SCOTTISH JOURNAL OF
ARTS, SOCIAL SCIENCES
AND
SCIENTIFIC STUDIES

VOLUME 12, ISSUE I
June, 2013

Articles

A Novel Approach to Tumor Quantification and Graphical Model for Image Guided Surgery

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Abstract:

One of the problems confronting image guided surgery (IGS) is the time consumed at some stages of the procedure. This paper presents a methodological approach to calculating tumor volume by processing the MR image data records of patients and goes further to develop tumor model which could be use as a standard graphical model for tumor growth and decline for quick visual observation of patient's tumor volume prior to IGS planning up to surgical intervention phase of the treatment. The work adopts a stepwise approach that starts with tumor area determination with the aid of iterative spatial sectoring (ISS) which enables tumor volume calculation using discrete integral function. This was followed by tumor area (TA) interpolation based on fast Fourier transform (FFT) and tumor averaging that engender tumor shape model in graphic form. This approach is novel and robust in that the model could also use non-IGS protocol images thereby enabling it reused for IGS planning and intervention. The resulting graphical model provide a quick way of comprehending tumor spread within the brain anatomy, and a fast method of approximating tumor volume during IGS planning, and intervention.

Keywords: Image guided surgery (IGS), iterative spatial sectoring (ISS), tumor quantification, fast Fourier transform (FFT), tumor graphical model.

1   Introduction

The image guided surgery (IGS) / computer aided surgery (CAS) procedure requires IGS protocol imaging which is then used at both the IGS planning and surgical intervention stages. The major work at the planning stage is slice reconstruction whose output is an approximate shape of the tumor. The planning stage also enables surgeons to plan incursion route, and the surgeon could as well virtually practice the intervention ahead of time. Researchers are concerned about the tediousness of the activities at that stage, the time to execute those activities [Warfield, 1998; Kundel & Dean, 2002; Aboaba et al 2011a], and the non-reusability of non-IGS protocol image slices for surgical intervention. Many researchers among whom are [Mehrara et al, 2011; Adebamowo, 2011; Algoul et al, 2011; Kazmi, Hossain, Phillips, 2011] have proposed tumor modeling as a way of achieving quality treatment within limited time and have equally worked on modeling tumor characteristics such as types, growth, and reaction to immune systems and external inhibitions like drug, et cetera for tumor chemotherapy purposes, furthermore, [Soltanian-Zadeh & Windham, 2002] have worked on tumor volume determination using partial volume model technique.

In this paper, a post-segmentation (figures 1 and 2) approach is described that addressed the problem of time spent at IGS planning stage by providing graphical bases for quick evaluation of tumor spread within brain anatomy supported with numerical evaluation of tumor volume using discrete integral function. As regards non-reusability of non-IGS images, the principal difference is slice thickness for whereas IGS protocol imaging requires thinner slice thickness, the non-IGS protocol imaging can do with thicker slices. Other differences are image registration, and the time lag between acquisition of non-IGS protocol images and the IGS protocol images. Since the non-IGS protocol images are done for patients' examination purposes, patient registration during imaging is not congruent with IGS protocol requirements, and if eventually the patient is recommended for IGS intervention, at that time, his tumor might have appreciated in size. However, clinical examination of two sets of slices for one patient and the work of [Chignola & Foroni, 2005; Mehrara et al, 2011], plus the Malthusian and Gompertzian curves have shown insignificant differences in patient registration, and tumor size at short intervals. These reduced the problem to that of slice thickness which is effectively tackled in this paper by means of data interpolation.

The approach adopted to arrive at formulating a graphical model of brain tumor starts by determining tumor area (TA) using iterative spatial sectoring (ISS) method [Aboaba et al, 2011b] for each of the tumor slices. The tumor areas (TAs) for all tumor slices are tabulated against their respective slice thicknesses (STs), the table is then extended using FFT-based interpolation which works by zero-stuffing data intervals. A number of such tables are formed with different patient image data (tables 1 and 2), and the average of each data point is found to form a single set of data that eventually results into a model. The averaged interpolated data is then plotted which represents graphical model of tumor spread within human brain anatomy. Tumor quantification is achieved by either direct discrete integration of individual patient interpolated data points or by first of all plotting each patient interpolated data and then integrate with the aid of a discrete integral function (equation 8).
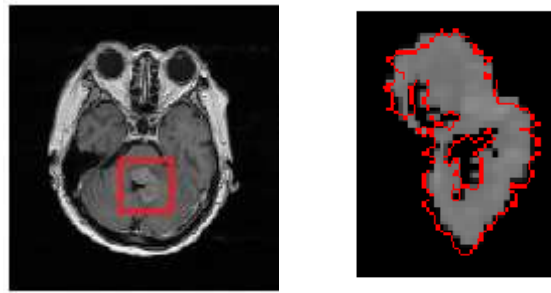
Fig. 1: Brain slice with tumor shown in rectangular block (left), and the segmented tumor (right)
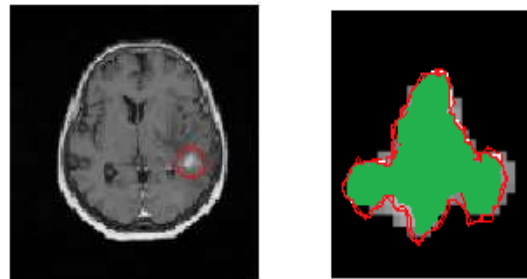
Fig. 2: Brain slice with tumor encircled in red (left), and the segmented tumor (right)

2   Tumor Area Determination Using ISS

Figures 1 and 2 are tumor slices from different patient brain tumor record, and both show typical shape of tumor appearance from slice to slice and for all patient. This implies that tumor appearance in two-dimensional (2D) is basically irregular; hence any of the formulae for determining area of irregular shape could be employed to find the area of tumor per slice. The idea of finding area of irregular closed shape by iterative spatial sectoring (ISS) was based on it high accuracy with less number iteration. The method stemmed from the Simpson's rule of approximate integral. Tumor shapes are divided into smaller sector of equal angle (θ_x) but mostly unequal radii as shown in figure 3. The radii bonding each sector are measured. The measured radii and sector angle are then used as input parameters into the ISS equation to determine the area of each sector, and the area of each sector is summed up to give tumor area (TA) per slice. A further reduction in sector angle (θ_{x+1}) is done with a new set of radii measured (figure 4) to determine tumor area a second time, and the process continues (figure 5) until convergence is achieved. Equations 1 and 2 are for determining sector angle while equations 3 and 4 are the iterative spatial sectoring functions for sector area, and tumor area (TA) respectively.
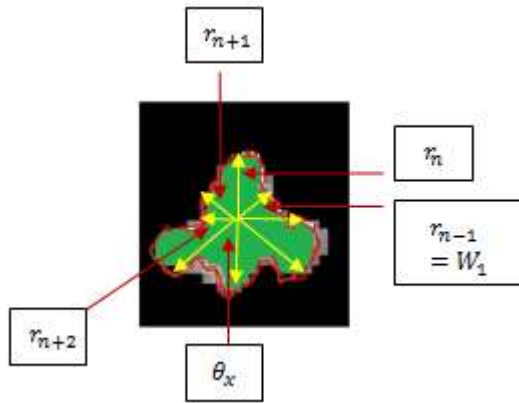
Fig.3: Division of tumor (irregular close shape) into sector
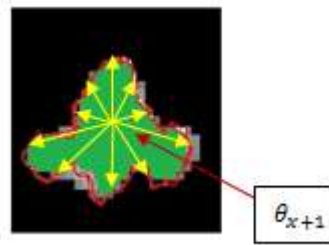
Fig.4: Reduction of sector angle to obtain smaller sector and more accurate tumor area
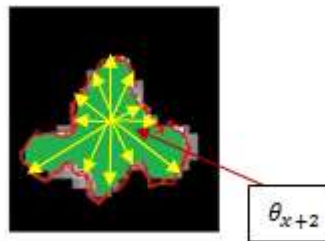
Fig.5: Further reduction in sector angle to obtain more accurate tumor area compared with figure 4

$$Initial\ Sector\ Angle(\theta_{x=1}) = \frac{|\left[\frac{A}{C}360° - 360°\right]|}{10} \dots \dots \dots (1)$$

Area of subsequent sectors in the iterative process is governed by the formula

$$Sector\ Angle(\theta_{x+i}) = \frac{|\left[\frac{A}{C}360° - 360°\right]|}{10.(i+1)} \dots \dots \dots (2)$$

Where θ_x is the sector angle, i is equal to current iteration, A is area of the circle exterior to the shape, and C is the area of the circle interior to the shape (Aboaba et al, 2011b). Therefore:

$$Area\ of\ a\ Sector\ (A_s) = \frac{\theta_x}{360°}\pi r_n . r_{n+1} \ldots\ldots\ldots (3)$$

Hence, the area of irregular close shape (R_s) for the first iteration is:

$$\sum A_s = \sum_{n=1}^{W_1-1} (\frac{\pi\theta_x}{360°})_n . r_n r_{n+1} + (\frac{\pi\theta_x}{360°})_{W_1} . r_{n-1}r_n \ldots\ldots\ldots (4)$$

Thus for subsequent (next) iteration the area of the irregular shape (R_{ss}) is:

$$\sum A_s = \sum_{n=1}^{W_1-1} (\frac{\pi\theta_{x+i}}{360°})_n . r_n r_{n+1} + (\frac{\pi\theta_{x+i}}{360°})_{W_1} . r_{n-1}r_n \ldots\ldots\ldots (5)$$

Finally the iteration stops at convergence, that is, when the area calculated from current iteration is equal or almost equal to the one in previous calculation. This is achieved when:

$$|R_{ss} - R_s| = 0 \ldots\ldots\ldots (6)$$

Hence, tumor area is said to be the value of the last iteration, and the same procedure is carried out on the next slice till all the tumor slices are processed. Furthermore, this procedure is repeated for all patients' image record to have substantial number of area versus slice thickness data.

3   Plotting Tumor Area Data

In table 1, tumor area (TA) calculated per slice for all tumor slices of three patients are tabulated. TA was calculated using iterative spatial sectoring (ISS). From the table, a plot of the three individual set of data on a single axis is shown in figure 6. It could be seen from figure 6 that all of the three curves in the figure have similar shape: blue colour for patient A, red colour for patient B, and green colour for patient C. This is an indication that a single shape model could be form for tumor growth and decay. Furthermore, individual patient's tumor volume could be determined from the data in the table.

Table 1: Tumor area versus slice thickness for three patients

Slice Thickness (ST)	Tumor Area Per Slice		
	Patient A	Patient B	Patient C
0	0.00002	0.00007	0.00003
0.002	0.00009	0.00020	0.00007
0.004	0.00020	0.00031	0.00021
0.006	0.00024	0.00035	0.00030
0.008	0.00026	0.00032	0.00038

0.010	0.00023	0.00034	0.00040
0.012	0.00017	0.00031	0.00042
0.014	0.00012	0.00028	0.00037
0.016	0.00014	0.00027	0.00033
0.018	0.00013	0.00025	0.00030
0.020	0.00009	0.00010	0.00023
0.022	0.00007	0.00005	0.00010
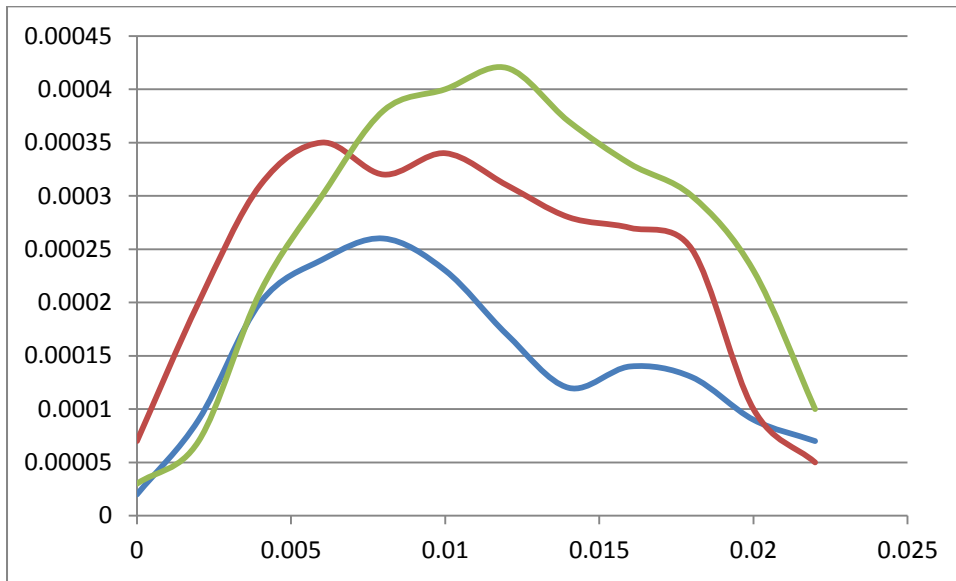
Fig.6: Three patient tumor area (TA) plots

4 Tumor Volume Determination Using Discrete Integral

Figure 6 is the plot of table 1 which is the slice thickness (ST) and tumor area (TA) information of patients' medical records. Since the curves in figure 6 are the plots of ST against TAs computed from each of the patient's MRI slice, integration of any of them with respect to the x-axis (slice thickness) results in tumor volume measured across all slice. However, since the curve is undefined, direct integration is impossible hence, we resort to approximate integral. The Simpson's rule of approximate integral is then modified for discrete data integration as in equation (7) and then applied in the form of equation (8) for tumor volume quantification.

$$\textbf{Area} \approx \textbf{s}\left(\frac{\textbf{F} + \textbf{L}}{\textbf{2}} + \sum_{\textbf{i=2}}^{\textbf{n-1}} \textbf{x}_{\textbf{i}}\right) \ldots \ldots \ldots (\textbf{7})$$

$$\textbf{Tumor Volume} \approx \textbf{st}\left(\frac{\textbf{Fta} + \textbf{Lta}}{\textbf{2}} + \sum_{\textbf{i=2}}^{\textbf{n-1}} \textbf{x}_{\textbf{ai}}\right) \ldots \ldots \ldots (\textbf{8})$$

Where $st, Fta, Lta,$ and Xai respectively stands for slice-thickness, first tumor area, last tumor area, and the rest of the tumor areas. And lastly n is the number of ordinates, and i is the ordinate counter.

4.1 Calculating Tumor Volume

For patient A: $Fta = 0.00002$, $Lta = 0.00007$, $Xai = $ (0.00009, 0.00020, 0.00024, 0.00026, 0.00023, 0.00017, 0.00012, 0.00014, 0.00013, 0.00009, and 0.00007), and $st = 0.002$

Applying equation (8),

$$
\begin{aligned}
Tumor\ Volume &= 0.002\left(\frac{0.00002 + 0.00007}{2} + (0.00009 + 0.00020 + 0.00024 + 0.00026 \right.\\
&+ 0.00023 + 0.00017 + 0.00012 + 0.00014 + 0.00013 + 0.00009 \\
&+ \left.0.00007)\right)
\end{aligned}
$$

$$Tumor\ Volume = 3.57 \times 10^{-6}$$

Similarly tumor volume for patient B and C are 5.58×10^{-6} and 6.15×10^{-6} respectively.

5 Data Point Interpolation Using Fft

Since the MRI machine is preset to certain intervals called thickness or height, and the area of tumor on the surface of individual slice is determined as in section 2, the collection of all tumor areas on the surface of every tumor slice therefore stand for tumor area at those discrete points. This leaves the volume within the slice unknown and could render volume determination inaccurate. A possible wayout is to preset the MRI machine to acquire images at thinner slice intervals. This is good but only to a certain point owing to the fact that such capability goes with either increase in image acquisition time or use of machine with high level of magnetic flux.

In order to know what is contained within the slice volume or height without reducing machine preset level, a special kind of interpolation is used. This interpolation technique makes it possible to determine any number of additional points inbetween two points, which renders the tumor volume within slice thickness and invariably results in good discrete representation of the actual tumor progression at nearly all points, and a correspondingly accurate curve. The interpolation technique adopted is the fast Fourier transform based interpolation using zero-stuffing [Weber, 1998], and it goes by this; given that $f(xi)$ is a series of numbers representing the discrete points (areas of tumor) in which the tumor in-between it volume is to be determined, the serial number is conceived as a time domain vector. Its frequency domain equivalent $f(Xi)$ after Fourier transform is given by:

$$\mathbf{f(X_i)} = \sum_{x_i=0}^{N-1} \mathbf{f(x_i)e^{\left(-j\frac{2\pi}{N}\right)X_i x_i}} \ \dots \dots \dots (9)$$

The frequency domain vector $f(X_i)$ (equation 9) is then zero-stuffed in the middle to produce Dxi -point vector called $f(X_{zi})$.

$$p(x_i) = \frac{1}{N-1} \sum_{x_i=0}^{N-1} f(X_{zi}) e^{\left(-j\frac{2\pi}{N}\right)x_i x_i} \ldots \ldots \ldots (10)$$

The zero-stuffed frequency domain vector $f(Xzi)$ is then transformed back to time domain vector (inverse Forier transform) to have Dxi – point vector called $p(xi)$ (equation 10). The interpolated tumor areas per slice for patient are then averaged to give a single set of data representing slice thickness and average tumor area. A sample of three patients' image data originally acquired at 2mm interval, their interpolation at 0.5mm interval, and the average are shown in table 2.

