (A detailed design of the scheme along with drawings of the artificial harvesters discussed are available with the authors).

Cost of the project

Developing and maintaining harvesting area : 6750 sq.m. at Rs.20 / - per sqm. = Rs. 135,000.

Constructing masonry underground or above ground tank of size 15x12x1.8 = 324,000 litres at the rate of Rs.2 / - per litre = Rs.648,000.

Add 10 percent towards misc. = Rs.78,300
Total Cost = Rs.861,300.
Therefore cost per head = Rs.1725.

Conclusions

- The efforts of state and central agencies to provide an adequate water supply to rural people have failed miserably due to non-availability of reliable sources of water. It is necessary to store water in lakes, ponds, and artificial ditches and improve the ground water table.
- It is also necessary to prepare a national water grid and connect the rivers. All irrigation projects must be taken up for completion immediately. Projects like Talagu Ganga Project and Narmada Project must be completed in priority. Similar projects should be conceptualized and implemented to overcome the problems of drinking water in India.