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Water Master Planning in rural areas of developing countries - A case study from Malawi

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WHAT IS WATER MASTER PLANNING ?

Water Master Planning is normally required by a government agency in order to provide a basis for the development strategy and long term planning outline in the nature sector. Because of its horizon of around 20 years, a water master plan must be a dynamic tool which needs ongoing re-appraisal and adjustment to take account of changing circumstances. An outline plan however is of immense value, in ensuring that short term planning and implementation is in line with longer term strategies and objectives, and in the planning of an economic and practical phased implementation programme.

Water master planning involves considerably more than just engineering inputs. Typically the following disciplines are involved in the development of a water master plan.

- . hydrological
- . hydrogeological
- . socio-economic
- . water engineering
- . surveying
- . water quality
- . water treatment
- . planning
- . tariff
- . management
- . economical

The present plan, in addition to presenting the relevant data and recommendations in respect of each discipline, will include an implementation programme over the planning horizon, which has been technically and economically derived as the optimum and which will be subsequently used to identify the following initial stages of implementation.

The collection, verification and presentation of data represents a large part of any water master plan input and therefore computerisation of data handling and analysis is essential.

The authors have been involved in water master planning throughout Africa over the last 20 years with the most recent example being in connection with 44 semi-urban supplies in Malawi. The project is set in a rural environment and takes into account the needs of

the rural fringe population in addition to that of the centre itself.

Malawi - 44 semi urban centres.

Background

The 44 centres are distributed throughout Malawi. They range in size from 5000 to 30,000 population at present. In character many are very much rural centres serving as a service centre for the surrounding population and often having agricultural extension facilities.

Around half of the centres have an improved water supply at present but even these are not fully serving the population in most cases. A significant recent development is the incorporation of the supply of rural fringe population of these centres from communal water points. This is increasing the demand from existing and proposed new water supplies for these centres.

Resources

Hydrological and hydrogeological teams visited all centres and investigated the potential sources in the vicinity. Although ground water had proven to be a significant proportion of the existing sources, the areas of the centres now under study were often found to be characterized by poor quality or yields. However with careful siting and development it is still expected that because of cost and treatment benefits, groundwater would represent the majority of the proposed new sources.

Mathematical simulation models were used to analyse potential surface sources where insufficient river gaugings were available.

Socio-Economic

A team of socio-economists similarly visited each centre and carried out in-depth studies in selected centres. A standard questionnaire was used to supplement base data with centre level information.

Aspects that were investigated included development potential, population growth, service level, affordability and tariff. The relationship between a central supply where

consumers pay for water through metered connections and a supply to rural populations which is traditionally free in Malawi, was a complex issue.

Water Engineering

All existing systems were inspected and evaluated to determine the degree and nature of rehabilitation and extension which would be appropriate.

For both existing and proposed schemes an outline of the system was developed from existing mapping as a basis for costing.

Taking into account different water characteristics from ground, lake and streams, standard treatment systems and processes were developed to ensure an acceptable quality at an appropriate operational level and cost.

The layout of the distribution system in outline as a basis for costing, was developed from the interpretation of plans by the socio-economical team. Account was taken of specific or probable plans for institutional and commercial developments and the zoning outlines within each centre.

Costing

A computerised cost catalogue was developed for the project by expanding unit costs into elemental costs for the main scheme components of:

- . source
- . treatment
- . pumping
- . storage
- . reticulation

By preparing this cost catalogue over a range of signs and types in respect of each component, the scheme costs could be readily compiled in each case.

Costs were broken down into foreign and local cost components and were compiled such that sensitivity studies could be carried out.

Development Programme

The development programme for the project has been prepared taking into account need/cost criteria. Need criteria as evaluated by equating production and distribution shortfalls both separately and combined over various time horizons.

The resultant objective programme was then considered subjectively both by the consultants and clients and a final recommendation of implementation was produced. During development this implementation programme was

subject to economic evaluation such that the resultant programme would represent an acceptable investment/revenue relationship.

The iterative process involved in this development was carried out on computer which also gave the consultants the flexibility to try alternative approaches and models to test sensitivity and to ensure that an optimum result was achieved.

A complication in the development of such an implementation programme is the practicality and economic viability of the phasing of different scheme units. For example a trunk supply main is often only economic to develop in one or at most two stages over a 20 year planning horizon, whereas distribution mains, treatment works, pumps and boreholes can be phased in smaller but varying periods. These practical considerations were developed into a model which was in turn applied to the development of the implementation programme.

Financial and Economic Analysis

The financial and economic analysis was carried out at these levels

aggregate profitability analysis of 44 centre projects

liquidity analysis of 44 centre projects

overall financial analysis of District Water Supply

Fund (DWSF)

The analyses were carried out on incremental basis both in respect of investments and revenue, and both individually for each of the 44 centres and on an aggregate basis in respect of financial analyses.

Sensitivity analyses on the base financial analysis were carried out to test the effect on the project in respect of

- . changing consumption and production levels
- . changing investment costs
- . changing operation and maintenance costs