Table 2: Interpolated and Averaged TA

Slice Thickness (ST)	Tumor Area Per Slice			All Patient Tumor Area (TA) Average
	Patient A	Patient B	Patient C	
0.0000	0.0000200	0.0000700	0.0000300	0.00012
0.0005	0.0000223	0.0000934	0.0000269	0.000143
0.0010	0.0000358	0.0001255	0.0000315	0.000193
0.0015	0.0000594	0.0001625	0.0000458	0.000268
0.0020	0.0000900	0.0002000	0.0000700	0.00036
0.0025	0.0001230	0.0002342	0.0001026	0.00046
0.0030	0.0001541	0.0002637	0.0001399	0.000558
0.0035	0.0001802	0.0002886	0.0001770	0.000646
0.0040	0.0002000	0.0003100	0.0002100	0.00072
0.0045	0.0002141	0.0003282	0.0002372	0.00078
0.0050	0.0002242	0.0003421	0.0002595	0.000826
0.0055	0.0002324	0.0003498	0.0002796	0.000862
0.0060	0.0002400	0.0003500	0.0003000	0.00089
0.0065	0.0002475	0.0003436	0.0003220	0.000913
0.0070	0.0002541	0.0003335	0.0003444	0.000932
0.0075	0.0002587	0.0003244	0.0003646	0.000948
0.0080	0.0002600	0.0003200	0.0003800	0.00096
0.0085	0.0002575	0.0003219	0.0003894	0.000969
0.0090	0.0002511	0.0003284	0.0003941	0.000974
0.0095	0.0002417	0.0003358	0.0003966	0.000974
0.0100	0.0002300	0.0003400	0.0004000	0.00097
0.0105	0.0002167	0.0003384	0.0004057	0.000961
0.0110	0.0002021	0.0003313	0.0004129	0.000946

0.0115	0.0001865	0.0003208	0.0004187	0.000926
0.0120	0.0001700	0.0003100	0.0004200	0.0009
0.0125	0.0001535	0.0003008	0.0004146	0.000869
0.0130	0.0001385	0.0002933	0.0004028	0.000835
0.0135	0.0001267	0.0002867	0.0003868	0.0008
0.0140	0.0001200	0.0002800	0.0003700	0.00077
0.0145	0.0001191	0.0002734	0.0003554	0.000748
0.0150	0.0001237	0.0002685	0.0003443	0.000737
0.0155	0.0001316	0.0002672	0.0003363	0.000735
0.0160	0.0001400	0.0002700	0.0003300	0.00074
0.0165	0.0001456	0.0002746	0.0003239	0.000744
0.0170	0.0001460	0.0002763	0.0003170	0.000739
0.0175	0.0001404	0.0002694	0.0003091	0.000719
0.0180	0.0001300	0.0002500	0.0003000	0.00068
0.0185	0.0001172	0.0002180	0.0002890	0.000624
0.0190	0.0001049	0.0001776	0.0002747	0.000557
0.0195	0.0000956	0.0001359	0.0002553	0.000487
0.0200	0.0000900	0.0001000	0.0002300	0.00042
0.0205	0.0000871	0.0000743	0.0001992	0.000361
0.0210	0.0000844	0.0000594	0.0001651	0.000309
0.0215	0.0000793	0.0000526	0.0001310	0.000263
0.0220	0.0000700	0.0000500	0.0001000	0.00022

5.1   Graphical Model of Tumor Progression

Column one (1) and five (5) of table 2 are plotted in figure 7. A careful comparison of the curve in figure 7 and those in figure 6 reveals their similarity in terms of gradual progress to maximum point and the descend. The descend phase in all three curves in figure 6 are not smooth but their slopes are more gentle than the accending phase. A similar characteristic is seen in figure 7 with a local minimum observed around slice thickness 0.015mm and thereafter a quick small rise before finally descending. Thus figure 7 is a general representation of the three curves in figure 6, and good for shape model of tumor volume progression and decline within the brain anatomy.
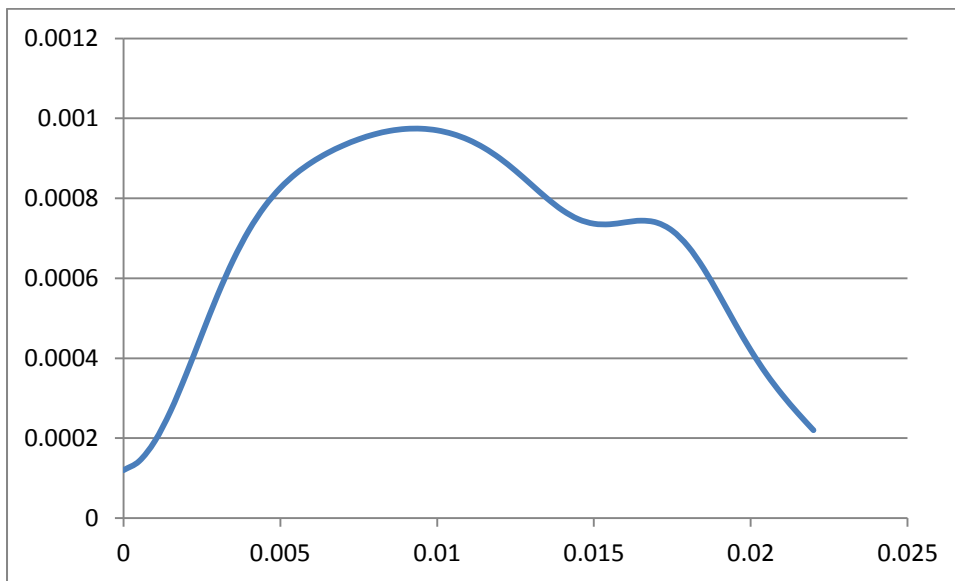
Fig.7: Plot of interpolated slice thickness versus interpolated average tumor area of three patients

6   Result Discussion

Tumor quantification using discrete integral function was demonstrated in section 4. Information about tumor area (TA) and slice thickness (ST) for three patients in table 1 were used as discrete data points from where the volume of tumor for patient A is 3.57 micro cubic meter, patient B tumor volume measured 5.58 micro cubic meter, and that of patient C is 6.15 micro cubic meter. With respect to tumor shape model, the curve in figure 7 is a generic form of the curves in figure 6, hence it could be said that tumor size progresses rapidly until the maximum size is reached from where it gradually decreases to minimum.

7   Conclusion

This paper presents a post-segmentation tumor quantification and modeling technique that is novel. The preceeding sections of this paper have shown a novel and simple approach to tumor quantification using a discrete integral function based on Simpson's rule of approximate integral. This was sequel to tumor area determination using iterative spatial sectoring (ISS).   In order to obtain TA with smaller intervals, the FFT-based interpolation was imployed which was followed by TA average for all patients to determining the tumor shape model in figure 7.

The ability to determine tumor volume shown in this paper could be combined with the IGS planning equipment capability for tumor shape extraction during IGS planning and surgical intervention. Moreover, the use FFT-based interpolation to unfold tumor size within slice thickness could enable reuse of non-IGS protocol images for IGS planning and intervention since the major difference between the two is slice thickness. And finally, figure 7 is the generic form of the three curves in figure 6, and useful for quick determination of tumor size progression and decline model within the human brain anatomy leading decrease in IGS proceedure time.

8   Recommendation and Future Work

What has been done in this paper emcompassed tumor quantification and a generic graphical model of tumor progression and decline within the human brain anatomy using novel techniques. This will be quite marvelous if tumor shape extraction could be added instead of

having to combine this with the IGS equipment capability. More so, the aspect on tumor grapical model would be more representative of patients' tumor size shape if more patients could be considered instead of three, and a mathematical model of the graphical model will be of tremendious help in simulation. All these and many more are the authors' focus for future engagement that is aimed at improving the results in this work.

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An Appraisal of the Health Management Problems of Rural Poultry Stock in Kwara State Nigeria.

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Abstract

Poultry production is very important source of livelihood for most rural communities. Poultry production has developed and occupies a place of pride among the livestock enterprice. The major factors affecting the production of poultry in Kwara State were investigated using structured questionnaire to gather data on health management practices and socio-economic factors.The socio-economic characteristics of respondents shows that majority of rural poultry farmers are women and illiterate, that sourced fund from their personal savings, relations and friends. The study also shows that seasonal variation and disease significantly influences poultry production and its marketability.There is the need to put in place enabling environment to encourage commercialization of poutry production in Kwara State, Nigeria.

Key words: Rural Poultry, Health Management, Socio-Economic, Kwara State.

Introdution

Rural poultry production is a very important source of livelihood for most rural communities. This is because it provides ready cash for emergency needs, supplies the fast growing human population with high quality protein, contributes significantly to food security, poverty alleviation and ecologically sound management of natural resources (Gueye, 2002). About 70% of the poultry product and 20% of animal protein intake in most African countries come from this sector (FAO, 2011).

The poultry production systems of Africa are mainly based on the scavenging indigeneous chickens found in virtually all villages and household in rural communities characterized by low output per bird. The types of poultry that are commonly reared are chicken, duck. guinea fowl, turkey, pigeon, amongst which the domestic fowl (chicken) predominate (Daniel, 2009).

Rural poultry are reared mainly on extensive system (scavenging). The scavenging system dominate the rural poultry sector of most African countries with very small number kept under semi intensive system (Bagnol, 2001). Rural poultry production is an hobby with about 85% of rural household in Sub-Sahara Africa rearing domestic fowl (chicken) or a mixture of chicken and other types of poultry while still engaging in other vocation such as trading, farming, fishing, and hunting (Gueye, 2002).

Due to inadequate care, rural poultry are exposed to theft, diseases, poor nutrition and vagaries of weather and environment, poor management practices and marketing (Omotosho, 2007).

Objectives of the study

To increase family / household income and animal protein intake of bulk of the populace living in the rural area.

To raise awareness and interest in rural poultry as diminishing resource that is neglected despite providing animal protein and income to rural dwellers.

To determine what the rural poultry farmer requires to enhance productivity and to contribute to information in the area of health management practices of rural poultry owners in kwara state.

Material and Method
The study area

This study covers the three senatorial district of kwara state namely: kwara Central (Afon), kwara South (Share) and kwara North (Patigi). Human population of kwara state is 2,371,089 (FGN, official gazette 2007).It lies on latitude $8^0 31$N and longitude 4^0 35E, shares boundaries with Oyo, Ekiti, Kogi, Niger and Osun states, in the North Central Geo political zone of Nigeria.

Data collection

The profile of the rural poultry owners were obtained by local interview with the respondents. Questionnaire was design to elicit data on the following (a) socio-economic factors, (b) health management practices (c) sales/marketing of rural poultry product

The person interviewed was the one that owned the birds and was responsible for all major decision affecting the bird such as sales, culling for use in the homes, purchase of feeds and veterinary drug (if any)

About 985 rural poultry owners / household were randomly selected and visited in order to collect data through the use of structured questionnaire, the duration of this study was three months.

Information obtained were analyzed and processed in descriptive statistical analysis which involved the use of statistical tool to generate frequency, distribution and percentages.

Results

The results of the studies are as shown in tables 1- 4

Table 1 Socio-economic factors of rural poultry farmer in kwara state, Nigeria

Parameter	Frequency	Percentage
Sex		
Female	837	85
Male	148	15
Education		
Literate	217	22
Illiterate	768	78

Table 2: Management system of rural poultry in kwara state Nigeria.

Parameter	Frequency	Percentage
(a) Management		
Extensive	955	97
Semi- intensive	30	3
(b) Bird type		
Domestic fowl	890	90.36
Others	95	9.64
(c) Source of labour		
Family	985	100
Hired labor	-	-
(d) Source of fund		
Personal saving	954	97
Relative	21	2
Friends	10	1
(e) Causes of mortality		
Diseases	904	91.8
Predator	75	7.6
Accident	6	0.6

Table 3: Health management practices of rural poultry owners in kwara state ,Nigeria.

Parameter	Frequency	Percentage
(a) Health management practices		
Rural poultry owner	952	96
Others(including vet)	33	4
(b) Bird vaccination		
Yes	4	0.34
No	981	99.6

Table 4: Sales of rural poultry product in kwara state,Nigeria

Parameter	Frequency	Percentage
1. **Period of high demand**		
Festive period	965	97.96
Any other time	20	2.04
2. **Marketing**		
Self	982	99.7
Retailer	3	0.3

Discussion

Generally bird scavenged around farms, compound or household. A handful of grains, household waste or wheat bran was thrown out to the birds as supplement every morning, but the newly hatched chicks were usually better cared for, than the adult ones. They were often given broken maize and other grains apart from what was made available to the other birds.Water was provided adlibitum in plastic containers or pot around the household.

Most respondents provided housing at night only, nesting places for laying birds were also frequently provided. In most cases, houses provided were either wooden, coops or baskets made with locally available material such as bricks, bamboo, cereal stovers and wood. Others allowed bird to roost in trees, under timber board or under piles of firewood.

Brooding of eggs occurred in the kitchen of most respondents or in specially elevated places above coops or in secluded places where hen and egg could be protected from rain and predators.

Consumption of poultry product was limited to festive occasion, live chicken and eggs are sold at local markets when in need of cash. Due to lack of care the rural poultry are exposed to theft, diseases, poor nutrition and vagaries of weather and environment (Adene, 1990).

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There were 985 respondents in the assessment data, majority 85% were female, 78% illiterate with an average flock size of 50-120 birds. About 90.36% had mainly domestic fowl (chicken). Most respondents reared poultry as hobby. The pattern at which the respondents practiced poultry keeping were similar to the findings of Sonaiya (2005) who reveals that scavenging system is mostly practiced by the farmer with little supplement.

It was reported by the respondents that the highest mortality rate (chicken death) was observed during raining season. This finding is similar to the work done by Halima (2007).

Conclusion

Rural poultry have adapted very well to the environment in which they are found. This positive feature helps to conserve and maintain them. Also, rural poultry thrived despite lack of adequate medical care suggesting presence of a rare trait which may be used for future improvement of rural poultry through research.

In order o sustain rural poultry and increase animal protein and income of the rural poultry owners effort should be geared toward improvement of production and health status of rural poultry in kwara state.

Recommendations

Regular Vaccination, Medication and Deworming of rural poultry stock would cause a rapid growth of rural poultry industry

Formation of Co-operative Society of rural poultry owners to promote their interest would also help the growth of rural poultry industry.

Record keeping by all rural poultry farmer is urgently needed

Feed Supplement usage should greatly be encouraged to improve the growth of rural poultry.

Rural poultry owners should be encouraged to purchase exotic cockerels (for cross breeding purposes) to be kept around the homesteads to upgrade the performance of the rural poultry industry.

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The Declined 'Country Ownership' in International Development Discourse: A Rhetorical Analysis

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Abstract:

Since 1945, after the decline of cold war it was a common wisdom that most developing countries would catch up with the level of economic development and social welfare achieved by industrialized countries by imitating their model of development. Soon the common wisdom withered away and it was globally felt that utterly imitation of development model of developed countries will not result in economic development. Due to its inherent nature of exogenous development programs, governments of developing countries at the national levels lost their maneuverability in formulating, implementing, and evaluating national programs and policies. International development discourse, therefore, has declined 'Country Ownership' in the development strategies. In this context, this paper considers World Development Report 1980 and World Development Report 1990 as international development discourse. Using Escobar and Foucault's conceptualization of development discourse and Buiter's concept of 'Country Ownership' this paper argues that international development discourse has declined 'country ownership'. The paper also investigates how international development discourse marginalizes local inclusion in the development programs and consequently analyzes how it turns out to be anti-developmental for developing countries.

Key Words: development model, country ownership, development discourse, local inclusion, anti-development.

1. Introduction

The embeddedness of economic theory in the international development discourse fails to take local dynamics of society, economy, politics and culture at the national level of developing countries into account. So the "one-size-fits-all" international development strategy, rather than ensuring economic growth, tends to fossilize the economic growth of developing countries inhibiting all endogenous opportunities of growth. Moreover, the conditionalities shrined in international development strategies pose more difficulties for the developing countries in their way of attaining economic growth. The socio-economic condition of Sub-Saharan African states, for example suggests the failure of development project to raise the quality of life on the continent. Arrighi captures the abundant assessments of the effects of underdevelopment that are in the political economy literature on Africa in the statement "over the quarter of a century, the African crisis of the late 1970 has been transformed into the African tragedy" (2002:5). UNDP more elaborately captures the African crisis in the assessment statement of 1980s decade" (1996:17). The decade of the 1980s was the lost decade for Latin America and Sub-Saharan Africa' (Ibid). African leader voiced "The effect of unfulfilled promises of global development strategy has been more sharply felt in Africa than in other continents of the world" (Ibid). The concept of local dynamics of society, economy, culture and politics refers to the country ownership which has not been taken into account while devising international development strategies embodied with conditionalities for developing countries. Therefore, international development discourse has declined country ownership resulting in anti-development for developing countries. In this context, this paper argues that international development discourse has declined 'country ownership' in the development strategies for developing countries.

2. Methodology

In order to investigate the declined 'country ownership' in the international development discourse 'World Bank Development Report 1980' and 'World Bank Development Report 1990' has been critically analyzed. More precisely, the language, power & symbol and economic concepts & theories of these two reports have been carefully analyzed in the light of country ownership. In addition, the investigation also concentrates on finding out how the absence of country ownership has led international development discourse to be anti-developmental for the developing countries marginalizing the maneuverability of developing countries in formulating, implementing and evaluating national development programs and policies at the national level.

3. Development Discourse

Foucault's conceptualization of discourse has been squarely used to define development discourse. Being deeply influenced by cultural studies, Foucault tried to understand discourse at the level of society as a whole. As noted by Peet and Hartwich (1999) "Foucault was particularly interested in the careful, rationalized, organized statements made by experts what he called discourse. Foucault's idea of discourse is the underpinning that helps to examine the rhetoric of international development discourse" (pp:129-130). Accordingly, Escobar (1995) describes development discourse is the process by which the social reality of development theory comes into being as a paradigm (p:78). Both Foucault and Escobar's conceptualization of development discourse conceives the notion of society as a whole. Foucault tries to understand the texture and nature of the social multidimensional factors. Escobar, on the other hand considers development as the social reality which implies understanding this social reality is the prerequisite of development. Therefore, the most noteworthy aspect in both Foucault and Escobar's strong suggestion on understanding the local social reality for which development

discourse needs to be deconstructed taking local languages and symbols, power relations, economic components into account. Therefore, development discourse is to be country-owned, not an exogenous imposition.

