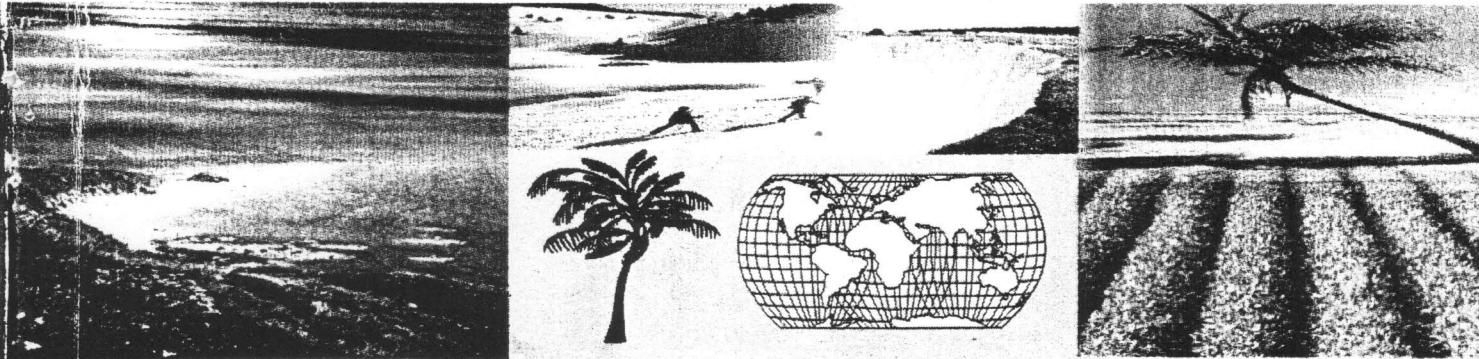
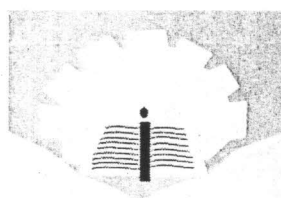




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IES Opening up the Rural areas in Kwara State through the Provision of Water Resources: The Policy Options

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Abstract

Many of the states in Nigeria have the provision of portable water supply for the people high on their priority list agenda. There are however quite a number of options to doing this particularly in rural areas. This paper examined the various options in Kwara State based on the physical resources available and the subsequent analysis shows that the state has enough water to open up the rural areas, not only for domestic purpose but also for industrial development too. Further, it was equally observed that the major hindrance to achieving this goal bothers largely on government commitments, finance and management.

Introduction

In the tropical developing countries a large amount of misery, sickness and death occur due to infectious water supplies related diseases. Such can be prevented by the use of multiple house-hold tap systems of safe water, but the provision of these in rural Africa is a luxury.

People can be affected by different diseases as a result of the water they drink. Examples include Typhoid, Cholera, Bacillary Dysentery, Guinea Worm, Hookworm and many others. Though the way in which water improvements reduce diseases depends on the particular diseases involved, yet the local authority should be able to provide ideal system for the people by way of getting them clean water either by providing tap water, covered wells or sanitary dams and weirs.

Adequate provision of rural water may be looked upon in terms of quality of water, its greater reliability, increased quantity of available water and a reduction of its distance from the consumer. A reduction in the walking distance of the water may lead to improved energy. The improved quality of the water may lead to improved health which can result in lower medical expenditure, improved sense of well-being, increased fitness hence increased productivity of agricultural workers leading to an increase in crop production and a lessening of disability effects of childhood infection.

If the goal of water provision in Kwara State is to supply water to every nook and corner of the state, the questions that follows thus forms the objectives of this study as follows:

- (i) Is this feat realizable?
- (ii) Are the physical resources available in the state sufficient enough to support this goal?

The study area
Kwara State lies between latitude $8^{\circ}10'$ and $19^{\circ}50'N$ and between longitudes $3^{\circ}10'$ and $6^{\circ}05'E$ (Fig. 1). The area falls within the southern limits of the tropical Savannah zone of Nigeria with mean annual rainfall of 1200mm concentrated between the months of April and October and mean annual temperature varying between $31.5^{\circ}C$ and $35^{\circ}C$.

ii.



