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RURAL WATER SUPPLY IN AYANGBA AREA, NIGERIA

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1. GENERAL

1.1 Introduction

In the development process one of the first aims is the establishment of reliable water supplies in rural areas. With this in mint the Ministry of Agriculture in Benue State, Nigeria, commissioned us as consultants to undertake a survey for the Ayangba Agricultural Development Project in the western part of the state. The aim of the survey (1980/81) was to examine the water resources and requirements for improving water supplies in the project area. The following conditions were given:-

- The survey to be of short duration and based as far as possible on existing information.

- An effort should be made to implement any proposals within three years.

- The conflicting interests of settled and nomadic population should be considered.

- Local resources and materials should be used.

- The use of the limited funds available should be confined to rural communities and urban centres should be excluded.

- The cost effectiveness of existing structures and supply systems should be investigated and their future usefulness assessed.

1.2 General Description of Area

The project area covers approximately 3000 sq. kilometres in which it is estimated that there is a rural population of about 1 million people. There are about 1800 communities. The settled populations are cultivators, but there are significant numbers of Fulani cattle folk who are nomadic. The country is fairly well watered but the need to protect the interests of both types of inhabitant is an added factor.

The area is bounded on the west by the River Niger and on the north by the River Benue, a major tributory of the Niger.

1.3 Method of Investigation

The study comprised three overlapping phases:

- orientation and data collection.
- field surveys.
- report production.

Existing mapping was used. Aneroid surveys were made. Stream gauging and well levels were recorded. Field appreciation of villages and their existing water supplies was made.
All data published by Government and Provincial agencies was collected.

2. WATER RESOURCES GEOGRAPHICAL CLASSIFICATION

2.1 Geological Study

Examination revealed that the area falls naturally into five water resource units, some of which could be further sub-divided:-

i) River Alluvium
ii) South-west Lowlands
iii) High Plateau
iv) Cretaceous Piedmont
v) Crystalline Lowlands

i) River alluvium. These consisted of sands yielding small supplies of clean water from shallow wells.

ii) Lowlands. These were mainly on clay and were crossed by streams draining from the Plateau, which had become polluted in transit.

iii) High Plateau. This covered a high proportion of the area and contained plentiful supplies of water at depth in the underlying sandstone. From the escarpment springs emerge which carry away water spilt from the sandstone and these form the streams which traverse the lowlands.

iv) Cretaceous Piedmont. These sandstones and sills lie to the north and west of the Plateau. Small springs can be used locally, but most communities use the surface streams originating from the escarpment of the Plateau.

v) Crystalline Lowlands. These are of laterite and contain little underground water. As in the case of the Piedmont local supplies are taken from surface streams.

3. EXISTING WATER SOURCES AND USAGE

3.1 Sources

Although not immediately apparent, the area is fairly well off for water.

In the Plateau area the Ajali sandstones can be tapped by boreholes of up to 70 metres depth to yield water of good quality.

The springs of the escarpment form streams flowing radially away towards the great rivers. These streams become polluted as they get further from source but are widely used by villagers and tanker lorries.

Peculiar to this part of Africa are excavated holes of large size called taphis which drain water from the silt in which they are dug to form stock-watering points.

The total amount of water used is small in relation to the large quantities available. The problems therefore are of distribution, quality and cost.

3.2 Cost

Most of the water used is abstracted from surface springs and streams and head-carried by village women, often for quite considerable distances, although the average would rarely exceed 2 kilometres. This is a chore often performed by elder daughters before going to school, and after their return.

A smaller, but still significant, amount is distributed by tanker lorry to outlying villages who store it in old oil drums placed on the roadside convenient to their houses.

In some of the bigger villages on the Plateau water is pumped from boreholes to public standpipes, and distributed free.

To the extent that head-carrying might be regarded as a household duty, water obtained this way is also free, but the cost of lorry borne supplies is extremely expensive and at the time of the survey was estimated to cost anything up to Naira 300 per annum per family according to their needs and location.