3.1 Country Ownership: Development Within

Buiter (2004) argues, unless an IMF program and the conditionalities are country-owned, the program will fail or unless an IMF program and the conditionality it embodies are country-owned, the program deserves to fail (p: 226). Country ownership is a property of programs, processes, plans or strategies involving both a 'domestic' party (generally a nation state) and a foreign party. Some of the programs or strategies to be defined as development discourse following Foucault and Escobar's conceptualization include the Poverty Reduction Strategy Papers (PRSPs), the World Bank's and IMF's Highly Indebted Poor Country Initiative (HIPC) and World Bank's Structural Adjustment Program (SAP). Buiter uses the term 'country ownership' to describe both positive and normative features of international financial institution (IFI) programs. For Buiter, country ownership can refer to a number of dimensions of multidimensional relationship of the domestic party to the program/process and its conditionality (Ibid: 224). Buiter's conceptualization of 'country ownership' is determined by any or more of the following features:

1) The country has designed and drafted the program; or its weaker siblings, ranging from 'The country has had a significant involvement in the drafting and design of the program' to ' The authorities of the country were informed of the program after it had been drawn up by other parties, typically of the World Bank and IMF.
2) The country agrees with the objectives of the program.
3) The country believes that the implementation of the program as envisaged will achieve the program's objectives.
4) 'The country implements the program' or its weaker siblings, ranging from 'The country plays a significant role in the implementation of the program' to 'The authorities of the country are kept informed of how and when the program has been implemented' (Ibid: 224).

For a country to own a development strategy, the county needs to have institutions for political and economic governance that are representative and legitimate voice to 'speak for the country' or 'to represent the interests of the country'. Buiter (2004) contextualizes three situations in which countries seek exogenous assistance.

1) They need external financial resources and cannot access these through the markets, because they are not credit worthy.
2) They need external expertise and do not have the resources to pay for this on market terms.
3) They need an external commitment device because of weak domestic political institutions (p: 225).

Buiter further argues, countries that need one or more of these external assistances - finance, expertise, commitment - are countries that are in trouble, countries that cannot help themselves, countries that are in a mess (2004: 225). Countries that are in trouble or mess are subservient to IFI development programs and thereby constrained by anti-developmental nature of the development program or discourse.

3.2 International Development Discourse as 'Anti-developmental'

Within the social sciences and in the mindset of Western people, development arguably remains as a vehicle for modernism. The 'post' within post-development refers to the

conviction that it is not a matter of identifying the most efficient way of delivering development, but questioning the very concept of development (McGregor, 2007:156). At prima facie, there appears to be little dispute over the contents and desirability of development in the post-World War II era. Development is generally understood as the intervention of aid structures and practices that would lead to rising living standards, manifested in an increase in income, which in turn would render better health and nutrition. This sympathetic vision has legitimized the rise of the development industry comprised of institutions, processes, discourses, and knowledge's, which have systemically attempted to help those 'underdeveloped' nations into idealized societies modeled after 'developed' nations in the West. Global campaigns, such as 'Make Poverty History' promote greater intervention by privileged societies into the developing world. In response to the uncritical acceptance of development, the last twenty years has seen the emergence of what can be broadly called post-modern critiques against Western development Schemas (Ibid:157).

Within the last twenty years, there has been a sprouting of literature that rejects the very meaning of development. This body of scholarship, inspired by Michel Foucault and the post-structuralist school of thought, problematizes the political and power aspects of what can be seen at face value as a neutral and practical problem – how to deliver the technological and institutional advances of the First World to 'poor' people in the subaltern (Nustad, 2001: 482). Several scholars who assert this caustic view towards development are collectively referred to as first wave 'post-development theorists' (Alvares, 1992; Escobar, 1995). This new chorus of critical theory proposes that development itself is an arbitrary concept rooted in a meta-narrative that, in turn, only benefits its practitioners. Post-development theorists maintain that the real aim of development is intimately linked to modernization, which broadens the control of the Western world and its nationalist allies within the 'developing' world (Rapley, 2004: 350).

Post-development theory has also been characterized as 'beyond development' and 'anti-development 'for its disruption of development's reductive nature. Development was subsequently rejected because its discourse essentialized non-Western cultures into their deficiencies, and thus portrayed it as a region in need of modernizing along Western models (Kothari, 1988; Rist, 1990). First-wave post-development theorists suggest that development processes undermine and destroy the diversity of social, cultural, economic, and political systems that pre-dated development, and were consequently replaced with externally imposed homogenous models of society. Escobar (1992) proposes that the problem with development is that it is external, based on the teleological path of the industrialized world, and 'more endogenous discourses' are needed instead. The assertion of 'endogenous development' harkens to dependency theory and asserts that "foreign is bad, local is good" (Kiely, 1999: 30-55). Escobar summarizes the hallmarks of the first wave of post-development theory: (1) an interest not in development alternatives, but in alternatives to development, and thus a rejection of the entire paradigm, (2) an interest in local and indigenous knowledge, (3) a critical stance towards established scientific discourses, and (4) the defense and promotion of localized, pluralistic grassroots movements (1995: 215). Escobar's concept of 'an interest in local and indigenous knowledge' clearly refers to the inclusion of local agents since without the inclusion of local agents, it is impossible to understand local knowledge. Buiter (2004) argues, the exclusion of local agents in the development discourse is variegated, yet multidimensional. The local agents whose actions are necessary for the program to succeed are, however, not necessarily those who speak for the country in the meeting or consultative processes where these programs are drafted and the conditionality is designed.

Again those on whom the success of the programs depends may not include all those affected by it. Often the majority of those affected by a program have had no voice in the design of the conditionality, and the program may not serve their interests, regardless of whether their efforts are essential to its success. If this is the reality in a country that is a candidate for a program, it is beyond the ability of the IMF, World Bank, or other IFIs to remedy it. The effective choice for the IFIs is then between not having a program and having one that is not 'country owned' in the sense of not in the interest of and supported by the majority of the population. Therefore, a common thread found in this first wave of post development theory is that it derides development as a Eurocentric discourse and advocates for new ways of thinking about non-Western countries. From this post-development perspective the indicators of anti-developmental are exclusion of local dynamics, imposition of development strategies, and destruction of local identities.

4. Rhetorical Analysis: Tracing 'Country Ownership'

Rhetoric of development discourse exhibits its appreciation of third world or developing countries. The sensuousness and glossiness of development discourse clearly reveals how the developed countries have appreciated the third world countries while devising development strategies for them neglecting 'country ownership' at the core. Therefore, rhetoric analysis of World Development Report 1980 and World Development Report 1990 has been critically analyzed to investigate the decline of country ownership in the World Development Reports.

4.1 The World Development Report 1980

To establish its development strategy, the World Bank publishes a yearly World Development Report, which describes current economic development challenges, and identifies strategies to accomplish development goals. Drawing on previous World Bank experience, the Report seeks to identify the causes and effects of progress in human development (1980). The first part of the World Development Report 1980 focuses on the economic policy choices facing both developing and developed countries, and the implications of these choices for growth (1980). This section looks specifically at the use of economic adjustment policies intended to redistribute payments imbalances. The second (and significantly larger) section considers how human development can work in tandem with adjustment policies to reduce poverty (1980). Heavily concentrated on economic adjustment policies, the World Development Report 1980 advocates the development as an exogenous imposition through economic policies mostly designed by the developed countries. This exogenous imposition of economic policies clearly neglects the local inclusion in the program design.

Language, Symbols, & Power

In the global context of rising oil prices and mounting debts, the overall language of the *Report* reveals urgency in addressing the immediate and long-term needs of the developing world. The language in the *Foreword* section, and the title 99 "this Third World Development Report" refers to the developing world as the "third world", which strongly defines the exogenous stance of the first world while designing developing programs (1980). The use of term 'third world' does not necessarily mean the inferior position of the third world, it is rather with the very sense 'they are third world and we need to do something for them'. This characterization implies that the developing world is needy, requiring policy intervention.

The World Bank paints a grim picture of the developing world without growth: "An unfavorable world economic environment casts shadows over the lives of people in developing countries; the poorest in particular face acute hardships" (1980:32). The Report suggests that "without rapid growth, hundreds of millions of very poor people will live and die with little or

no improvement in their lot" (1980:13). Thus, in the World Bank discourse of 1980, the idea that underdevelopment is a deficient standard of living is ratified.

Having identified the problem of underdevelopment, the report calls on the industrialized nations to help resolve it. As described in the first part of the report: The developing countries face formidable obstacles on the way to rapid growth – many of which – many of which they will have to overcome themselves. But through their policies on trade, aid and other capital flows, the industrialized countries and the capital-surplus oil exporters have a striking impact on how much the developing countries can accomplish (Ibid). The complete text reinforces the role of the developed world as the principal facilitator of international growth and poverty alleviation through trade, fiscal policy, and foreign direct investment. There is no mention, however, of the role of developing nations in this process. Rather, developing nations are portrayed as incapable of contributing to their own development, and therefore as having no ownership in this process. Instead, developing countries are conceived to be the "project" of other nations who have already benefited from capitalism.

Economic Theories & Concepts

The policy goals and prescriptions in the *World Development Report 1980* incorporate both a neoclassical and an institutional economic perspective. The first section, emphasizing the benefits of a rapid growth economic model, calls on countries to improve their domestic efficiency by avoiding protectionism, participating in heavy structural adjustment, restructuring their trade patterns, restricting their spending/public expenditures, and increasing investments (1980). By encouraging trade liberalization and increasing capital flows, the World Bank assumed that the market would efficiently set prices and determine wages to reduce global income and development disparities. The IFIs prescription of trade liberalization and structural adjustment programs are two invading tools designed by the first world. Both these two prescriptions are designed without hearing the voices that are affected by the program. The immediate question that can be encountered is how the country ownership is declined when the country implements liberalization and structural adjustment program.

For a program to be country owned in this case, the objective of the program is to be well addressed with the participation of those local voices that are going to be affected by the conditionality of the program. Complementing this strategy, however, are some institutional elements that emphasize sociological factors designed to contribute to rapid growth policies. This Report suggests that human development programs improve the fundamental quality of life in developing countries, by strengthening local institutions and developing human capital. In so doing, they indirectly support the economy and increase wealth. In conclusion, the report calls on development practitioners to tailor their programs to include both rapid economic growth policies (neoclassical) and human development initiatives (institutional). Yet this is strong depiction of declined country ownership in the World Development Report 1980.

4.2 The World Development Report 1990

The World Development Report 1990 promotes a message similar to that of the 1980 text. However, the message is now framed differently. Instead of separating economic growth from poverty reduction, the 1990 Report integrates the two throughout. Contending that the "most pressing issue" facing the development community is how to reduce poverty, the mission and focus of World Bank policy is directed towards measuring poverty and drawing policy lessons from countries that have experienced poverty reduction (1990: iii). Again the Report advocates the policy lessons of those countries that have experience poverty reduction. But the local dynamics of society, politics, economy and culture could be different from the one for

which the experiences and policies are going to be implemented. So the 'one size fits all' strategy dominantly excludes the country ownership in the programs. In addition, citing past development experience, the Report shows that, by incorporating poverty reduction approaches into development practices, growth strategies can more effectively sustain a higher quality of life.

The text offers a two-part strategy. The first element of the strategy is the pursuit of a pattern of growth that ensures productive use of the poor's most abundant asset – labor. The second element is widespread provision to the poor of basic social services, especially primary education, primary health care, and family planning (1990). According to the World Bank, these two elements are "mutually reinforcing; one without the other is not sufficient" (1990). The first element uses international assistance to establish local employment opportunities and to invest in local entrepreneurship. The second increases the capacity of the poor to take advantage of these opportunities (1990: iii). In concluding its assessment of effective development policy, the 1990 *Report* challenges governments in both rich and poor countries alike to make it their goal to alleviate poverty by the 21st century (1990).

Language, Symbols, & Power

Abandoning the paternalistic language of the 1980 Report, the tone of the 1990 *World Development Report* is more neutral in arguing for poverty intervention. However, the *Report's* authors continue to make a strong case for policy intervention in developing areas. What is different is that the text emphasizes that the industrialized countries should focus on those countries that help themselves: "Where developing countries are committed to reducing poverty, the industrial countries should respond with increased assistance" (1990: 6). This notion that developing countries are accountable for themselves repositions power relations where developing or low income countries are still to be considered dependent on developed countries for their strategies. No longer are developing countries seen to be completely helpless. At the same time, developed countries are reminded of their responsibility to help the less fortunate. Again the rhetoric of the *World Development Report 1990* creates a deep abyss between the developing countries and developed countries.

Economic Theories & Concepts

As in the 1980 *World Development Report*, the 1990 text recommends economic development strategies that are representative of both the institutional and neoclassical schools. The two frameworks are mutually supportive: without growth, there will be no poverty reduction, but without human capital, developing countries cannot take advantage of growth strategies. Thus, the *Report* calls for programs that develop human capital; provide access to knowledge/Education; and build institutions. At the same time, the *Report* argues that these programs must be cost-effective to be sustainable. According to the Bank, anti-poverty programs cannot substitute "for efforts to attune the broad stance of economic policy to the needs of the poor" (1990). In this sense, the primary recommendation continues to be neoclassical policies, including macroeconomic adjustment, government intervention, trade liberalization, a shift in public spending in favor of the poor, and increased capital inflows (to cushion the impact of adjustment). The discussion of economic policies tailored to local needs is limited to the section regarding transfers and safety nets. Again IFI's strong advocacy for trade liberalization and structural adjustment program fails to assess the local needs and opportunities to be realized in order to facilitate better living standard and thus it becomes an exogenous imposition of development prescriptions.

5. Declined 'Country Ownership': Encumbered National Development Programs

The decline of 'country ownership' arguably creates the question of the space for national policy-making and development strategies, particularly in developing countries. Buiter (2004) argues, if this is the reality in a country that is a candidate for a program, it is beyond the ability of the IMF, World Bank, and other IFIs to remedy it (227). The effective choice for the IFIs is then between not having a program and having one that is not 'country owned' in the sense of not in the interest of and supported by the majority of the population. So, the question of national policy space contains at least two main aspects. First, national policy space is above all a political vision of national development and welfare that countries have to fight for including their local voices in the development programs. In this regard, the identification of national and local needs is the key to the formulation and implementation of appropriate national policies. Such process can be long and painful as it entails local social dialogue among divergent interests groups as well as a political balance of powers through legal frameworks that strike a balance between rights and obligations of citizens. It also must be an endogenous process, and can neither be dictated nor passed down internationally. One aspect is related to the impact of international rules on developing countries lacking appropriate regulatory frameworks.

The capacity of developing countries to regulate according to national needs might be limited as a result of too demanding international commitments. In concrete terms, this means that international disciplines and commitments shall not be construed to prevent countries from exercising the right to regulate, and to introduce new regulations, i.e., on the supply of services, including public services, in their territories to meet national policy objectives. Therefore, services provided by central, regional and local governments and authorities shall continue to be excluded from trade negotiations as they remain as central means to maintain social cohesion and redistribution. The international macro-economic global framework and conditionality, however, continue to weaken the capabilities of developing countries to regulate internally. One could wonder indeed how developing countries, in particular in Africa, exercise their policy space, in situations where almost half of them do not have an independent monetary policy, have entered into structural adjustment program with the World Bank, and are facing the black hole of debt constraints.

Secondly, at the national level, international decisions and structures have limited governments' capacity to improve both legislation and implementation of more need based development strategies or programs which could open the new horizon of opportunities for the country.

6. Case Study: Bangladesh

Bangladesh, a country of diminished by poverty since its emergence in 1971, has been continuously seeking its way to attain economic growth and development. Therefore, the development paradigm of Bangladesh has always been significantly influenced by the IFIs. Theoretical analysis of the development paradigm of Bangladesh indicates the shifts of paradigm which are manifold in nature which positions the fact that with the development discourse being affected by exogenous IFIs, the 'country ownership' has been declined. Rahman and Eusuf (2004) argue, after independence, Bangladesh followed a policy of very rigid import substitution in its industrialization strategy. The emphasis on rigid import substitution as the development strategy clearly conceives or patronizes the expansion of domestic industry which positions local voices in the development strategy.

After the emergence of structural adjustment policies, Bangladesh became one of the countries to resort to the structural adjustment facility set by IMF in 1986. Bangladesh

embraced also Enhanced Structural Adjustment Facility by the same year. In all these strategies the notion of 'country ownership' was completely disengaged and declined. Rahman and Eusuf (2004) observes, due to structural adjustment program which advocated trade liberalization , Bangladesh faced a reduction of mean nominal protection for all tradable goods in the economy from 89 percent in 1989 to about 28 percent in 1999 which set the domestic industry off the competitive market leaving a large number of laborers unemployed (p: 21). So the absence of labour intensiveness in the development strategy clearly justifies the argument that while devising strategy under the structural adjustment program, local dynamics and voices were not considered. Again, de-subsidization in agricultural sector under the structural adjustment program led subsistence farmers to more fragile economic condition. This ineffective strategy indicates the local exclusion in the development strategy.

As a response to the failure of SAP, in 1990, World Bank and IMF launched Poverty Reduction Strategy Papers (PRSP) for developing countries like Bangladesh. Again the inclusion of local voice in the development of PRSP has been an issue of long debate. Buiter (2004) maintains, despite the large number of NGOs and civil society groups, organizations, and factions involved in some of the PRSP consultative processes, the representativeness of the constitutions remains an open issue (p: 227). So the under-representation of the enterprise sector, and especially the private enterprise sector, in most PRSP consultative processes represents a serious dent in its claim to be representative of all the parties whose efforts are essential to a successful attack on poverty or who are affected by it. Thus, the international development strategies or programs for Bangladesh have declined the very notion of 'country ownership'.

7. Conclusion

Over the years international development discourse has evolved a great deal to deal with the new issues. Comprehensive human development through local participation on the basis of country ownership has been the present notion of development discourse. Although the notion of 'country ownership' in development discourse is variegated and multidimensional and needs to be deconstructed in terms of variegated local social reality of development as mentioned by Escobar, development discourse should be mainstreamed and designed with the voices of those for which the programs are going to be designed and who are going to be affected by these.

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Auditing for Efficiency in Local Government

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Abstract

Local governments' efficiency is very important for a harmonious and stable community. Therefore, best information management and monitoring-feedback system is necessary in supporting this important service provider to community. External auditing has gained reputation for its ability to certify the extant of performance of an organization with supporting evidence. Hence, utilising the avenue of checking and reporting provided by auditors could support continuous improvement desired by local government agencies. This paper reports a mixed method research done on 22 local governments as multiple cases to account their experiences, performance and perception upon external auditing. The study concludes that external auditing practices at these local governments have to some extent helped improved efficiency and effectiveness in some of the targeted areas, although it raises several issues along the process.