Fig.1. Kwara state showing the study area. Source: Min. of Lands & housing Ilorin.

There are seven major rivers in the state (Wuruma, Moshi, Awan, Oshin, Oyun, Asa and Ero) all draining into River Niger which forms the Eastern and Northern limit of the state. The drainage pattern is mainly dendritic which reflects the horizontal strata of the underlying geology.

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The study method

The study made use of secondary data collected from Kwara State water Corporation, Nigerian Population Commission and meteorological stations located in different parts of the state. From these data sources, indices such as annual water need, precipitable water, precipitation efficiencies, water opportunity ratios and bore-hole risk were computed for major towns and cities in the state. The formulae for derivation of the above named indices are as follows:

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Where,

WC = Annual water consumption/need

N = Number of residence

X = Water consumption in litres/day

(The value of 115 lit/head/day - National Average for Nigeria was substituted for X in this equation).

ii. **Precipitable water:**

This is defined as the amount of vapour in a vertical column of air with a cross section of 1cm^2 and a fixed depth; expressed in centimeters or millimeters. Ojo (1977) expressed the relationship between precipitable water and dew point temperature thus:

$$W = 0.6225 + 0.0279T_d \dots\dots\dots \text{equation (ii)}$$

Where,

W = Precipitable water

T_d = Dew point temperature ($^{\circ}\text{F}$)

iii. **Precipitation efficiency:**

This is the fraction of the precipitable water over a particular location that is available at the surface as rainfall (Ojo, 1977). This is obtained by dividing the mean annual rainfall (r) by the number of rainy days in the year. Result obtained is then expressed as a fraction of mean precipitable water and converted to percentages as follows:

$$\text{Peff} = \frac{r}{365w} \times 100 \dots\dots\dots \text{equation (iii)}$$

Where,

Peff = Precipitation efficiency

r = Mean annual rainfall

w = Number of rainy days in the year

W = Precipitable water

iv. **Borehole risk**

The ratio of water yield per hour from boreholes in the basement complex and cretaceous deposits was used as a column vector and matrix operator respectively to derive the borehole risk value thus:

$$V_{bc} = \begin{bmatrix} 1.0 \\ 2.4 \end{bmatrix}$$

Where V = Vector

bc = Yield ratio of basement to cretaceous rock

The vector was subsequently multiplied by a row vector whose entries a_{11} and a_{12} where, geological areal coverage of basement rock and cretaceous within a given unit area of 400sqkm. The product of the matrix is given by

$$A = (a_{11} \ a_{12}) \ b_{11} \begin{bmatrix} b_{21} \end{bmatrix}$$

$$\begin{bmatrix} a_{11} \\ b_{21} \end{bmatrix} = \begin{bmatrix} 1.0 \\ 2.4 \end{bmatrix} = \text{Matrix operator}$$

Where,

A_{11} = areal coverage by percent of basement rock

A12 = areal coverage by percent of cretaceous rock
 Thus, $R\% = \frac{a_{11} b_{11} + b_{12} b_{21} \times 100}{240}$ equation (iv)

Where R% = risk percent

240 is yield index if the whole unit area of 400sqkm is all covered by cretaceous deposits.

Data presentation, Analysis and Discussion of Results

Water Demand and supply

The climatic locations notwithstanding, most Nations of the world have water resources problems high on their list of National priorities (Douglas, 1970). For many countries, the amount of water needed per person is unknown.

Table I shows a very high water opportunity ratio for all the sampled towns in Kwara State. Based on an annual average of 900mm rainfall in Kwara State and assuming about 70% of this is lost through evaporation, the available water for every sqkm is about 192,000million litres. On the third column in the same table are the computed water need for each town. The practical realization of these theoretical values is however dependent on other climatic considerations such as, the amount of precipitable water and precipitation efficiency.

