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WATER AND SANITATION FOR ALL: PARTNERSHIPS AND INNOVATIONS

Towards affordable water supply

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KADUNA STATE OF Nigeria has a 1991 population of 4.1 million of which 58 per cent is served with water supply by Kaduna State Water Board. A State-Wide Water Resources Masterplan is being developed to improve coverage to more than 70 per cent covering a projected population of 7.1 million by the year 2020.

Paying for water

Until recently, water supply in Nigeria was regarded as a social service and, therefore, Government provided the infrastructure and gave subvention in form of cash or material to State Water Agencies (SWAs). In most cases, communities are charged for only a fraction of the O&M costs.

Things are changing

However, with on-going awareness campaign being intensified for consumers to realise that fund for providing potable water must be generated from the volume of water sold, things are changing. As such Kaduna State Water Board (one of the 37 SWAs in the country) has been operating as a commercial entity, since 1993, paying for nearly all its operational expenses from internally generated revenue.

The ideal model

With cost recovery in mind, it is clear that new water supply schemes need to be essentially low cost. The recently commissioned Zonkwa Regional Water Supply scheme is seen as a model for affordable water supply both in terms of capital and running costs. Of special interest is that this model is a result of a reviewed concept for a project which has virtually been shelved. Also, this experience becomes very important in the light of the eleven new water schemes proposed in the new Water Resources Masterplan for the State.

Zonkwa regional water supply scheme

This water supply scheme is financed under the World Bank funded First Multi-State Water Supply Project.

The Project was conceived in 1976 to be a regional scheme supplying water to the towns of Zonkwa, Manchok, Samaru, Zangon Kataf and all villages en-route. The project has a design population of 122,400. Maximum daily demand for the scheme was determined as 12,868 m^3/d or 4.71 MCM (million cubic metres) per annum.

Initial concept

Zonkwa is sited on a basement complex formation with generally poor ground water potential insufficient to meet the demand of the population. For this reason there is an urgent need for piped supplies from surface water sources.

Hydrological investigation revealed that River Kwasau is the only nearby source of surface water which can be envisaged for development. The river has a catchment area of 22km2. Surface runoff records from a gauging station at Zonkwa were available from 1973. Characteristic discharges of 9.53 MCM annual mean and 4.9.MCM monthly maximum were obtained.

The result further revealed that River Kwasau is not a perennial river and ,therefore, it was concluded that the base flow is unreliable to support a direct river abstraction and that an impounding reservoir will be ultimately required.

Impounding reservoir

The anticipated raw water demand of the Zonkwa was to be made available by construction of an earth dam on River Kwasau to store any flows in excess of demand during the rainy season for use during the low/dry flow season.

Monthly inflow/outflow budget was simulated along with sediment load calculation, and the gross storage capacity of the reservoir was determined as 3.45MCM. The safe yield of the reservoir was determined as 18.67m3/day.

Treatment processes

Based on the above concept and the result of the chemical and bacteriological analysis of the raw water, a conventional water treatment plant of 536m3/hr (12,868 m3/yr) was proposed having the following treatment processes to meet the demand of the project area in year 2005:

- Aeration
- Floculation
- Clarification
- Rapid gravity filtration, and
- Disinfection

These processes require the extensive application of Alum, Lime, Sodium alginate and Chlorine.

The projected capital cost of the proposed scheme was found to be beyond the limit of the loan and the operation cost beyond the affordability of the population because of

the agrarian setting of the community. Hence, the need to review the concept was initiated by the World Bank.

Reviewed concept

Change of raw water source

The new concept was based on the discovery of a spring (Kajim Spring) at the town of Manchok (35km from Zonkwa) which is capable of meeting the required demand. The yield of the spring was investigated to confirm its reliability to meet the demand of the project area to the planning horizon (year 2005).

A safe yield of 17,280 m3/d (720 m3/hr) was established which is just slightly lower than that of the reservoir in the initial concept. The reliability of this source discarded the previous concept of using an impounding reservoir for abstraction.

Raw water quality

Water from Kajim Spring was sampled for Chemical and Bacteriological analysis at two different Laboratories. The test reports confirmed the presence of E. Coli apart from that they concluded that the water was of very good quality, very soft with low levels of minerals and nutrients, and non-aggressive.

The results of the parameters tested were all within acceptable limits of the World Health Organisation (WHO) recommended guidelines. But the presence of E.Coli has rendered the water unfit for direct human consumption.