Keywords: public sector performance measurement, public sector auditing, local government

Introduction

Government organizations are known for its oversize and complexities. Thus, information management and technologies for such a sector should be efficient to ensure satisfaction among the recipients their service as well as to avoid complaints and chaos. Public sector around the globe are evolving and changing in the aspects of their management and the ways they provide services for society. One of the aspects which continuously evolving is the external auditing services for the public sector. Many countries have utilised external auditing as a means for checking and providing feedback for their future improvements. External auditing itself has had a long history of assuring stewardship and accountability between principal and agent, mainly in the private sector but also encompassing and benefiting the public sector. External auditing, though independent, and meant to provide assurance to the public- it could also contribute liking to consultation for the public sector organizations and the non-profit organizations.

External auditing too has been used widely as one of many inspection activities performed on local authorities especially in the developed countries. In the local government, audit started as tools to provide assurance concerning the reliability of the accounts of an authority and on the legality of the underlying transactions. However, since the 1980s, external auditing has been applied in a variety of contexts referring to new and (or) more intense account-giving and verification requirements [Courville et al, 2003], which is argued by Power [1997] as the 'audit explosion'. This article intends to introduce the success of external auditing in driving improvement at local government in England particularly in terms of information management and sharing. This experience is good lesson to other countries and non-profit organization alike.

Utilising External Audit for the Public Sector

An effective public sector audit activity strengthens governance by materially increasing citizens' ability to hold their government accountable (The IIA, 2006). Auditors perform an especially important functions in those aspects of governance that are crucial in the public sector to promote credibility, equity, and appropriate behaviour of government officials, while reducing the risk of public corruption. Therefore it is crucial that government audit activities are configured appropriately and have a broad mandate to achieve these objectives. The audit activity must be empowered to act with integrity and produce reliable services, although the specific means by which auditors achieve these goals vary. Government auditing supports the governance roles of oversight, insight and foresight [The IIA, 2006]. Because government's success is measured mainly by its ability to deliver services successfully and carry out programs in an equitable and appropriate manner, government audit activities should have the authority and competency to evaluate financial and program integrity, effectiveness, and efficiency. Auditors also have to protect the core values of the government as it serves all citizens.

The public sector represents a principal-agent relationship [The IIA, 2006]. The officials, acting as the agent, must periodically account to the principal for their use and stewardship of resources and the extent to which the public's objectives have been accomplished. The inherent risks in the principal-agent relationship may be reduced by an effective accountability mechanism. Thus, governments place greater value on public audit to secure local authorities' accountability [Laughlin, 1996]. There has been much evidence of increasing inspection activities since 1980s which is described as audit [Kelly, 2003; Hood et al, 1998]. The principal relies upon the auditor to provide an independent, objective evaluation of the accuracy of the agent's accounting and to report on whether the agent uses the resources

in accordance with the principal's wishes. This is also reflected in Power's [1997] argument that there had been an explosion in audit, in which auditors' work extends to cover assessment of services. The author also argues that there are more people watching and less people doing; increase in the policing of policing where an auditor inspects the control systems of local government. The money spent for these policing of policing activities is also increasing [Hood et. al., 1999].

Accountability is said to be improved by transparency, when an agent is required to provide more information, that would make them more accountable and more likely to work for common good [Prat, 2006, Heald, 2006b]. However, there is not more transparency in practice for several reasons such as that 'strong entrenched interests' prevent transparency, full disclosure may not be an optimal policy, the direct cost of information disclosure and difficulty in communicating the information [Prat, 2006, p. 94-96]. Introducing or increasing transparency would be beneficial only if it is seen to make a difference [Heald, 2006a]. Furthermore, the ability to objectively measure efficiency, effectiveness and economy has always been argued by many researchers to be problematic because of its complexity for auditors and as a concept in practice [Lapsley and Pong, 2000].

English Local Government Experience

In the context of local authorities in England, the establishment of the Audit Commission (AC) was clearly an important landmark. Although inspection is not new for English local authorities, its intensity has been increasing since the 1980s, because of government concern that local authorities and councillors were losing accountability, effectiveness, even legitimacy [Kelly, 2003]. Governments have had recourse to placing greater value on external auditing to secure local authority accountability to their various stakeholders [Laughlin, 1996]. External auditors' work for local authorities in England covers the Use of Resources (UoR) assessment which is one component of the Comprehensive Performance Assessment (CPA) regime. Figure 1 below shows the framework of comprehensive assessment performed at English local government.
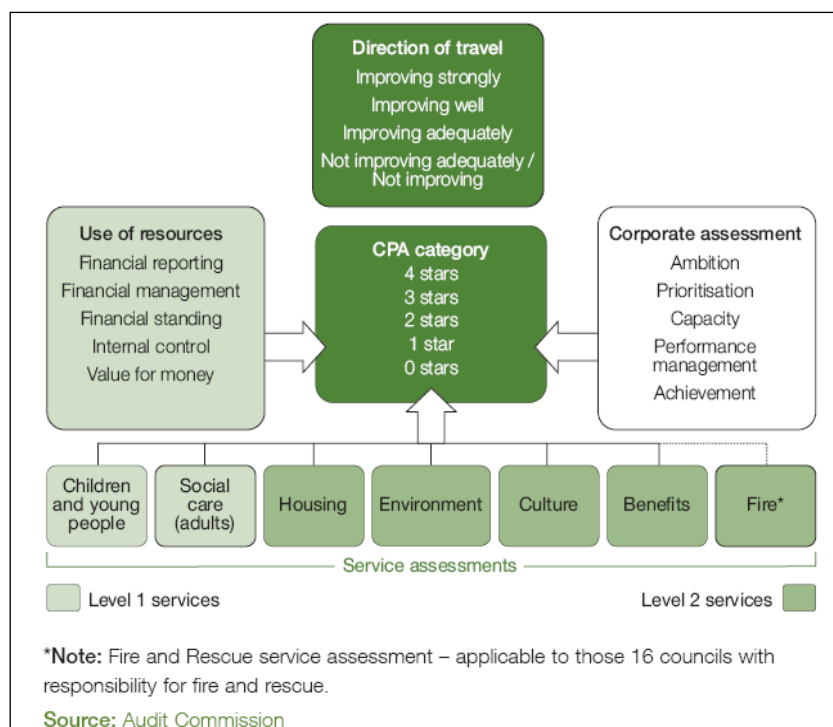

Source: Audit Commission

Figure 1: Single Tier and County Councils *CPA –the harder test* Framework for 2006-2008

(Source: Audit Commission, 2006b)

UoR assessment which also covers aspects of certification audit besides assessment of local government performance is part of the bigger assessment framework called CPA. UoR assessment is divided into five themes of financial reporting, financial management, financial standing, internal control and value for money. All these themes have specific criteria and evidence for evaluation. Local governments are invited to provide inputs prior to setting the indicators and criteria for evaluation through consultation processes. The AC communicates and disseminated the indicators, criteria and evidence for these assessments to all local government at the beginning of the year of audit so to provide clear picture of what local government should ensure are in place when auditors visit and evaluate their activities and documentation.

These inspection activities have been called 'auditing' and performed by auditors, even though the coverage of inspection goes beyond traditional definitions of auditing. HM Treasury [in Byatt and Lyons, 2001] believes that external review provides a potentially valuable incentive for improving performance as well as providing independent assurance on standards. Although the 'Modernising Government' agenda demands that inspection activities be combined with performance management to achieve the goal of continuous improvement [Cabinet Office, 1999, p. 40], coordination and sharing of learning between inspectorates was weak [Byatt and Lyons, 2001]. Thus the AC has been proposed to take the lead role of coordinating inspection in 2001 to achieve the aspiration of 'Modernising Government' agenda.

The road travelled by AC and English local government was not easy and short. Establishment of the AC was done during an earlier period of controversy about the performance, roles, size, and funding of local government and the wider public service [McSweeney, 1988]. It was part of the Conservative Government's agenda to improve local authorities, introducing 'market' systems where local authorities had to function more like business organizations. The emphasis on service standards has subsequently been maintained by the Labour Government after 1997; their pledge to improve public services during general election campaign in 1997 was a major element contributing to their electoral success [Boyne, 1998]. The AC, carrying the mandate from central government to regulate local authorities since 1980 has introduced a number of inspection activities using various indicators, which have been changed from one year to another.

The AC's first set of statutory performance indicators (PI) in English and Welsh local government was introduced and applied from assessment year of 1993/94 until later in the assessment year 2001/02, when Best Value Performance Indicators (BVPI) were introduced to replace the PI. To coordinate the performance of local authorities assessed by various inspectorates, the AC introduced CPA in 2002. CPA is an extension to the auditor's work of certifying the financial statements to include certifying services provided by the local authorities. Under the CPA regime, external auditors perform their duties of inspection to gather data and evidence on almost all aspects of local authority activities from financial matters to services provided to the public.

The CPA exercise is done on an annual basis and covers all local authorities in England. The AC's appointed auditors write a report on each local authority's performance and later the individual local authority performance is combined to form a report on the performance of the country as a whole. Local authorities are also ranked according to their performance ranging on a five star scale from 0 stars to 4 stars. Reports are published on the AC website. The CPA has come to its 8th year of assessing local authorities in 2009 and has gone through various changes

since it was first introduced. The CPA will be replaced by Comprehensive Area Assessment in 2010.

Result and Discussion

Supporting arguments on the ability of comprehensive assessment in promoting improvement is an analysis of English local governments' improvement. Auditors' evaluation of local government concluded in scores of 1 to 5 have been obtained and tabulated. Mean scores were calculated and compared for all local authorities in England as well as combined local authorities in each region. Insights from the Director of Finance (DoF) of each local authorities included in the multiple cases study were also gathered. This was done for UoR overall and its themes scores from 2002 to 2006. English local authorities are divided into two main categories – the single tier and county councils (STCC) and the district councils (DC). As STCC and DC represents different sizes and activities, their separation is deemed necessary to prove that the assessment regime could enhance performance regardless of local authorities' sizes.

Table 1: Overall UoR Mean Score for England 2002-2006*

Mean Score for England	2002	2003	2004	2005	2006
Single Tier and County councils	3.00	3.49	3.67	2.57	2.86
District councils				2.32	2.57
All councils	3.00	3.49	3.67	2.41	2.68

*Data presented throughout this article are from Abu Hasan, H. (2009)

Table 1 shows the overall UoR mean scores from 2002 to 2006 calculated for England. As the DC only have scores from 2005, the mean score for 2002 to 2004 for England is the same mean score for all STCC. The mean score for whole England shows an increased from 3.00 in 2002 to 3.67 in 2004. Many DoF responded that having a clear indicators provided by the AC has helped them in a great deal. They could focus more on areas require improvement and maintained on areas that has been certified as good or excellent. This exhibits that providing clear information supports improvement at local government. In England, information is disseminated through website of the AC as well frequent communication and visits by both sides. Local government also established groups of peers which communicate and share experience and methods in achieving the required indicators. One of the DoF responded:

> *"...we have got our league tables; we share resources and reports when we meet. We verbally share experience and we get seven-page document that identifies areas to improve and areas not to improve; we have done this on local basis." [DoF 5]*

To encourage continuous improvement, the AC keeps improving the indicators they provided and communicated the changes to local government efficiently. A break in improvement pattern exhibited from 2005 is due to the changes made on the assessment regime where *'the harder test'* was introduced. The mean score was restarted at 2.41 in 2005, and shows an increased to 2.68 in 2006. The mean score for STCC throughout England experienced similar steady increases from 2002 to 2004; a drop in the mean score in 2005 and an increase from 2005 to 2006. The mean score for the DC is lower than the STCC in both 2005 and 2006. As a triangulation for the improvement shown in published scores, opinions from the DoF were sought. Majority (65%) of the respondents agree that the improvement shown in the published scores are a fair reflection of their performance, one DoF responded:

"I think local authorities are getting better now." [DoF 1]

90% of respondents agree that the published scores rose because local authorities knew where to improve through the indicators provided, which strongly support the notion of best information management helps to drive improvement at local government. Table below compares results of 2005 and 2006 only, to highlight the shared improvement patterns among all English local authorities. 2005 and 2006 were chosen as both utilises the same assessment regime, CPA –*the harder test*.

Table 2: Single tier and county councils – mean scores for overall UoR based on governmental region

Mean Score for Overall UoR	2005	2006
England- 150 councils	2.57	2.86
Yorkshire and The Humber- 15 councils	2.67	2.73
West Midlands- 13 councils	2.85	3.15
South West- 16 councils	2.38	2.69
South East- 19 councils	2.53	2.89
North West- 22 councils	2.55	2.86
North East- 12 councils	2.58	3.17
London- 33 councils	2.73	3.00
East of England- 10 councils	2.20	2.50
East Midlands- 9 councils	2.56	2.67

Table 2 shows the UoR mean scores for single tier and county councils for the whole of England and also the mean scores when these local authorities are divided into their respective government regions. There are nine government region altogether, where each government region comprises of several single tier and county councils, the numbers of councils in each region are shown in the table. From the information presented, all government regions exhibit improvement from 2005 to 2006. Variation between the regions scoring the lowest mean to the regions with the highest mean was 0.65 in 2005 and 0.5 in 2006.

Table 3: District councils – mean scores for overall UoR based on governmental region

Mean Score for Overall UoR	2005	2006
England- 238 councils	2.32	2.57
Yorkshire and The Humber- 7 councils	2.14	2.71
West Midlands- 24 councils	2.21	2.50
South West- 35 councils	2.09	2.40
South East- 55 councils	2.56	2.76
North West- 24 councils	2.46	2.46
North East- 13 councils	2.15	2.77
East of England- 44 councils	2.27	2.45
East Midlands- 36 councils	2.28	2.58

Table 3 shows the mean scores calculated for all the district councils in England and also the mean scores when these district councils are divided into their respective government regions. Although there are nine government regions altogether in England, only eight regions have district councils. Governmental region of London comprises only of the single tier and county councils. The numbers of district councils in each of the region are also reported in the table.

Mean scores for the district councils are lower compared to the mean scores for single tier and county councils except for the scores of the district councils in South East and East of England regions. The variation in mean score between the regions from lowest to the highest is small, 0.47 in 2005 and 0.37 in 2006 with the South West region being the poorest performing in both years. The range of mean scores between regions narrows from 2005 to 2006 for both the single tier and county councils and the district councils. The district councils obtained lower scores compared to the single tier and county councils. Many DoF responded that resources were among the factors which slowed down improvement as well as the size of district councils in the region which are enormous. Several respondents express their sympathy for the district councils on limited resources especially accounting staff to deal with documentation. One DoF said:

 "...I sympathise with the district councils, they just don't have a resource base, and they don't have enough people. We just don't have enough people to work on it. We are struggling with our annual accounts and difficulty in getting permanent, qualified staff." [DoF 13]

Table 4: All councils – mean scores for overall UoR based on governmental regions

Mean Score for Overall UoR	2005	2006
England- 388 councils	2.41	2.68
Yorkshire and The Humber- 22 councils	2.50	2.73
West Midlands- 37 councils	2.43	2.73
South West- 51 councils	2.18	2.49
South East- 74 councils	2.55	2.80
North West- 46 councils	2.50	2.65
North East- 25 councils	2.36	2.96
London- 33 councils	2.73	3.00
East of England- 54 councils	2.26	2.46
East Midlands- 45 councils	2.33	2.60

Table 4 shows mean scores calculated for the whole of England and its nine regions combining both the STCC and the DC. The best performing was London in both years (London has no district councils). The worst performing was the South West region in 2005 and East of England region in 2006. However, the range between the best and worst performing region not wide, 0.55 in 2005 and 0.54 in 2006.

Conclusion

The results analysed above revealed patterns of improvement in local authorities' performance. This pattern indicated that best information management components which are (i) the comprehensive performance measurement coupled with (ii) clear indicators; (iii) effective audit; (iv) effective communication; and (v) effective medium of communication, are excellent drivers for improvement. The assessment method also has to be regularly evaluated

and upgraded to foster continuous improvement effort. Although the change in assessment regime resulted in a drop of scored performance, the scored performance seems to be higher in the following year. Clearer indicators and effective measurement by auditors also encouraged learning and motivation among the staff at local authorities. Local authorities would have clearer target with the indicators and detailed procedures and evidence that are required of them.

These will attain their focus and encouraged local authorities to exhibit good achievement. However the assessment regime has to be carefully designed, consulted and communicated among all stakeholders to achieve an optimum measures so to avoid measuring the unnecessary. Therefore similar effort could be initiated at our local government. Starting from clear objective statements, detail assessment criteria can be developed, consulted and communicated to the local authorities.

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Land Evaluation for Sustainble Sugarcane Production in the Guinea Savannah Zone of Nigeria

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Abstract

The Unilorin Sugar Research Institute (USRI) farm in the Southern Guinea Savanna ecology of Nigeria was characterized, classified and evaluated for its suitability for sustainable sugarcane production. The land is generally too low in organic matter and the length of raining season is inadequate for sugarcane production. Current (actual) aggregate suitability rating shows that none of the four soil types (Arenic Tropustalf, Plinthic Tropustalf, Plinthic ustropept and Arenic Ustropept), as well as the area excavated for laterite is suitable for sugarcane production. Inadequate lengths of raining season, as well as fertility in terms of very low organic matter are common to all the pedons. If irrigation facility and fertility enhancement measures are put in place 55% of the land area becomes moderately suitable (class $s_{2)}$ and 19.46% becomes marginally suitable (class $s_{3)}$ while the remaining 25.4% remains non-suitable. Other problems with the marginally and non suitable parcels are depth limitations while the non-suitable parcel is pebbly and has iron stone boulders on the surface of the soil and these can be impedance to root, water and nutrient penetration as well as to mechanical operations.

Keywords: suitability index, potential, current, aggregate suitability, Sustainable Sugarcane Production.