Table I: Water requirement in Kwara State by settlement

LGA	Towns	Population	Water required (million litres)	Rainfall received (million litres)	Water opportunity ratio
Asa	Afon	4,012	168.4	192,000	1,140
	Otte	4,562	191.5	"	1,003
Edu	Lafiagi	23,274	976.9	"	197
	Tsaragi	4,505	189.1	"	1,015
Ifelodun	Share	17,508	734.9	"	261
	Oro-Ago	9,499	398.7	"	482
Ilorin West	Wara	266	11.2	"	17,143
	Gbako	381	16.0	"	12,000
Ilorin East	Iponrin	1,895	79.5	"	2,415
	Oke-Oyi	6,887	289.1	"	664
Ilorin South	Fufu	347	14.6	"	13,151
	Ilofa	1,285	53.9	"	3,562
Irepodun	Omu-Aran	10,207	428.4	"	448
	Agbamu	2,838	119.1	"	1,612
Kaiama	Kaiama	9,868	414.2	"	464
	Aboki	1,040	43.7	"	4,394
Moro	Jebba	22,047	925.4	"	208
	Shao	7,466	313.4	"	613
Oyun	Ijagbo	9,331	391.7	"	490
	Erin-Ile	19,383	813.7	"	236
Baruten	Kosubosu	1,622	68.1	"	2,819
	Okuta	7,535	316.3	"	54
Offa	Offa	84,725	3,556.3	"	54
	Igbosun	413	17.3	"	11,098
Ekiti	Obbo-Ile	2,736	114.8	"	1,673
	Eruku	4,293	180.2	"	1,066
Oke-Ero	Odo-Owa	13,641	572.6	"	335
	Ilofa	9,153	384.2	"	500
Isin	Iwo	4,598	193.0	"	995
	Oke-onigbin	4,443	186.5	"	1,030
Pategi	Pategi	15,054	631.9	"	304
	Ladde	5,272	221.3	"	868

Source: Author's fieldwork (2006)

*Data based on an average of 900mm rainfall per annum and a 70% evaporation rate for a town of 1sqkm. Population figures are 1996 projections .

Precipitable water

On the average, the precipitable water over Kwara State using equation (ii) is about 3.25cm. This is quite considerable in terms of water resources.

Groundwater assessment, borehole risk and borehole projects in Kwara State

The assessment of groundwater for Kwara State is based on the geophysical surveys of Nigeria, by the Federal Department of Water Resources, which delimits Nigeria into groundwater provinces.

The basement rocks are generally poor aquifer because of their limited storage capacity. On the other hand, the cretaceous formation, which makes up about 15% of Kwara State is an unconfirmed aquifer. It has large quantity of underground water in storage. This is evident from Table II, which shows the success ratio in the cretaceous formation and basement area as 2.40 to 1.0.

Table II: Boreholes Yield in Different Geological Formations

Geological formation	Borehole location	State	Depth (m)	Static water level (m)	Yield (lit/hr.)
Basement complex	Ilorin	Kwara	28.9	3.9	16.275
	Kaduna	Kaduna	45.0	7.80	14.000
Cretaceous formation	Bida	Niger	67	16.0	32.000
	Kainji	Niger	64	18.2	40.000

Source: Ayoade and Oyebande (1978)

The Kwara State Water Corporation was established by an Edict in 1972. Among other things, the corporation is charged with responsibility of supplying water in good and sufficient quantity to almost all parts of the state. One way in which the corporation has tried to do this is through the sinking of wells and the drilling of bore-holes. The bore-hole failure rate in the state is about 40% partly because of the fact that degree of hydrogeological and geophysical surveys are superficial, and usually mostly done by direct labour (Kwara Water 1981, p. 8). When viewed in relation to the staffing position as shown in Table III, the reason for the failure rate should be obvious.

Table III: Kwara State Water Corporation Staffing Position as at December, 2006

	Cadre	Number needed	Number filled	Vacancies
1	Administrative officer	8	8	-
2	Accounts/Auditor	5	5	-
3	Engineers	8	7	1
4	Geologist/Geophysicist	4	-	4
5	Bio-Chemist	2	2	-
6	Technical officers	12	8	4
7	Superintendents	8	6	2
8	Foreman	10	6	4
9	Executive officers	8	4	4
10	Secretarial staff	12	12	-
11	Stores officers	8	8	-
12	Technical assistants	5	5	-
13	Craftsmen/Artisans	45	40	5
	Total	135	111	24

Source: Kwara State Water Corporation (2006)

In spite of these hindrances, the Kwara State Government is one of the most committed state governments in Nigeria in water production and provision for its rural citizens.