Treatment processes

The use of sand filtration and precautionary disinfection were therefore the only treatment processes applied. This development has resulted in savings both in terms of development of treatment plant infrastructure and operation cost.

The elimination of the use of Alum for coagulation and Lime for pH correction in the treatment processes is very vital due to the cost of this chemicals in developing countries. This is especially significant, noting that these two chemicals alone constitutes about 40 per cent of the Board's overall operating cost in 1996.

Construction cost

The costs of construction of abstraction and treatment units for both concepts are compared to determine the most affordable to the consumers. Table 1 below shows the estimated costs of the components.

The change in raw water source has lowered the capital cost by 56 per cent. The community is therefore on a better footing to repay the loan which has to be recouped from the sale of water.

Chemical cost

Aluminium Sulphate, hydrated lime, sodium alginate and chlorine were all envisaged to be applied in the treatment of raw water in the initial concept. But the reviewed concept has chlorine as the only water treatment chemical to be applied. A comparative cost of treatment for the two concept is reviewed to determine the most affordable to the community as shown in Table 2.

Table 1. Comparative construction costs

Component	*Cost ($ million)* *Initial concept*	*Reviewed concept*
Earth dam	11.10	Nil
Raw water Intake	0.460	0.364
Treatment plant	3.880	2.879
Transmission/ reticulation mains	6.510	5.970
Service reservoirs	2.170	1.390
Total cost ($million)	24.120	10.603

The annual cost of water treatment for the reviewed concept has proved to be only 19 per cent of the initial concept.

Energy cost

The total power requirement of the initial concept was projected to be 325Kw/yr while that of the reviewed concept was estimated at 240Kw/yr. The cost savings was worked out to be 20 per cent of the initial concept.

Average incremental cost

Two alternatives have been analysed from economic perspectives to determine the most affordable option for the community. In this last stage, attempt is made to work out the average incremental cost of each concept.

Loan maturity period (World Bank)	–	25 years
Interest rate	–	15% per annum
Capital recovery factor	–	0.15470
Unaccounted-for-water	–	30 per cent
Exchange rate	–	1USD$ = ₦82

Below is a comparison of equivalent annual costs for the two alternatives:

Initial concept

Capital recovery cost	=	$3,731,364.00
Annual chemical cost	=	36,472.00
Annual energy cost	=	73,125.00
Total annual cost	=	$4,001,697.00

Reviewed concept

Capital recovery cost	=	$1,640,284.00
Annual chemical cost	=	36,472.00
Annual energy cost	=	52,875.00
Total annual cost	=	$1,729,631.00

The Average Incremental Cost of both schemes were calculated from above parameters to be *$1.15/m3* for the

Table 2. Annual cost of treatment chemicals

Chemical	*Quantity (tons)*	*Amount ($) Initial*	*Reviewed*
Chlorine	9.4	36,472	Nil
Hydrated lime	94.2	18,840	Nil
Aluminium sulphate	283	95,654	Nil
Sodium alginate	1.4	350	Nil
Hydrated lime	47.1	9,420	Nil
Chlorine	9.4	36,472	36,472
		197,208	36,472

Initial and *$0.49/m3* for the Reviewed concept. The tariff now required to break even is *₦58/m3* instead of *₦136/m3* for the initial option. That is, of course, if the community will directly bear the cost without cross-subsidy.

Other costs

With the reviewed concept, other economic costs to the community associated with the environmental impact of siting and construction of large reservoirs have also been eliminated. The overall benefits of this project to a community who have waited for over 20 years without safe water supply is very high indeed.

Cost recovery initiatives

While ensuring that water is affordable and available to communities, the Board is at the same time looking at measures to ensure effective cost recovery. Such include a policy which implies that new projects (like Zonkwa) are provided with Water Selling Kiosks (WSK) so that those who cannot afford house connections can buy directly from licensed vendors. This is to ensure that revenue is collected directly from users instead of from Local Government accounts as is the case with Public Stand Posts (PSP).

Conclusion

Today, the Zonkwa Water Supply Scheme has seen the light of the day mainly because there was willingness on the part of the donor (The World Bank) and KDSWB to seek for low cost solutions. This has not only made the project possible but the community will now pay only 43 per cent of the annual cost of the initial option.

If this trend continues, the newly proposed Water Supply schemes will mean cheaper water and better service coverage for the population of Kaduna State.

One lesson learnt from this experience is that low cost alternatives are always available as long as there is the willingness to pursue them by all parties concerned.

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