Introduction

Soil is a very important factor in crop production. When all other factors remain constant, it dictates variations in crop performance and response to management as well as the yield. The characteristics of each soil type which determines its suitability for crop production is an agglomeration of the characteristics of each horizon in its profile. A mapping unit therefore is better managed than the landscape as a whole because the characteristics of a mapping unit are a better judge of its suitability for a named crop.

Olaniyan and Ogunwale (2006) defined land evaluation, as the assessment of land qualities for alternative uses. The purpose for which the land is required to serve is always the basis of the evaluation system. They evaluated Kusogi land for its suitability for cashew production and found out that 78% of the land was marginally suitable while 22% was non-suitable for cashew production. Ogunwale et al (2007) also evaluated the suitability of University of Ilorin farm land for cowpea production; they found out that each soil type possesses different constraints to production. These are evaluation works being carried out around this environment. Other Authors such as Ogunkunle (1993), Onasanya and Ogunkunle (1996) and Fasina (1998) evaluated soils of the rain forest of Nigeria for various crops. They also reported different constraints from different soil types.

The Unilorin Sugar Research Institute is commissioned to carry out Research and Training on sugarcane. It has acquired a parcel of land of about 51ha in size. The soil characteristics of this site are not known neither do we have an idea of its fertility status nor its suitability for sugarcane production. Knowledge of these characteristics obtainable from soil survey will ease the process of decision making on the use to put each portion of the land as well as the management practices suitable for each soil type for effective cropping at a sustainable level. The objectives of this studies therefore include characterization of the new site, classifying it and determining the suitability or otherwise of the mapping units for sustainable sugarcane production.

Materials and Methods

Field Studies

Unilorin Sugar Research Institute is located between the Oyun river and the University Stadium complex on the permanent site of the University located between latitude 8^0 29' and 8^0 30' N and longitudes 4^0 50' and 4^0 52' east.

A total of 51 ha were earmarked for this project. Soil Survey of the area was conducted using a rigid-grid method. Soil profiles were dug in areas representative of these soil types and soil samples were taken from the genetic horizons for laboratory analyses.

Laboratory Analyses

The soil samples were air-dried, prepared and routinely analysed following standard analytical procedure (Udo and Ogunwale, 1986) for the following parameters: particle size, Na, Ca, Mg, K. Exchangeable acidity, pH, available P, organic matter, particle size and total N.

Soil Classification

The results of the morphological, physical and chemical analyses were used to classify the soils following USDA taxonomy (Soil Survey Staff; 1994).

Land Evaluation Procedure

The method used by Ogunkunle (1993) as modified by Olaniyan and Ogunwale (2006) was adopted in this study. However, calcium mole fraction was not included as a parameter under fertility index since sugarcane is in the grass family. Each pedon was assigned to a suitability class by matching its qualities (Tables 1 and 2) with the land requirements for sugarcane production (Table 3) following the ratings of limiting characteristics (Table 4). Following the law of minimum, the most limiting characteristic in a group determined the class of pedon.

The groups of land qualities considered for evaluation are climate (c), topography (t), soil physical characteristics (s), wetness (w), chemical fertility (f), and salinity and alkalinity (n). From the generated data, index of productivity was calculated for each pedon using the equation.

$$IP = A \; \frac{B}{100} \; . \; \frac{C}{100} \; ... \; \frac{F}{100}$$

Where A is the overall lowest characteristics rating

B,C,-- F are the lowest characteristics rating for each land quality group.

From this, the potential index of productivity (IP_p) as well as the actual (current) index of productivity (IPc) was thus calculated. The IP_p was calculated with length of rainy season not being part of climate (c) group; calcium mole fraction, available p and organic matter not being part of the 'f' group while they were included in the calculation of IP_C.

Results and Discussion

The characteristics of the soil of Unilorin Sugar Research Institute (USRI) farm is as presented in Tables 1 and 2. Five soil types were encountered on the farm, four of which was characterized and the fifth was not characterized. This is because laterite has been excavated from this site for road construction. The area was therefore mapped out as miscellaneous

Mapping unit I and IV are very deep (at least 120 cm deep) while pits II and III are not deep. In fact pit II did not go beyond 65 cm depth before an impervious plinthic layer was encountered. These depths may be adequate for many arables, but the possibility of water accumulation on soil surface and consequent run-off make the depth limiting most especially for irrigation purpose.

The texture of these soils is generally loamy sand which will adequately support sugarcane production. Again, pit II and III are pebbly, pit III even have boulders of iron stone scattered on the soil surface and this may hinder mechanized agriculture. The sandy nature of the soils also indicate low water and nutrient holding capacities of these soils, hence, the need for supplementary irrigation and fertilizer.

The structures are generally crumbs which is adequate for sugarcane production. The bulk density (1730 to 1930kg/cm^3) also falls within the range of 1600kg/cm^3 recommended by Miller and Danalive (1990) for sandy soils.

The chemical properties of the soils that might affect their suitability for rainFed agriculture are acidity, fertility and salinity. The reaction of the soils are slightly acidic ($_p$H of 5.5 − 6.5). However the use of soil $_p$H in water as a criterion for crop productivity without reference to the total acidity values is not complete. The total acidity values are within a range

of 0.2 to 10.4cmOl/kg. This implies that the exchangeable aluminium levels are still within the non-toxic range (Ogunwale et al, 2008).

None of the soils show any indication of getting saline as they have pH < 7 in all the horizons and values of exchangeable sodium are low hence there could be no salt problems under rainfed agriculture. However care must be taken to prevent salt accumulation most especially in mapping unit I under irrigated crop production.

The ECEC values for the plough layers of the four pedons vary from 7.16 to 2.02

Cmol/kg soil. These values fall within the moderate to high levels (FPDD, 1988). Pedons I and II however have higher values. The Organic matter contents are very low. Under the prevailing climate, this may further decline when the land is cleared of vegetation. The low organic matter contents may be attributed to annual bush burning and over grazing by cattle coupled with the harsh climate. As organic matter is known to be a major contributor to ECEC, the latter is bound to decline as a result of decline in organic matter. None of the exchangeable cations is limiting in these soil (FPDD 1988). Exchangeable calcium dominated the exchangeable sites. However, supplementary application of k may be required for the second cropping.

Sugarcane, a member of grass family requires substantial quantity of Nitrogen for its development. The levels of Nitrogen in all the mapping units are very low and decline with soil depth. This level can not meet the requirement of sugarcane hence, mineral Nitrogen fertilizers will be required on the farm.

Soil Classification

Pedon I covering 23.5% of the entire farm exhibits argillic horizon at the subsurface. The subsurface horizon has >3% higher clay than that of the horizon above it and the clay content of these horizons is < 15%. The base saturation is also high (95% to 98%). The pedon classifies as Alfisol. Ilorin has ustic moisture regime: the pedon therefore belongs to the suborder ustalf. It has no lithic or paralithic contact within 50cm of the mineral soil surface, and the difference between mean minimum and mean maximum temperatures is $< 5^0$ c. It was therefore classified as Tropustalf at the Great group level. The pedon is sandy throughout (sand content of between 751 and 851.2g/kg). It therefore classified as Arenic Tropustalf (Soil Survey Staff, 1994)

Pedon II covers 19.6% of the total land area. It has similarities with pedon I and was consequently classified as Tropustalf at the Great group level. However, it has high gravel content (677g/kg) at a depth of 55cm and an impervious layer at 80cm depth. It therefore qualified as plinthic Tropustalf (Soil Survey Staff, 1994).

Pedon III covers 13.73% of the total land area. It has no argillic or any distinct diagnostic horizon, it therefore classified as inceptisol. It is found in the Iso-temperature and ustic moisture regime area, it then classified as utropept at the great group level. It is gravelly throughout and even has iron stone boulders on the soil surface and an impervious layer at 64cm dept. This pedon was classified as plinthic utstropept at the subgroup level (Soil Survey Staff 1994).

Pendon IV also covers 31.37% of the total land area. It has not distinct diagnostic horizon. It has other properties like pendon III except gravel content. It classifies as ustropept. It is sand throughout with loamy sand texture. It was therefore classified as Arenic ustropept at the subgroup level (Soil Survey Staff 1994).

Suitability Evaluation of the Pedons

Table 5 presents the suitability (actual and potential) ratings for the four pedons.

Climate

The climate of the studied area is quite favourable for the production of sugarcane. The mean annual temperature (28-32^{0}C), average sunshine hours, annual rainfall and relative humility are all adequate by the standards of Yates (1977). The length of raining season (7 months average) is however, not adequate, hence supplementary water supply is required. Therefore length of raining season was not included in potential suitability. In terms of current aggregate suitability length of raining season was the most limiting climatic index.

The topography of the study area (< 2% slopes) is adequate. So also is the drainage, the four pedons are well drained under natural conditions.

Soil Physical Characteristics

Both the structure (crumbs) and the texture of the pedons are adequate for a good crop of sugarcane. However, the soil depth is limiting in pedons II and III. In fact pendon II is highly pebbly and has iron stone boulders on the soil surface. This apart from hindering root and water penetration thereby aiding run off will also be an impedance to mechanical operations on the farm.

Soil Fertility

The base saturation and available P are the two fertility indices adequate for sugarcane production on the farm. Effective cation exchange capacity(ECEC) were adequate in pedon II and IV but marginal in pedons I and II. The $_pH$ is fairly low though not to a level of causing acidity. Calcium mole fraction is also marginal while organic matter is grossly inadequate in all the pedons.

Potential Soil Fertility

Only base saturation available P, pH and ECEC were considered for potential fertility. Organic matter was only considered for current fertility as against Ogunkunle's (1993) suggestion. This is because despite the very low levels of organic matter sugarcane was still growing fairly well on these soils. Again if the seasonal burning and frequent grazng of these mapping units is stopped, organic matter will definitely build up. In terms of potential fertility, pendons III and IV are better than I and II for ECEC while pedon II is the worst for all the indices.

Suitability Ratings

Suitability ratings of the various land characteristics as well as their aggregate rating (potential and actual) is as presented in Table 5. Pedons I and IV occupying a land area of 12 ha and 16 ha (23.53% and 31.37%) of the total land area) were rated as the best (63.35%) in terms of potential aggregate suitability. These were followed by pendon II scoring 45.30 and occupying a land area of 10has (29.62% of the total land area). This was rated as marginally suitable. Pedon III which covered an area of 7 ha (13.73% of the total land area) scored 35.36% making it non suitable for sugarcane cultivation. Soil depth and volume of coarse fragments are the main limitations of pendon III and this corroborates the findings by Olaniyan and Ogunwale (2006) that a single limiting factor may impose major influence on the suitability rating of soils. Water and nutrient application to these mapping units must also be splitted (a little at a time) for more effective utilization by crops and prevention of run off.

Mapping unit I (Arenic tropustalf) and IV (Arenic Ustropept) belonging to different soil taxonomy classes were rated as suitability class S_2. This shows that different soil types can belong to the same suitability class. This is where a natural classification system differs from a technical classification system.

The aggregate actual suitability ratings are all very low. This is as a result of the inadequate length of raining season and low fertility status of the soils most especially the organic matter content. The low organic matter content drastically reduced the rating of the pedons. Pedon I rated 15.90% was still the best while pedon IV rated as 8/37 was the worst. It could be seen again, that a single limitation index (organic matter) caused the very low rating of pedon IV under actual suitability rating. In terms of actual suitability, all the pedon are non-suitably. The implication is that if irrigation facility and fertility improvement packages such as a good residue management practice, fertilizer application especially organic fertilizers are put in place, the suitability of these soils will be greatly enhanced.

Conclusion

Four soil types (Arenic Tropustalf (23.5% of the total land area), Plinthic Tropustalf (19.6% of the total land area), Plinthic Ustropept (13.7% of the total land area) and Arenic Ustropept(31.4% of the total land area)) were encountered on the 51 ha farm site of Unilorin Sugar Research Institute (USRI), University of Ilorin. The soils that are plinthic are shallow and pebbly. Mechanical impedance as well as hindrance to root, nutrient and water penetration are envisaged. This may lead to run-off. In their current states, none of the pedons is stuiable for sugarcane production. They are generally very low in organic matter and length of raining season is generally inadequate. If irrigation facilities as well as fertility management techniques are put in place, pedons I and IV occupying about 55% of the total land area) will be moderately suitable (S_2), pedon II (19.6% of the total area will be marginally suitable (S_3) while pedon III (13.7%) and the site from which laterite has been excavated (11.7%) remain non-suitable. It has also been established that a single limiting factor can exert so much influence on the suitability or otherwise of a soil. It has also been established that indices constituting aggregate potential suitability will vary from crop to crop.

Table 1 Morphological Characteristics and Classification of Unilorin Sugar Research Institute

Taxonomic	Horizon	Horizon Thickness	Colour (moist)	Mottles +++	Texture ++	Consistence+	Structure *	Drainage
Arenic	A	43 (cm)	5YR3/1	a	LS	M,fr	I,M,cr	IV
Tropustalf	B	150	7.5.YR5/6	a	LS	M,fr	I,M,cr	IV
Plinttuc	A	25	7.5.YR4/4	a	LS	M,fr	I,M,cr	IV
Tropustalf	B	80	5.YR4/6	a	LS	M,fr	I,M,cr	IV

Plinthic	A	15	7.5YR ¾	a	LS	M,fr	I,M,cr	IV
Ustropept	B	65	2.5.YR ¾	a	LS	M,fr	I,M,cr	IV
Arenic	A	50	5 YR 3/1	a	LS	M,fr	I,M,cr	IV
Ustropept	B	150	7.5YR 5/6	a	LS	M,fr	I,M,cr	IV

+++ 1 – fine 2 – medium; 3 – coarse f – few, d – distinct; a – absent

++ S- sand; LS Loamy sand

+ M-Moist; fr friable; fi - frim

* 1 week; 2 – moderate; 3 – well developed; M – medium; C – coarse; cr – Crumbs.

** II – poorly drained; IV - well drained.

Table 2: **Land Qualities/Characteristics of Unilorin Sugar Research Institute Farm Soils**

on	Annual Rainfall (mm)	Length of Dry Season (days)	Meen Atm. Temp (^{0}c)	Slope %	Drainage	Soil Depth	Coarse Fragments (A-horizon)	Ex.ca cmol/kg	Ca Mole fraction	ECEC cmol/kg	Avail P cmol/kg	BS %	PH in H_2
	1200	120	≥ 29	1-2	Good	> 150	Negligible	2-5	0.41-	5-10	2-9	96-98	5.7-5
	1200	120	≥ 29	1-2	Good	80	Common	1-3	0.36-	4-7	4-8	94.97	5.4-5
	1200	120	≥ 29	1-2	Good	65	High	1-5	0.40.0.5	8-10	4-6	77-98	5.8-6
	1200	120	≥ 29	1-2	Good	150	Negligible	2-5	0.40-0.46	5-12	5-7	83-98	5.9

Table 3: **Land Requirement for Suitability classes for Sugarcane Cultivation**

Land Qualities	Suitability				Classes	
	S1	S1	S2	S3	N1	N2
Climate (c):						
Annual Rainfall (mm)	>1200	1000-1200	800-1000	600-800	L600	
Length of raining Season moths)	>11	9-11	7-9	5-7	3-5	<3
Mean annual maximum temp (^{0}c)	>29>29	27-29	24-27	22-24	<22	
Average daily minimum temp (^{0}c)	>20	18-20	16-18	14-16	<14	
Mean annual maximum temp (^{0}c)	>25	22-25	20-22	18-2024	<18	
Relative humidity (^{0}c)	>75	70-75	65-70	60-65	<60	
Topography (t)	0-4	4-8	8-12	12-16	<16	
Wetness (w) slope (S)	F_0	F_0	F_1	F_1	F_2	F_3
flooding Drainage	I	I	II	III	IV	IV
Soil Physical properties (s):						
Texture	LS	SL	SCL	SC	Any	CI
Structure	Crumb	Crumb	SAB	SAB	Columnar	Columnar
Coarse fragments(Vol %) 0-30cm	3-10	10-15	15-25	25-55	>55	-
Depth(cm):	>100	90-100	50-90	25-50	125	-
Fertility (f):						
Cation exchange capacity (cmol/kg)	>10	8-10	6-8	4-6	2-4	<2.0
Base Saturation	>70	60-70	40-60	20-40	<20	-
PH	6.5-7.0	6.0-6.5	5.506.0	5.05.5	4.4-5.0	<4.5, >7.5
Organic carbon (%) 0-30 cm	>2.0 1.5.2.0	1.25.15	1.0-15	1.0-1.25	<10	<10
Ca mole Fraction	0.8-0.9	0.7.0.8	0.6-07	0.4-60.6	0.2-04	<0.2
Avail. P (mg/kg) 0-30cm	>200	16-20	12-16	8-12	4-8	<4
Salinity and Alkalinity	<1	1-2	2-3	3-4	4-8	>8

LS   -   Loamy sand; SL-   Sandy loamy, SCI   -   Sandy   clay   loam,   CL   -   clayey loam

SAB   -   Subangular blocky, F_0 -Not flooded, F_1 -   Slightly   flooded, F_2 -   flooded, & F_3 - highly flooded.

I   -   Well drained, II – fairly drained, III – impeded drained, IV – not drained.

Source: Ogunkunle (1993).