There is a lot of guess work in the siting of bore-holes, however, a general appraisal of ground water potential of the country-side is possible where a good geological map is available.

The bore-hole risk percentage computed for the state using equation (iv) shows that, there is a minimum of 50% risk involved in drilling in the basement complex rock area of Kwara State, as against 15% in areas of cretaceous deposits. Field surveys carried out also shows that many of the existing and proposed bore-hole locations are in the high risk area. The decision therefore, to site bore-hole is other than geophysical; it is more often than not to suit people aspiration and agitation.

The Kwara State Government has an ambitious bore-hole programme covering all local government areas of the state. The Federal Government is also supplementing the Kwara State Bore-hole programme.

Bore-hole programme in Kwara State started in the 1950's with a very high failure rate. For example, in 1956, about 14 bore-holes were drilled in Offa province and all were abandoned because they were unproductive. The failure rate decreased from 100% in the 1950's to about 40% in the 1960's and up till now. At present (December, 2006) there are over 250 producing bore-holes in Kwara State and drilled by the state, Federal Government and other International agencies such as UNDP, UNICEF among others. Table IV shows the depth and yield range of bore-holes for each local government.

Table IV: Bore-holes in Kwara State by Local Government Areas as at December, 2006

	LGA	No of bore-holes	Depth range (m)	Yield range Lit/hr
1	Asa	45	32	0.25
2	Edu	30	45	2.5
3	Ifelodun	25	35	0.25
4	Ilorin West	30	30	0.31
5	Irepodun	20	32	0.32
6	Kaiama	15	45	0.3
7	Moro	25	32	0.3
8	Oyun	25	30	0.35
9	Baruten	23	32	0.2
10	Offa	30	30	0.35
11	Ilorin East	20	30	0.25
12	Ekiti	15	30	0.35
13	Ilorin South	13	32	0.3
14	Oke-Ero	12	35	0.35
15	Isin	15	32	0.5
16	Patigi	25	45m	3
	Total	368		

Source: Kwara State Water Corporation, Ilorin (2006)

The highest yield from bore-hole in Kwara State is on cretaceous rock at Patigi Local Government Area producing at 3 lit/sec. A single bore-hole may cost between N120,000-150,000 and takes an average of 15 days of site operation to complete. Bore-hole drilling is therefore a very costly venture for any state government. However, if the rural communities are to be served with adequate water, the numerous regolith aquifers both in the basement complex and sedimentary areas of Nigeria must be tapped through either bore-holes or wells.

The options to efficient water supply in Kwara State

There are a number of options to efficient water supply system in Kwara State. The success of these schemes must be based on the understanding that water supply scheme is essentially a transport undertaking. The following options can be examined namely:

- Establishment of water storage centres: The storage centres could be a dam storage or a storage reservoir. The pipelines can be laid along the major roads. This is what is being done in the state presently, but it is a very costly scheme.
- Establishment of water retail outlets similar to those for petrol stations. Water supply to the underground storages at those depots should be from rainfall during the rainy season, and by trailer tankers in the dry season.
- Establishment of water panel stations to feed underground storage tanks, from which water can be pumped. If a storage reservoir can hold up to 10,000 cubic meter of water, eight of such reservoirs would be required for a population of 10,000 people. if the average daily consumption is 60 lit/day for an area having four months of dry season. Such water can be stored during the raining season.
- The use of regolith aquifers in rural areas.

This last option appears to be clearly the best and most preferable in a state where political boundaries keep changing and surface water are often unwholesome and unreliable. Moreover, the development of surface water is costly compared with the development of wells and boreholes. The regolith aquifers in the basement complex are ubiquitous (Omorinbola, 1983) although the thickness of each regolith patch varies from place to place. This uneven nature of the basal platform and the depth to it, determines the amount of water available in the regolith. In the Ilorin area for example, the average depth to water is about 6.00 meters as evidenced by the log of the Philip-Morris Bore-hole No. 1 (Table V).