3.3 Social Usage and Quality

Head-carrying and the washing of clothes at the sources provide a daily opportunity for the exchange of views on village affairs, but it is noticeable that as progress is made, first to communal taps, and later to individual services, village women are pleased to be relieved of head-carrying duties.

Both villages and tankers take water from unprotected sources, the latter generally from the larger, more accessible sites.

Little effort was made to protect or organise abstraction although at any given point, as a matter of common sense, clothes were washed below the point where drinking water was abstracted.

However, villages in the lower reaches of the stream were bound to accept water polluted by those nearest to the spring.

Water from boreholes, and initially from springs, was of high quality. There were few dug-wells in the area but where these were to be found they were often polluted.

4. POPULATION AND PROJECTED REQUIREMENTS

No exact figure for the population was available but it is believed that upwards of 1 million people inhabit the area. The scattered nature and small size of many of the communities precluded the possibility that all could be served. The basic minimum supply envisaged was 25 litres per capita per day. The funds available were to be expended to give the maximum betterment of supply to as many people as possible.

5. GENERAL RECOMMENDATIONS

5.1 Scope of Timing

It should be accepted this scheme is a first step only towards improvement of the general water position, and is limited by the practical use of the funds available. The natural sequence of events is expected to be:

Present. Improvement of existing facilities for head-carrying and distribution by tanker.

Near Future. Supply by public tap to central points.

More Distant Future. Supply of treated water by individual service pipe.

At all times the need to look ahead should be observed. Any new boreholes should be constructed so as to remain effective at a later stage. Sectional steel plate reservoirs should be used. At some future time they can be pulled down and used elsewhere. In these days of mounting inflation it is often the case that a sectional steel tank can be purchased, serve ten or more years in some village, and when at last it becomes too small it can generally be sold to a smaller place for more than it originally cost!

As living standards rise and there is demand for full treatment of the raw water, the accompanying rising prosperity will take care of the costs.

5.2 Present Improvements - General

The immediate objective was to improve present arrangements. An initial step was to reduce the distance villagers had to walk by increasing the number of watering points, and this in turn would reduce the number of those being forced to use expensive tankered supplies. A further consideration of utmost importance was that of quality. Where new boreholes were a practical possiblity high natural quality could easily be achieved. Simple protective measures could be introduced at springs. Lower down the river, treatment being out of the question, concrete troughs and hard standings were provided, and areas for various usage were defined and railed off.

It had been noted that in parts of the Plateau, women had to walk as much as 8 kilometres for water. New watering points were to be established to ensure no villagers would have to walk more than 2 kilometres.

5.3 Types of Improvement

Boreholes - storage tank - common taps. where possible, in areas of favourable hydrogeology and larger communities, were ideal. It produced pure water in centres of population and it was the type of scheme that could be expanded. The problem was cost. In 1979 it was expected that each installation would cost Naira 67,000, and that as many as 120 might be needed. (March 1980 1 Naira = £0.81)

Spring protection, pumping and improvement of existing supply. There were many springs at the foot of the escarpement and it was already possible to fence these off and instal a diesel driven pump which would lift water by pipe to a row of common taps in the village.

Spring and stream improvement of local bucket filling facilities. A large number of bucket filling points existed. Water is used sequentially for drinking, bathing and laundry purposes. The weaknesses are that the water slope is flat and soap suds may be projected upstream, and the sandy bottoms get churned up by users and silt is thrown into suspension. The action proposed was to create concrete lined channels with concrete aprons for the villagers to stand on. The cost per installation was estimated to be Naira 8500.

These installations have a life limited by the future provision of any form of piped supply.

Flowing borehole and bucket dipping point in parts of the alluvium deep artesian boreholes from which hot water flows. There would be no running costs but the capital cost of Naira 1300 was too high.