Table 4: Rating of Limiting Characteristics

Limitation	Rating(%)	Class
None	95-100	$S1_1$
Very Slight	70-94	$S1_2$
Slight	55-69	$S1_2$
Moderate	40-54	S_3
Severe	20-39	N_1
Very severe	0-19	N_2

Table 5: Suitability class scores of Unilorin Sugar Research Institute Farm Soils

	Soil Types			
Climate (c);	I	II	III	IV
Annual rainfall	$S_1(95)$	$S_1(95)$	$S_1(95)$	$S_1(95)$
Length of raining Season	$S_2(70)$	$S2(70)$	$S_1(70)$	$S_1(70)$
Mean annual maximum temp	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Average Sunshine hours	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Relative humidity	$S_1(95)$	$S_1(95)$	$S_1(95)$	$S_1(95)$
Topography (t)				
Slope %	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Wetness (w):				
Drainage	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Soil Physical Characteristics (s):				
Texture	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Structure	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Volume of Coars frag	$S_1(100)$	$S_2(60)$	$S_3(45)$	$S_1(100)$
Soil Depth	$S_1(100)$	$S_2(65)$	$S_2(55)$	$S_1(100)$
Soil Fertility (f):				
ECEC	$S_2(65)$	$S_2(60)$	$S_1(90)$	$S_1(95)$
Base Saturation	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
PH	$S_2(60)$	$S_2(60)$	$S_2(65)$	$S_2(65)$
Organic Matter	$N_2(19)$	$N_2(15)$	$N_2(19)$	$N_2(10)$
Available P	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Ca mole Fraction	$S_3(50)$	$S_3(45)$	$S_3(50)$	$S_3(45)$
Avail. P (mg/kg) 0-30cm	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Salinity /Alkelinity s(n)				
Electrical Conductivity	$S_1(100)$	$S_1(100)$	$S_1(100)$	$S_1(100)$
Aggregate Suitability (%)				
Potential:	63.35	45.30	35.36	63.35

Actual:	15.90	9.72	10.66	8.37

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Effects of Testwiseness Training on Mathematics Achievement among Selected Secondary School Students in Ado Ekiti, Nigeria.

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Abstract

This study investigated the effects of testwiseness training on students' achievement in Mathematics among selected secondary school students in Ekiti State. The study employed the pre test-post test control group, quasi experimental research design. A total of four hundred and twenty five (425) participants consisting of two hundred and nineteen (219) male and two hundred and six (206) female Senior Secondary two (SS2) students drawn from six secondary schools in Ado-Ekiti through stratified random sampling procedure participated in the study. Testwiseness training module and traditional teaching method were used as treatment approaches. Two instruments; Socio-Demographic Questionnaire and Mathematics Achievement Test were used to collect data. One hypothesis was formulated and data collected were treated statistically using one way Analysis of Covariance. Results of the data analysis revealed that testwiseness training was efficacious in improving the Mathematics performance of students.

Keywords: Testwiseness, Mathematics Achievement**.**

Introduction

Over the years, students' performance in Mathematics at the Senior Secondary Certificate Examination shows a persistent problem of poor performance. While teachers and parents are worried about this, many students also see Mathematics as one of the highest hurdles to cross in their academic life. The Nigerian government, in her quest to achieving scientific and technological progress, has introduced a number of innovations, policies and practices aimed at encouraging the learning of science in schools. This is because of the nation's need for technological development and advancement of which Science, Technology and Mathematics have vital roles to play.

The Federal Government of Nigeria (2008) places Mathematics in a core position at all levels. By the provision of the curriculum, students are not only expected to acquire Mathematical skills but also to be able to apply them in their daily undertakings. Efforts are not spared by various tiers of government in Nigeria to promote the teaching and learning of Mathematics including the establishment of a Mathematical centre, the introduction of special allowances for Mathematics teachers, the implementation of innovative curriculum and use of Computer Technology instructional resources and the participation of Nigerian students in international Mathematics competitions such as the Mathematics Olympiad and award of scholarships to deserving students. The questions to be asked are: Have all these efforts yielded the desired results? Has there been any significant success recorded in terms of improving students' performance in the subject in external examinations such as Unified Tertiary Matriculation Examination (UTME) and Senior Secondary Certificate Examination (SSCE)? Obe and Nigwo (1999) summarized the Mathematics Chief Examiners' reports on variables leading to students' poor performance in Mathematics. The variables identified in the reports include: - Lack of interest in the subject, low quantitative aptitude, weak memory for formula and inability to derive them, poor comprehension for worded problems, fear of the subject, fear of the Mathematics teachers, avoidance of numbers/figures, absenteeism and lateness to class.

A closer look at West Africa Examination Council (WAEC) Examiners' reports between 1999 and 2008 shows that of the 967,998 students that sat for May/June Senior Secondary Certificate Examinations during the period, only 371,959 candidates (37.6%) passed Mathematics at credit level. This trend is disturbing considering the fact that the result of secondary education is a pre-requisite for students' entry into tertiary institutions. In essence, the nation's potential for development in Science and Technology is directly thwarted.

The concern has often been expressed that the problem with Mathematics is not just about low grades obtained by students but that these low scores are usually not a true reflection of students' abilities. The argument is that the nature of Mathematics test items and a lack of test-taking skills on the part of testees conspire with other variables to deny students grades that represent their true abilities. Scruggs and Mastropieri (1992) opined that a testee who is testwise can outperform a testee of equal ability but who lacks test-wiseness. It is vital that testees master the content of the tests they take but it is also important that testees are knowledgeable and experienced in various test formats and the characteristics of the testing environment. Teaching test-taking strategies should therefore help testees to understand the format and convention of a specific type of test and make them feel comfortable in a testing environment. It is also suggested that learning test-taking strategies actually improves the validity of a test by making scores reflect more accurately what a testee knows. A test-wise testee will answer a question incorrectly only if he or she does not know the content, not because the test format is confusing or intimidating (Scruggs and Mastropieri, 1992). Recent thinking in educational measurement and in language testing recognizes the need to include in the investigation of construct validity, information about how test-takers go about processing

test tasks and relating this information to test content and test performance. In view of this, instruction in testwiseness may serve the purpose of increasing testees' confidence during test-taking and hence, positively improve Mathematics achievement.

Theoretical Framework

Polya's Theory of Teaching Mathematics

This study is anchored on Polya's (1957) theory of teaching Mathenatics. Polya (1957) identified problem-solving as a major problem in the teaching and learning of Mathematics. A problem is a difficult issue or event which has to be solved. It is an issue which is completely new to an individual and to which he or she has no ready-made response or method of solution. Solving a problem therefore means finding a way out of a difficult situation. Polya (1957) identified the problems area in problem-solving as:

I.   Incomplete understanding of the problem due to lack of concentration

II.   Rushing into calculation without any plans of ideas

III. In carrying out the plans, the most frequently faults are impatience in checking each steps and carelessness

IV.   Failure to read through the work.

Polya (1957) also identified four phases of problem-solving as understanding the problem, devising a plan, carrying out the plan and looking back. Polya (1957) asserted that an instructor or teacher of Mathematics needs to understand a problem, devise a plan for solving the problem, carry out the plan successfully and look back to find out if the problem has been resolved. He described these as the four necessary phases required in solving Mathematical problems.

The principles in Polya's phases of problem-solving are relevant to ideology of testwiseness. Testwiseness principles emphasize the process or method of solution to a problem rather than the solution itself and this can be linked to the four phases of problem-solving (Understanding the Problem, devising a plan, carrying out the plan and looking back) as identified by Polya (1957). These phases in Polya's theory of solving mathematical problems corroborate with deductive reasoning, time using strategies, cue using and error avoidance strategies as found in teswiseness principles. Understanding the problem is often the most important and probably the most fundamental step because it involves forming a suitable mathematical model to be defined in related terms, rejecting extraneous information and analyzing the questions.

Students solving problems in Mathematics need to apply a variety of testwiseness strategies which includes elimination of options known to be incorrect, using content information from the stem (question), working quickly and efficiently, setting up a schedule for progress through the test, avoiding minor mistakes, paying careful attention to directions, determining clearly the nature of the task and the intended basis of response or other test information in arriving at correct solutions to mathematical problems. In devising a plan for solutions to Mathematics questions, all mathematical skills and techniques previously acquired need to be called to play and also all results obtained at every stage of problem solving need to be verified for accuracy or correctness.

Statement of Problem

Academic success in any discipline is generally measured in terms of test performance for which knowledge of the content area is a major pre-requisite. In addition to this, students

should be able to read and understand instructions and test items based on the knowledge acquired during teaching and learning processes and most importantly work independently with confidence to give correct responses to questions. Ability to acquire this skill and other test-taking skills is essential for obtaining high scores in a test.

Over the years, many researchers have pondered on the academic performance of students especially in secondary school Mathematics. While some students perform well, others perform poorly. A lot of factors have been identified as responsible for the differential performance among students. Most studies focusing on the level of examination performance centred on factors such as teacher factors (Makinde, 2010), student factors (Ubangha, 1999; 2000), curriculum (Kalejaiye, 1985), school and classroom environment (Okebukola, 1986).

Efforts aimed at improving students' performance in mathematics by government, educators and other stakeholder have centred on intellective factors such as mastery of facts or concepts and other learning strategies with no attempt at incorporating soft skills such as test taking skills into the Mathematics curriculum. Since these have not yielded the desired results and leave a substantial percentage of the variance in students' performance unexplained the time has come for the teachers of Mathematics at all levels of educational endeavour to explore certain age-long assumptions regarding the teaching, learning and preparation of students for Mathematics examinations. It becomes necessary to explore if training in testwiseness will be effective in improving students' test scores in Mathematics.

Hypothesis

Based on the central problem of the study, it was therefore hypothesized that there will be no significant difference in post-test Mathematics achievement between students exposed to testwiseness training and those not exposed to testwiseness training.

Methods

The research design used for the study was a quasi-experimental pre-test post-test control group design (Campbell and Stanley, 1966). It is a factorial design involving one treatment group exposed to testwiseness training and a control group which was instructed using the traditional lecture method of teaching Mathematics.

Baseline data including prior Mathematics ability were obtained from participants in the two groups and both groups were tested after experimental treatments. Randomization was achieved through the random assignment of intact classes to treatment and control groups.

The study was carried out in Ado in Ekiti central senatorial district of Ekiti State of Nigeria. The accessible population consisted of all the Senior Secondary 2 students (SS2) in Ado in Ekiti central senatorial district. The sample for the study was made up of four hundred and twenty-five (425) SS2 students consisting of two hundred and nineteen (219) male, and two hundred and six (206) female drawn from twelve intact classes such that two intact classes were randomly chosen from each of the six schools of the three strata of public schools available in Ado - Ekiti. That is, co-educational, single sex boys only and single sex girls only. Three schools were used as treatment group and another three schools served as the control group.

Mathematics Achievement Test (MAT) was the major instrument used to collect data for this study.

The MAT is a multiple choice test with 5 response options. It consisted of 50-items each constructed by the researchers. The items covered the prescribed syllabus for SS2 and only the topics studied during the experimental period.

A pilot study was carried out by the researchers before the main study to have a tryout of the instrument and to determine the psychometric properties. The Mathematics achievement test was validated in two phases. During the first phase, a draft consisting of one hundred and sixty multiple choice objective type items that were relevant to the topics to be taught were constructed using standardized objective test questions in Mathematics from past question papers of WASSCE for the period 2005 – 2010 as a guide. The draft was given to three Mathematics Education lecturers and also experts in Measurement and Evaluation to critique before final selection. The outcomes of these assessments were used to re-define the items. The second phase was a tryout of the good items in a school located outside the Senatorial district under study. The conditions were similar as much as possible to those expected in the actual study. Fifty students (25 boys and 25 girls) were randomly selected among SS11 students of United High School (Ilawe) in Ekiti South Senatorial district of Ekiti-State and the instruments (MAT) was administered on the participants.

To establish the stability of the instrument, the test-retest method was used. The interval between the first and second administration was three weeks. The results of the two administrations of the instruments were collated and based on this, Pearson product moment correlation co-efficient was used to estimate the test re-test reliability coefficient. The results are presented in Table 1.

Table 1: Test-retest reliability of the instrument

Instrument	N	Test Position	Mean	S.D	r_{cal}
Mathematics Achievement Test (MAT)	25	1st 2nd	33.71	12.84 5.97	0.96

The result presented in table 1 indicates that the test-retest reliability index of Mathematics Achievement Test was 0.96. The value was adjudged to be positively high, hence proved the suitability and reliability of the instrument. Furthermore, the participants' responses were used for item analysis.

Step-wise Procedure for Item Analysis

  i. Administer the test, score the items and arrange the students' scores in order of merit (highest to lowest)

  ii. Select the item analysis group (N). This is made up of: The upper group (best 30% or so) and the lower group (last 30% or so)

  iii. Beginning with item number one, count how many students in the upper group (U) that got it right. Thereafter, count how many students in the lower group (L) that got the item right

  iv. Repeat step 3 for other items

  v. For each item, compute the item discrimination power

Identify the poor items and analyze their item choices or the effectiveness of the distracters.

Hypothetical Illustration

In the achievement test, each item has five options or choices labeled A – E, only one of which is correct.

Positive discriminating item 2

Question: Simplify: $5/\sqrt{3}$ - $3/\sqrt{2}$

A. $1/6(5\sqrt{3} - 3\sqrt{2})$ C. $1/6(15\sqrt{3} - 6\sqrt{2})$

B. $1/6(3\sqrt{2} - \sqrt{3})$ D. $1/6(10\sqrt{3} - 9\sqrt{2})$ E. $1/6(5\sqrt{3} - 2\sqrt{3})$

Result:	A	B	C	D*	E
Upper 25	1	0	1	22	1
Lower 25	7	5	2	5	6

Key = D

$$P = \frac{U + L}{N} \times 100 \qquad = \frac{27}{50} \times \frac{100}{1} = 54\%$$

$$D = \frac{U - L}{1/2N} \qquad = \frac{17}{25} = 0.68$$

Comment: This question is good because distracter analysis shows that substantial number of students in the lower group responded to the distracter and large number of students in the upper group selected the correct alternative. It implies that item number 2 distinguishes between those who scored low or high marks in the test.

Based on the above procedures of item analysis, items that had D discriminating index of 0.4 to 0.8 and were option distracting were selected. From this, two form of Mathematics Achievement Test were assembled. The test consisted of fifty items of five response options each. One form was used for the pre test and the second form of Mathematics ability was used for post test.

The Mathematics ability test was used as pre-test to measure the entry ability of the students before exposing them to training.

The testwiseness training module (TTM) was developed by the researcher and it was an adaptation of the "Taxonomy of test-taking strategies" by Nitko (2001), Sarnaki (1979) and Millman (1965). The testwiseness training module focused on training for test taking skills and it was treated in three parts as follows:

i. The test – rationale, types and purposes

ii. Testwiseness – definition and five test-taking strategies or principles which include: Time using strategies, error avoidance, guessing strategies, deductive reasoning strategies and cue-using strategies.

iii. Test conduct – Composure for a test and test conduct.

The treatment groups had the testwiseness training module every time they had Mathematics class for six weeks and the researchers spent the last fifteen minutes of each forty-minute period training participants on testwiseness using the testwiseness training module.

Training for the Experimental Group

Session one: Introduction of researcher as the new Mathematics teacher to the participating classes was done by the Vice principals (Academic) of the respective schools. The

researcher then established rapport and stressed the need for the students to feel free to ask questions during the period of treatment. This was followed by administration of MAT.

Session two: The researcher assumed the role of a teacher. The topic for the week was taught and test-taking strategies were embedded in each lesson. The researcher focused on: Time-Using Strategy. It involves guidelines that help to avoid loss of marks for reasons other than lack of knowledge of the test item. The points discussed under this strategy included:

i. How to work quickly and efficiently, solving the problems and answering items you know and saving the more difficult item for the last.

ii. Setting up a schedule for progress through the test.

iii. Omitting or guessing at items which you cannot quickly answer.

iv. Marking omitted items which need further consideration, to assure easy relocation.

v. How to make use of the time remaining after the completion of the test.

Participants were allowed to ask questions at every stage of the session and class work and assignment were given at the end of the lesson.

Third and fourth Sessions: The researcher repeated steps stated in session two in teaching the students other topics using a variety of procedures, useful application of mathematical concepts, jokes, humour, deep breathing and relaxation technique in order to alleviate anxieties and motivate the participants to develop positive attitude towards learning of Mathematics. In addition, the students were also exposed to test-taking strategies which are: Error avoidance and Deductive reasoning strategies. Error avoidance strategies centered on:

i. How to avoid minor mistakes

ii. Pay careful attention to directions, determining clearly the nature of the task and the intended basis of response

iii. Examine items carefully and determine the nature of the question before response

The deductive reasoning strategy allowed examinees to gain marks beyond that which they would have obtained through direct knowledge of the subject matter. Here, it is assumed that the examinee already has some knowledge of the subject matter but he/she is unsure of the answer. The researcher explained to the participants how to apply a variety of strategies including eliminating options known to be incorrect, using content information from the stem (question) or other test information. At the end of the lesson, the researcher gave class work and assignment to the students and marked the class work with the help of research assistants. Corrections were done afterwards.

Fifth Session: The focus of this session was to expose participants to guessing strategy as well as making effective use of guessing when it is likely to benefit the testee. To achieve this, questions were set from the topics that had been covered during the training session by the researcher. The researcher gave a practical illustration of how to guess for correct answers. The areas of discussion under guessing strategy included:

i. How to eliminate most or all of the foils before guessing. That is, using partial knowledge;

ii. Guess if right answers only are scored;

iii.   Always guess even if the usual correction or a more severe penalty for guessing is employed, whenever elimination of option provides sufficient chance of profiting;

iv.   Guess if you can do so intelligently. Do not guess if you know nothing about the question.

At the end of the session, class test was administered.

Sixth Session: This session aimed at exposing students to the use of cues and intent consideration strategies. The discussion focussed on:

i.   Use of known idiosyncrasies of the test-maker. That is, using content clues to determine answers.

ii.   Understanding the purpose of the test

iii.   Test conduct – Composure for a test and test conduct.

At the end of this session, an achievement test was administered to identify the types of questions the students needed to master and their areas of weaknesses in answering multiple choice objective questions. The same type of achievement test questions were modeled for students and the process for choosing a correct answer was discussed.

Seventh Session: Students were guided through authentic practice in a timed testing environment using the entire test-taking strategies which included: Time using strategies, error avoidance, guessing strategies, deductive reasoning and cue using strategies.

Session Eight: Summary of the training, feedback from the students and administration of post-test MAT and MARS-R.

The participants in the control group did not receive any treatment; rather, they were taught the same Mathematics topics for the same duration as the treatment groups by the researchers using the same lesson notes and scheme of work. In the eighth week, the instrument was administered again to the treatment and control groups. This was done to find out if treatment had any impact on the participants.