Table V: Philip Morris Bore-hole Log No 1 for Ilorin

Thickness of Bed	Lithology	Absence of water
0 - 3m	Brown to soil	-
0.30 - 0.9m	Laterite	-
0.9 - 2.0m	Weathered micaceous crystalline rocks	-
2.0 - 4.0m	Weathered micaceous quartzo - feldspathic rock (clay)	-
4.0 - 5.50	Kaolinitized feldspathic rock clay	Water present
5.50 - 9.00	White kaolinitized feldspathic rock (clay)	- Do -
9 - 12.50	Weathered Schistose micaceous crystalline rock	- Do -
12.50 - 13.00	Quartzo feldspathic (pegmatic rock)	- Do -
13.00 - 16.50	Weathered schistose macaceous crystalline rock	- Do -
16.50 - 21.00	Pegmatitic rock	- Do -
Below 21.00	Granite crystalline rock	- Do -

Source: Oyegun (1983)

Furthermore, some useful descriptive statistics have been given by Omorinbola (1983) regarding some geohydrological parameters (Table VI)

Table VI: Some Geohydrological parameters in Ilorin Area.

	Mean	Standard deviation	Coefficient of variation (%)
Saturated zone thickness	11.46	4.20	37
Porosity (%)	38.50	2.02	5
Specific yield (%)	20.35	2.32	11
Permeability (cm/hr)	0.19	0.04	21
Percent clay	44	8	18
Percent slit	28	5	18
Percent sand	28	6	21

Source: Omorinbola (1983)

Groundwater is often not affected by the vagaries of weather; it is also clean, and according to De Wiest (1967), it is more abundant but less expensive to develop, than surface water, for example, the Asa-Dam in Ilorin cost the Kwara State Government N24 million to build. If the average cost of sinking a well then was N20,000, the 24 million naira would have given 1,200 bore-holes; enough for every large community in Kwara State. One other major advantage of bore-holes is that the water is portable, that is, it is found where needed.

In other to open up the rural areas and attract small scale industries, such as block making, the best option is well sinking. Large scale irrigation farms, or small scale farm holdings can depend solely on water from bore-holes to make them productive all year round. The above assertions are based on the assumption that, water containing regolith aquifers are generally widespread throughout the Nigerian basement complex area. This assumption has been reliably proved by the work of scholars (Assez, 1972; Faniran and Omorinbola, 1980; Omorinbola, 1983).

The four options outlined above imply that

- 1) Rain water is the source of all water
- 2) Such water can be collected in the air before reaching the surface by use of water panels/house roofs (Traditional method)
- 3) The water can be collected on the surface by dependence on streams and rivers.
- 4) The water can be collected from underground by tapping it through wells and bore-holes, (use of well is traditional).

Apart from pure economic, and geohydrological consideration, the choice of any of the options by a state government is often coloured by politics. This is unfortunately a major hindrance to optimal use of evidences by the executive branch of Government. More confidence should be put in the technical services by the government if the benefits of nature are to be fully tapped to the advantage of all the people.

Conclusion

Kwara State of Nigeria with resources such as the two large rivers, the Niger and Benue and hundreds of perennial streams supplementable by underground sources has enough water to open up the rural areas, both for domestic and industrial uses. The major reasons for the inability of the government in the state to make water available to all parts of the state is due largely to finance and management problems. The first causality in any meaningful water supply scheme in the state will be the central authority of water such as Water Corporation; it should be decentralized into mini river basin authorities manned by competent staff. The major rivers must be gauged and everyday record must be kept. In this regard, rural primary school pupils can be taught how to read and record rate values in stream near their schools. They should be made to take, at least three daily records. Such pupils, if they prove competent, can be awarded certificates as gauge readers, when they leave school as a way of encouraging others. The supervision should fall on the village headmasters. No remunerations should be involved at all.

Recommendation

For adequate provision of water supply in the state, the following recommendations are therefore put forward as most promising alternatives:

1. To collect and store rainwater for use in the dry season to offset demands especially for agriculture
2. To tap the numerous regolith aquifers within the basement rock within the high risk zone area
3. To sink private wells in compounds
4. To build numerous small dams and storage reservoirs in the perennial streams throughout the state. The State Government would have to be very committed for any of the schemes to succeed.

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