Repairs of existing pumps and boreholes. There were many existing borehole installations and a high percentage of these were not operational. A quick survey indicated that most of the problems were due to minor mechanical deficiencies.

Piped extensions. Certain big villages with rudimentary pipe systems had outlying appendages which could be served by minor extensions to the pipe system. Twenty such cases were located and the average cost of the pipework and common taps amounted in each case to about Naira 15000.

5.4 Pumping Plant

Power. Power is not available and any form of electrically driven pump would have to be accompanied by a diesel engine driven alternator.

5.4.2 Alternative pumping methods.

Hand pumps could be used, but the cost would be high. No cheap form of boring can be used and the cost of individual boreholes would be high per unit of water raised. The water lies at considerable depth and much physical effort would go into filling a bucket.

Hydraulic rams and air lifts are not suited to local groundwater conditions. The ground is too flat for the former, and the latter cannot operate with the high lift/immersion ratios in the local boreholes.

Windmills are not popular in Nigeria for two reasons :

- They are bolted structures and the nuts and bolts tend to get stolen. This could be cured by welding.
- The water is far below surface so the pump rods are long and heavy. Therefore much of the energy generated by the windmill is employed in lifting the rods.

5.5 Cost of Water

The cost of water varies according to the sophistication of the methods proposed. Each cost quoted was calculated in 1979 and includes both capital and running costs.

Types of Installation	Cost per m^3	Yearly cost per head
Borehole & filling points	30 kobo	Naira 2.72
Improved spring filling points	21 kobo	Naira 1.90
Bucket dipping point on stream	11 kobo	Naira 1.00
Flowing bore-hole with filling points	41 kobo	Naira 3

(1 Naira = 100 kobos = US$ 1.25)

The costs per unit of water delivered appear to be high because they are related to the very small quantities used. The cost of giving one person a year's supply of water at a dipping point would only amount to Naira 1 per annum.

All the above should be compared with the average cost of buying tanker-truck delivered water (Naira 2.75 per m^3.)

6. CATTLE REQUIREMENTS

Eight cattle reserves were proposed. Each reserve was divided into four quadrants, watering points being provided in each quadrant. Stock were rotated between quadrants for grazing purposes. Dipping points were also provided in each quadrant. It is expected that up to 3000 cattle could be accommodated in each reserve.

In every case surface water sources were used.

The dipping points were of 20 m^3 capacity.

Flumes and drinking troughs sited away from the stream and fed by a shadoof were proposed. The object was to keep the cattle away from fouling the stream, and this cannot be done without extensive fencing. The cost of the concrete facilities was Naira 6600. There were no running costs.

Keeping the cattle away from the streams depends mostly on the herdsman. It is clearly easier for him to let the cattle go into the stream and relieve him from operating the shadoof.

6.1 Organisation

The main problem of water supply in developing countries is of maintenance. There are innumerable examples of competently constructed works falling into disrepair and disuse.

In considering how to implement the project the Ayangba Agricultural Development Project staff chose to proceed by direct labour not only because of the greater flexibility this would permit in meeting the needs of hundreds of local circumstances but because the presence of skilled permanent employees would ensure constant back-up maintenance, and provide training for local personnel.

It was decided to use two drilling rigs and planned to sink 15 boreholes per rig per annum.

Quite apart from the merit of having staff and equipment available, it could be shown to be cheaper than employing a contractor.

6.2 Rate Collection

Water is given free throughout the supply area but in some of the bigger towns, not included in the survey, more standard supplies have been established and charges are made. Working on the assumption that running costs will be incurred on the borehole installations for power and for attendance, thought was given to the need for some form of annual levy to be made. It was suggested that any form of control and book-keeping would be uneconomic and where no annual running charges would arise it would be cheaper to continue to give the water away freely.

Where running costs indicated the need for water charge collection it was recommended that a levy should be made on each community on an annual basis, and that its collection should be a local responsibility.