Results

The data collected from the research instruments were treated statistically using both descriptive and inferential statistics appropriate for the hypothesis at the 0.05 level of significance. One-way Analysis of Covariance was utilized. Post-test Mathematics achievement scores of the participants were entered as the dependent variable while their pre-test Mathematics achievement scores were entered as the covariate. Experimental condition served as the independent factor. The result are presented in Table 2

Table 2: Descriptive Data of Pre and Post test Scores of the Participants across the Experimental Conditions.

Group	N	Pretest Scores		Post test Scores		Mean Difference
		Mean	S.d	Mean	S.d	
Testwise Training	233	46.38	14.21	68.28	12.80	21.90
Control Group	192	46.97	12.31	49.14	15.02	2.17
Total	425	46.64	13.37	59.63	16.80	12.99

The results in Table 2 show that before the training intervention, the Mathematics performance of the students, irrespective of the experimental condition to which they were assigned, was generally below average as indicated in their respective mean scores of 46.97 (Sd

= 12.31) for the control group and 46.38 (Sd = 14.21) for the treatment group. The grand mean score of the two groups was 46.64 (Sd = 13.37).

At post-test, the average performance of students in the control group slightly improved from 46.97 recorded at pre-test to 49.14 (Sd = 15.02) thus yielding a gain score of 2.17. For those students who received training in test-taking skills, their Mathematics performance greatly improved from a below average performance of 46.38 obtained before the training intervention to an outstanding performance as evidenced from a mean score of 68.28 (Sd = 12.80) recorded after the treatment intervention. The pre and post test mean difference was therefore 21.90.

To determine if the differences in post-test Mathematics performance between the treatment and control groups were statistically significant, ANCOVA was performed and results are presented in Table 3.

Table 3: ANCOVA Test of Difference in Post-test Mathematics Performance between Treatment and Control Groups.

Source	Sum of Squares		Mean Squares	F	Partial Eta Squared
Model	1596745.29	3	532248.43	6557.40*	.98
Covariate(Pretest Maths Achievement)	46853.36	1	46853.36	577.24*	.58
Experimental Conditions	58517.88	2	29258.94	360.48*	.63
Error	34252.71	422	81.17		
Total	1630998.00	425			

(a) R Squared = .98 (Adjusted R Squared = .98).

*Significant, $p < 0.05$, $F_{critical}$ (1/422) = 3.85. $p < 0.05$, $F_{critical}$ (2/422) = 3.00

$p < 0.05$, $F_{critical}$ (3/422) = 2.61

Evidence from the ANCOVA result presented in Table 3 shows that for the Experimental condition, the F–value obtained was 360.48 as against a theoretical F–value of 3.00 given 2 and 422 degrees of freedom at the .05 level of significance. This therefore suggests that training was effective in improving the Mathematics performance of the students. A closer look at the mean scores of the treatment and control groups shows that although the two groups were generally poor in Mathematics before the training intervention, at post test, the students who received training in testwiseness improved their performance significantly better than their control group counterparts. The independent contribution of experimental condition to the explained variance in post-test Mathematics Achievement was generally high and about 63% as indicated by the partial Eta squared coefficient of 0.63

The analyses therefore led to the rejection of the null hypothesis which states that there is no significant difference in post-test Mathematics Achievement between the treatment and control groups. On the contrary, the findings showed that students who received training in testwiseness significantly improved in their Mathematics performance more than their control group counterparts.

Discussion of Findings

The hypothesis stated that there will be no significant difference in post test Mathematics achievement between students exposed to testwiseness training and those in the control group. The findings showed that there was a significant difference in post test Mathematics achievement between participants exposed to testwiseness training and their control group counterparts. Testwiseness training enhanced greater academic achievement in students. This finding supports the research literature on the relationship between training in testwiseness and test performance. Rowley (1974), Sapp (1999) and Yien (2001) had shown that students who received training in testwiseness significantly improved in their performance than those not trained in testwiseness. One issue raised by this finding is whether knowledge in test-taking strategies plays a mediating role between test takers' characteristics and test performance.

The results of this study have therefore shown that testwiseness can be effectively taught within the classroom setting in secondary schools and a number of methods may be successfully used. The methods include embedded instruction, terminal instruction and self-instruction. Many schools and private organizations organize "extra or coaching lessons" for students when major examinations such as Senior Secondary Certificate Examination (SSCE) and Unified Tertiary Matriculation Examination (UTME) are approaching. Even when schools do not make such arrangements, parents tend to believe in the efficacy of the "coaching lesson" in assisting their wards pass major examinations. The fundamental issue about this "extra or coaching lessons" is the extent to which testwiseness principles are taught and the duration of teaching. The lapses in the way testwiseness is taught leaves room for extraneous influences.

The study result confirmed that if students, through embedded instruction were appropriately exposed to the five test-taking strategies which are: time using strategies, error avoidance, guessing strategies, deductive reasoning and cue-using strategies, then their test scores in multiple choice questions have a high probability of improving significantly than those of students not exposed to training in testwiseness.

Recommendations

Based on the findings of this study, the following specific recommendations were made:

1. Teachers should lead students to solve Mathematical problems using different strategies and ensure that the topics are well comprehended by the students.

2. Training in testwiseness is a practicable means to positively improve students' test scores. This therefore implies that testwiseness training may serve as a viable means of improving students' poor performance in Mathematics. Based on this, frantic effort should be made to formally teach students different strategies needed for test-taking.

3. Teachers should use embedded instructional methods in the training of students on testwiseness in order to enhance students' mastery and retention of knowledge and skills gained during the lessons.

4. It is recommended that teachers in training and practicing teachers should be taught the principles of test construction in general and testwiseness in particular. It may be necessary to organize orientation programmes, seminars and workshops on principles of test construction in general and testwiseness in particular at local, state and national levels.

Conclusion

Testwiseness training has been found to improve the problem solving skills of students. To improve students' performance in Mathematics, testwiseness principles should be taught at the secondary school level. The training is likely to reduce the test-taking impediment of test-naïve students especially those low in testwiseness and place students at relatively equal levels of testwiseness knowledge.

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Suitability of Groundwater for Multipurpose Use: A Case Study of Sabon Gari Area, Kaduna State, Northcentral Nigeria

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Abstract

The physical and chemical properties of groundwater from parts of Kaduna State, north central Nigeria, have been investigated. The area is underlain by rocks of the Basement Complex comprising granites, migmatites, gneisses and basalts. 20 water samples, comprising five from dug-wells and 15 from boreholes were analysed for physical parameters and dissolved chemical constituents. The cations were analysed using AAS while the anions were analysed using titrimetry methods. Results show that pH varies from 5.14 – 6.66; temperature, 27 ^{o}C – 33 ^{o}C; and TDS, 30 – 280. The concentration of the ions are: Na^{+}, 0.63 –14.40; K^{+}, 0.32 – 4.5; Ca^{2+} , 0.24 –21.00; Mg^{2+}, 0.27 – 5.52; Cl^{-}, 2.49- 13.49; HCO_3^{-}, 50.50 – 373.70; CO_3^{2-}, 16.20 – 105.20; and SO_4^{2-}, 0 –20.00. Analysis of the results reveals that sodium adsorption ration ranges from 0.18 – 5.5; residual sodium carbonate, 1.11 – 6.22; percentage sodium, 2 – 37%, permeability index, 1.53 – 7.32%; and total hardness varies from 0.11 – 2.83. The water species are Ca-Mg-HCO3 and Na-K-CO3. The groundwater is potable, and generally suitable for irrigation and industrial uses.

*Keywords***:** Basement Complex; Total Dissolved Solids; Groundwater Quality; Nigeria.

Introduction

Groundwater is usually clear, colourless and has less chances of pollution than surface water. However, groundwater has a higher salt content than surface water as the slow moving water remains in contact with the aquifer materials. The quantity and composition of the dissolved minerals in natural water depends on the rock type or aquifer with which it has been in contact or through which it has percolated, and the duration it has been in contact with these rocks. Water quality data can also provide information about the geologic history of rocks, groundwater recharge and discharge as well as movement and storage.

The quality requirements of groundwater for various uses, for example, for drinking, industry and for agriculture vary widely. In order to determine the suitability of the groundwater for such uses especially for a fast developing/expanding town like Sabon Gari, there is the need to identify the various chemical constituents and their relation to the use to which the water would be put.

Physical Characteristics of the Study Area

The area under investigation is located at the southern part of Kaduna State, Nigeria and lies between latitude $9^.15 - 9^.30$ N and between longitude 8. 00 - 8 .30 E, Fig. 1. It falls within the Guinea Savannah climatic belt of West Africa with two distinct seasons, namely the wet season and the dry. The wet season lasts for 7 months starting from March/April. The rainfall is greater in the eastern part of the area than in the other parts due to its close proximity to the Jos Plateau. The average annual rainfall is about 1575 mm while the average annual temperature is about 27^oC. The dry season is characterised by the north – west trade wind known as the harmattan. This is dusty and dry with low humidity. The area is accessible from the north east direction through the Jos – Nimbia – Gidan waya (Old Jema'a) road from the north west, by the Kafanchan – Fadan Kagoma – Kwoi road, and from the south – west, through the Gitata - Barde road. A railway track also passes through the area, and connects the northern part with the southern part of Nigeria. Easy accessibility is equally provided by a network of footpaths as well as rural feeder roads which are not tarred.

The area is drained by a network of rivers and streams which are mostly perennial. The north eastern part has three major rivers, Assob, Gimi and Sanga. These have their sources from the western escarpment of the Jos Plateau. They join southward to form the River Mada. All these rivers have tributaries, like the Dangwa, Masoyi, Jema'a and river Ojib. The north western part of the area has the Kogum and Kanock Rivers as the major rivers. These have their sources at the Kagoro and Samban hills, respectively and their tributaries include the Garti, Chori, Nok, Pyneba, Pynecho rivers. All the rivers in the area flow southward and drain into the Mada River which belongs to the Benue system. The tributaries are controlled either by master-joint pattern or the schistosity of the basement rock. The resulting drainage pattern is largely trellised and less dendritic. Kaduna State Water Board (1989) has subdivided the drainage system into seven sub catchments/river basins and the area under investigation falls into two of the catchments namely the Mada and Gurara.

Geology and Hydrogeology

The geology of the area is made up of four distinct rock units namely, porphyritic granites, migmatites, gneisses, and volcanic/basaltic units (McCurry, 1976; Okezie, 1970; Jacobson and Webb, 1946; and Nahikhare, 1971), Fig. 2.
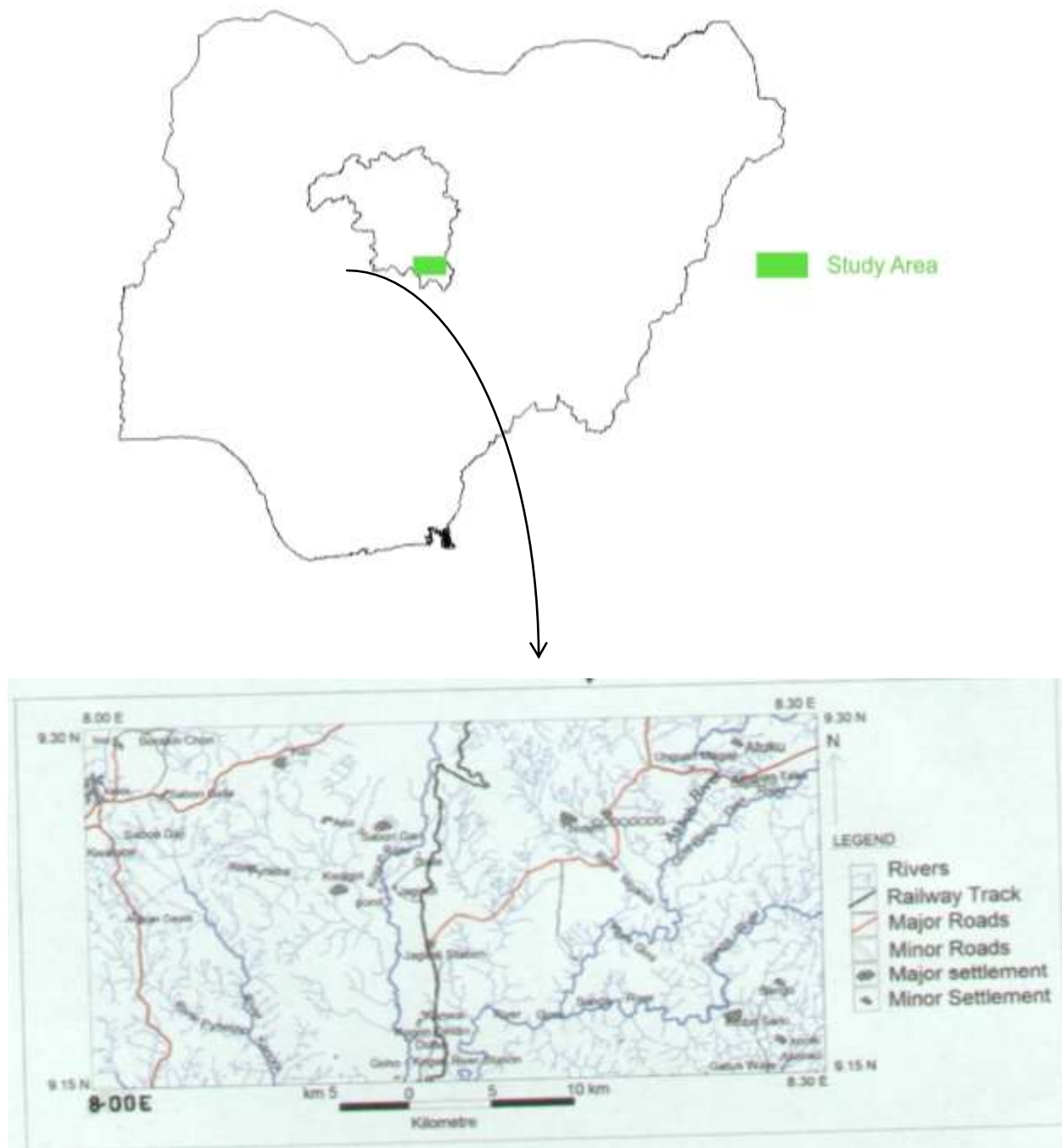
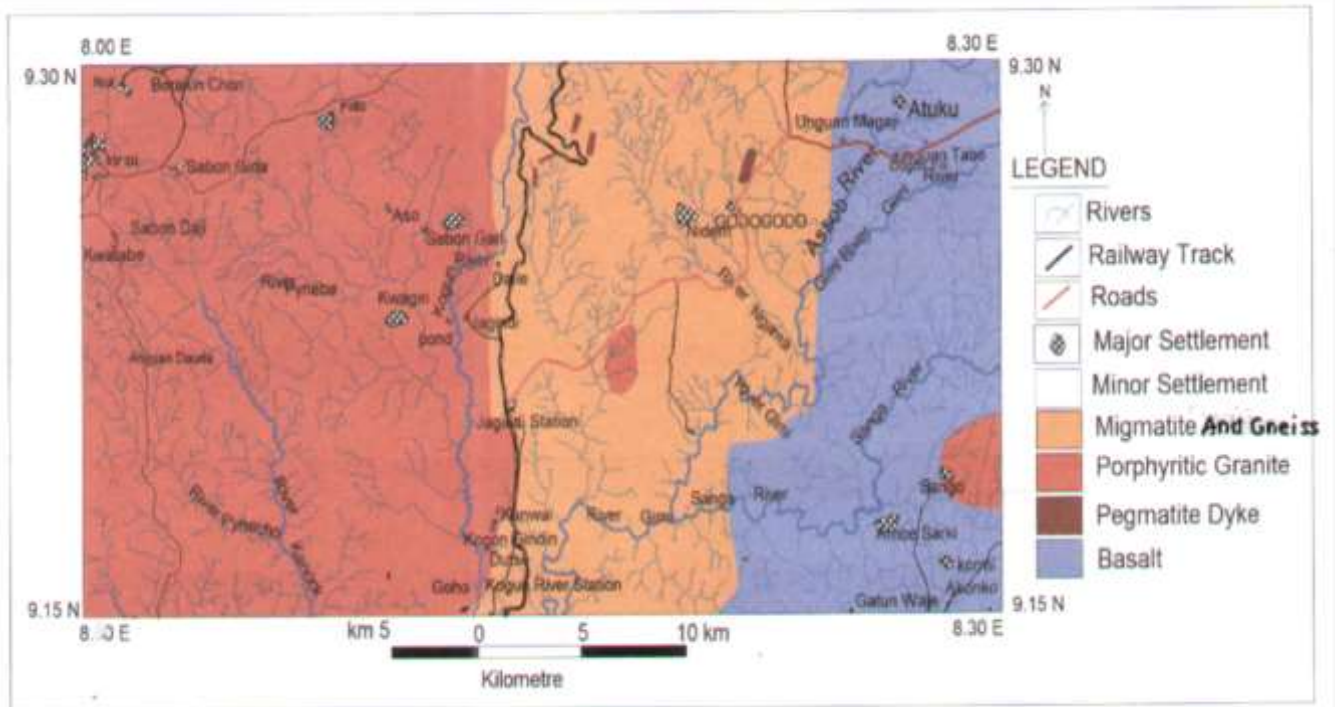Fig. 1. Location map of the study area.

Fig. 2. The geological map of the study area.

Varieties of granites include biotite granite and porphyritic granite. Their textures vary from coarse–, medium–, to fine-grained; the migmatite shows alternating and discontinuous dark and light coloured bandings and, the gneisses occur as ortho- and paragneisses, with former type characterized by layered structures while the latter has bands of light and dark alignment of minerals mostly of biotite and quartz. The basaltic rock occurs as boulders which are either vesicular or amygdaloidal. The boulders occur at the subsurface within the regolith at depths between 5–10 metres and sometimes as flow at the surface. Joints, pegmatite and aplite dykes, quartz veins and minor folds constitute some of the structural elements in the area.

Groundwater is contained in the porous and permeable weathered basement rock, fractured and/or jointed basement columns. Alluvium which is deposited mostly along the river/stream channels contains large quantities of groundwater depending on its thickness. The alluvium, been derived from the granitic rocks possesses high porosity and permeability. During the dry season and drought periods, the sands in the river valley are dug to create water pits from which water is obtained by the villagers for irrigation farming, for domestic uses and to water the animals.

Materials and Methods

Twenty water samples from both boreholes and dug wells were collected from the area for physicochemical analysis. Four samples were obtained from dug wells and sixteen samples were from boreholes. From each well, two samples were collected in plastic containers with cover. One sample was preserved for analysis of cations while the other, for the anions. Few drops of concentrated solution of nitric acid were added to the samples from which the cations were to be analysed. This was done to digest the sample and also to lower the pH in other to minimize precipitation and absorption on the container walls. Fig. 3 shows the locations of the samples.
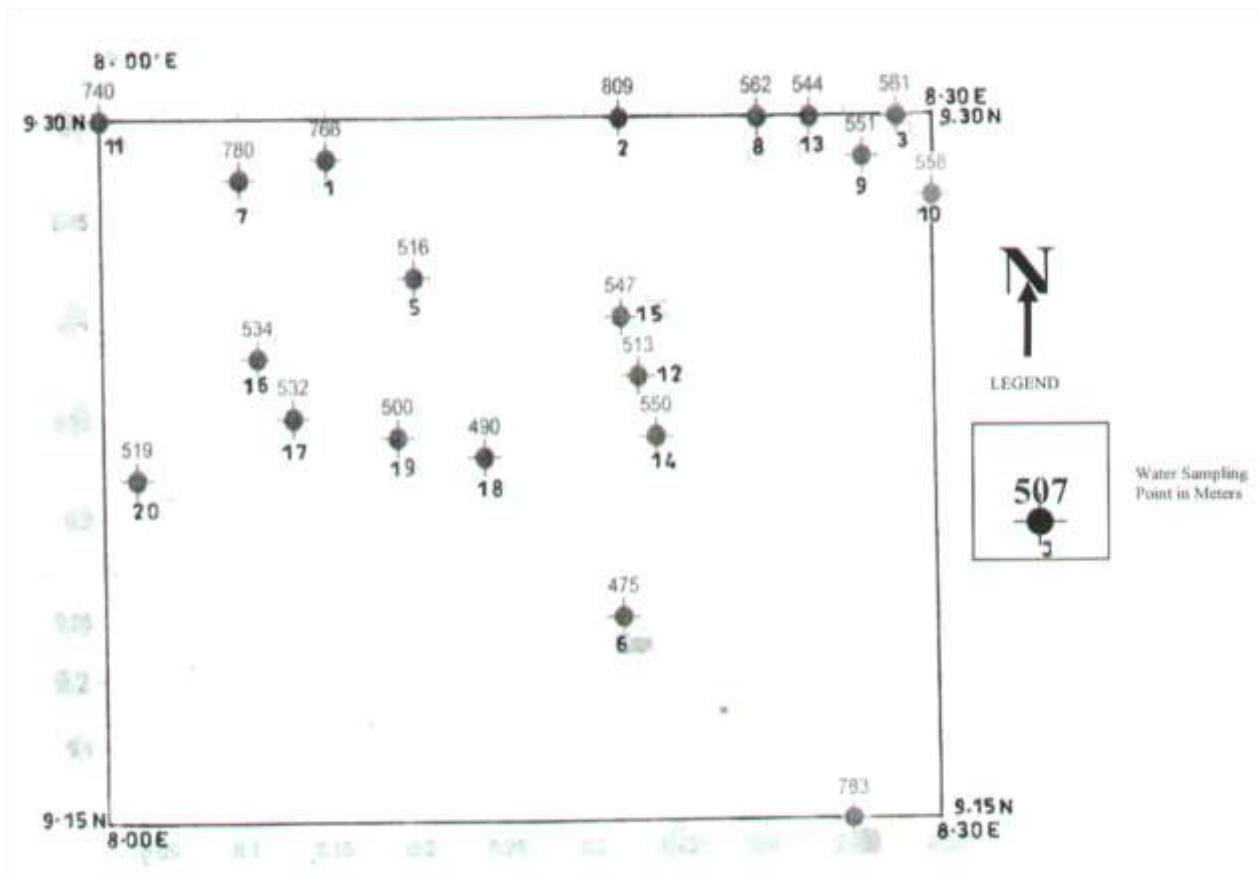
Fig. 3. Location map of water samples

The physical parameters of the untreated water samples namely, pH, total dissolved solids

(TDS), and temperature were measured insitu using a pH meter Exstik model (pH100 and RE300) Version 2.2 and the conductivity meter model TDS Elodo 5031 respectively. Then the two sets of samples were ice packed in a container and taken to the laboratories for analysis.

The cations (K^+, Ca^{2+}, Na^+ and Mg^{2+}) were analysed at the laboratory of the National Research Institute for Chemical Technology Zaria using the Atomic Absorption Spectrometer (AAS) while the anions (HCO_3^-, Cl^-, CO_3^{2-}, NO_3^-, SO_4^{2-} and Fe^{2+}) were analysed at the Department of Water Resources Ahmadu Bello University Zaria Public Health Laboratory. The laboratory results were presented in grams per litre and these were subsequently converted to milli-equivalent per liter. After that, the ionic balance was computed to verify the accuracy of the laboratory results. This was found to be generally satisfactory. Using the results, the groundwater species were determined using the Piper (1944) classification scheme. Then an attempt was made to determine the suitability of the water for various uses notably irrigation and other uses, through the determination of some parameters like Sodium Absorption Ratio (SAR), Residual Sodium Carbonate (RSC), Percentage Sodium (Na%), Permeability Index (PI%) and, Total Hardness (TH). The parameters used to determine suitability of groundwater for the various uses were determined as follows:

$$\text{Sodium Adsorption Ratio (SAR)} = \frac{Na}{\frac{\sqrt{Ca + Mg}}{2}};$$

Residual Calcium Carbonate (RSC) = $(HCO_3^- + CO_3^{2-}) - (Ca^{2+} + Mg^{2+})$;

Percentage Sodium (Na %) = $\dfrac{Na^+ + K^+}{(Ca^{2+} + Mg^{2+} + Na^+ + K^+)} \, x100$;

Permeability Index (PI %) = $\dfrac{(Na^+ + \sqrt{HCO_3})}{\left(Ca^{2+} + Mg^{2+} + Na^+\right)} \, x100$; and

Total Hardness (TH) = 2.5 Ca + 4.1 Mg.

Results

The results of the field tests are presented in Table 1. Table 2 shows the results from the laboratories in g/l which were converted to meq/l and presented in Table 3.

Table 1: Physical properties of the groundwater.

S/N	LOCATION	COORDINATES		pH	TEMP	TDS
		LATTITUDE N	**LONGITUDE E**	**pH**	**TEMP**	**TDS**
1	**BARA**	09.29' 15.6"	08.09' 02.9"	6.66	28	240
2	**DANGOMA**	09.29' 22.5"	08.19' 09.5"	5.30	28	80
3	**CLINIC ATUKU**	09.28' 54.9"	08.27' 49.9"	5.48	29	80
4	**KOGOM RIVER**	09.15' 04.7"	08.13' 30.7"	5.14	30	30
5	**KARIYO**	09.25' 08.7"	08.11' 57.1"	5.75	29	80
6	**J/TASHA**	09.20' 04.1"	08.14' 09.8"	5.86	28	170
7	**SAMBAN GIDA**	09.27' 57 .1"	08.03' 25.9"	5.58	30	110
8	**TAFAN**	09.29' 40.7"	08.25' 30.9"	5.94	29	140
9	**DENJ II**	09.27' 39.0"	08.27' 29.2"	6.25	29	200
10	**LGEA ATUKU**	09.29' 07.6"	08.28' 53.5"	5.52	20	40
11	**NOK**	09.30' 01.0"	08.01' 21.2"	5.69	33	120
12	**BAYYA**	09.27' 30.2"	08.23' 31.9"	5.74	31	60
13	**NINDEM**	09.25' 45.5"	08.20' 09.9"	5.38	29	70
14	**NINTE CLINIC**	09.22' 29.1"	08.19' 47.8"	5.59	30	50
15	**FARIN HAWA**	09.24' 01.3"	08.19' 34.3"	5.96	32	180
16	**FORIBY CHURCH**	09.28' 12.5"	08.06' 01.5"	5.38	27	50
17	**GHAUTA**	09.22' 43.8"	08.06' 36.5"	5.38	29	170
18	**GDSS KWAGIRI**	09.20' 16.5"	08.11' 39.5"	5.80	29	230
19	**KYAYYA II**	09.21' 10.7"	08.07' 36.0"	6.16	29	90
20	**BARDE CLINIC**	09.21 12.5"	08.02 12.5"	6.09	29	280

Samples 1- 4 were from dug wells; *Samples* 5-20, from Boreholes

Table 2: **Result of chemical analysis of the groundwater samples.**

S/N	LOCATION	COORDINATES		CONCENTRATION (mg/l)									
		LATTITUDE	**LONGITUDE**	K^+	Na^+	Ca^{2+}	Mg^{2+}	Cl^-	CO_3^-	HCO_3	SO_4^-	Fe^+	NO_3^-
1	**BARA**	09.29' 15.6"	08.09' 02.9"	1.95	3.46	21.00	0.62	5.49	105.20	232.30	5.00	0.002	9.60
2	**DANGOMA**	09.29' 22.5"	08.19' 09.5"	1.70	4.58	2.02	2.30	7.49	48.50	121.00	5.00	0.002	4.00
3	**CLINIC ATUKU**	09.28' 54.9"	08.27' 49.9"	1.95	4.64	0.45	2.11	4.49	48.50	141.40	5.00	0.002	4.30
4	**KOGOM**	09.15' 04.7"	08.13' 30.7"	1.44	1.16	0.39	0.91	3.99	28.30	50.50	10.00	0.006	1.00
5	**KARIYO**	09.25' 08.7"	08.11' 57.1"	2.40	10.99	0.24	0.27	4.99	40.40	80.80	5.00	0.002	1.10
6	**J/TASHA**	09.20' 04.1"	08.14' 09.8"	4.50	14.40	0.85	1.30	6.49	60.70	141.40	0.00	0.002	3.70
7	**SAMBAN GIDA**	09.27' 57 .1"	08.03' 25.9"	1.99	11.75	1.08	0.75	11.99	56.20	101.00	5.00	0.002	3.70
8	**TAFAN**	09.29' 40.7"	08.25' 30.9"	2.14	9.79	0.90	5.52	5.49	56.60	90.90	20.00	0.002	1.40
9	**DENJ II**	09.27' 39.0"	08.27' 29.2"	0.32	0.63	0.92	0.69	3.49	20.20	60.60	10.00	0.002	0.30
10	**LGEA ATUKU**	09.29' 07.6"	08.28' 53.5"	1.12	2.73	0.63	0.73	2.49	16.20	101.00	0.00	0.002	3.40
11	**NOK**	09.30' 01.0"	08.01' 21.2"	3.09	8.72	0.85	1.71	4.99	28.30	101.00	0.00	0.002	1.50
12	**BAYYA**	09.27' 30.2"	08.23' 31.9"	0.49	1.78	1.11	2.05	2.49	40.40	101.00	5.00	0.002	10.30
13	**NINDEM**	09.25' 45.5"	08.20' 09.9"	2.87	5.36	0.54	1.33	4.49	36.40	101.00	5.00	0.002	3.70
14	**NINTE CLINIC**	09.22' 29.1"	08.19' 47.8"	1.22	5.04	0.28	0.73	4.49	40.40	111.00	0.00	0.002	3.20
15	**FARIN HAWA**	09.24' 01.3"	08.19' 34.3"	3.35	12.8	1.18	2.44	4.49	52.60	90.90	0.00	0.002	2.10
16	**FORIBY CHURCH**	09.28' 12.5"	08.06' 01.5"	1.56	4.70	0.68	0.49	6.99	36.40	70.70	5.00	0.002	4.30
17	**GHAUTA**	09.22' 43.8"	08.06' 36.5"	3.98	13.21	1.13	2.14	10.49	52.60	101.00	0.00	0.002	2.00
18	**GDSS KWAGIRI**	09.20' 16.5"	08.11' 39.5"	1.61	4.43	0.24	0.50	13.49	105.20	373.70	0.00	0.002	4.50
19	**KYAYYA II**	09.21' 10.7"	08.07' 36.0"	2.16	12.36	0.79	0.49	4.49	36.40	80.80	0.00	0.002	5.20
20	**BARDE CLINIC**	09.21 12.5	08.02 12.5"	4.33	13.20	2.05	3.15	9.49	80.90	191.90	0.00	O.006	4.40

Table 3: Results of chemical analysis of groundwater expressed in meq/l

S/N	COORDINATES		CONCENTRATION IN meq/l									
	LOCATION	LATITUDE	LONGITUDE	K^+	Na^+	Ca^{2+}	Mg^{2+}	Cl^-	CO_3^-	HCO_3^-	$SO4^{2-}$	Fe^{2+}	NO_3^{2-}
1	BARA	09.29' 15.6"	08.09' 02.9"	0.05	0.15	1.05	0.05	0.15	3.51	3.81	0.10	0.001	0.15
2	DANGOMA	09.29' 22.5"	08.19' 09.5"	0.04	0.20	0.10	0.19	0.21	1.62	1.98	0.10	0.002	0.06
3	CLINIC ATUKU	09.28' 54.9"	08.27' 49.9"	0.05	0.20	0.02	0.17	0.14	1.62	2.31	0.10	0.001	0.07
4	KOGOM RIVER	09.15' 04.7"	08.13' 30.7"	0.04	0.05	0.02	0.07	0.11	0.94	0.83	0.21	0.001	0.02
5	KARIYO	09.25' 08.7"	08.09' 02.1"	0.06	0.48	0.01	0.02	0.14	1.34	1.32	0.10	0.001	0.02
6	J/TASHA	09.20' 04.1"	08.14' 09.8"	0.12	0.63	0.04	0.11	0.18	2.02	2.32	0.00	0.001	0.06

7	SAMBAN GIDA	09.27' 57.1"	08.03' 25.9"	0.05	0.51	0.05	0.06	0.34	1.87	1.65	0.10	0.001	0.06
8	TAFAN	09.29' 40.7"	08.25' 30.9"	0.05	0.43	0.04	0.45	0.15	1.89	1.49	0.42	0.001	0.02
9	DENJ II	09.27' 39.0"	08.27' 29.2"	0.01	0.03	0.05	0.06	0.09	0.67	0.99	0.21	0.001	0.01
10	LGEA ATUKU	09.29' 07.6"	08.28' 53.5"	0.03	0.12	0.03	0.06	0.07	0.54	0.66	0.10	0.001	0.07
11	NOK	09.30' 01.0"	08.01' 21.2"	0.08	0.37	0.04	0.14	0.14	0.94	1.65	0.00	0.001	0.02
12	BAYYA	09.29' 15.2"	08.09' 02.1"	0.01	0.08	0.06	0.17	0.07	1.34	1.66	0.10	0.001	1.17
13	NINDEN	09.25' 45.5"	08.20' 09.9"	0.03	0.23	0.03	0.11	0.7	1.21	1.66	1.10	0.001	0.06
14	NINTE CLINIC	09.22' 29.1"	08.19' 47.8"	0.03	0.22	0.01	0.06	0.13	1.35	1.82	0.00	0.001	0.05
15	FARIN HAWA	09.24' 01.3"	08.19' 34.3"	0.09	0.56	0.06	0.20	0.13	1.75	1.49	0.00	0.001	0.34
16	FORI BY CHURCH	09.28' 12.5"	08.06' 01.5"	0.07	0.20	0.03	0.04	0.20	1.21	1.16	0.10	0.001	0.07
17	GHAUTA	09.22' 43.8"	08.06' 36.5"	0.10	0.57	0.06	0.18	0.30	1.75	1.66	0.00	0.001	0.03
18	GDSS KWAGIRI	09.20' 16.5"	08.11' 39.5"	0.04	0.19	0.12	0.04	0.38	3.51	0.12	0.00	0.001	0.07
19	KYAYYA II	09.21' 10.7"	08.07' 36.0"	0.06	0.54	0.04	0.04	0.13	1.21	1.32	0.00	0.001	0.08
20	BARDE CLINIC	09.21' 12.5"	08.02' 12.5"	0.11	0.57	0.10	0.27	0.25	3.26	2.70	0,00	0.002	0.07

DISCUSSION

Table 1 shows the physical properties of the groundwater of the area. The temperature varies from about 27 $^{\circ}$C to 33 $^{\circ}$C; the pH, varies from 5.14 to 6.66, indicating that the groundwater is slightly acidic; and the total dissolved solids, a measure of all solid materials present in water whether ionized or not, and which will determine the suitability of the water for various uses ranges between 30 and 280. Groundwater having a concentration such as this can be regarded as fresh, Carroll (1962), Table 4

Table 4: Nature of groundwater based on TDS values after (Carroll 1962)

TDS(mg/l)	NATURE OF WATER
<1000	Fresh
1000-10000	Brackish water
10000-100000	Saline
100000	Brine water

(Ragunath 1987) excess salinity in the soil TDS can lead to the reduction of the osmotic activity of plants which will interferes with the absorption of water and nutrients from such soil Salleh et al., (1999). The values obtained for the area shows the groundwater to be of low salinity which is good for irrigation and domestic uses. Such values of TDS are said to be due to high leaching of soluble minerals from the weathered zone or that such groundwater was likely to have been derived from recent recharge, Chilton and Smith-Caringhton (1984). For the study area both assertions are true.

Results obtained using the various indices for evaluating the suitability of the groundwater for various uses were compared with set standards and the suitability of water was determined accordingly. The different results are presented in Table 4.

Table 5: Results for Indices used to evaluate groundwater for various

Water uses in the area

Sample No.	Sodium Absorption (SAR)	Residual Sodium Carbonate(RSC)	Percentage Sodium (Na %)	Permeability Index (PI %)	Total Hardness (TH)
1	0.29	6.22	10.0	1.68	2.83
2	0.74	3.31	12.0	3.27	1.03
3	0.92	3.74	12.5	4.41	0.75
4	0.33	1.68	4.5	6.86	0.34
5	5.54	2.63	27.0	3.19	0.11
6	3.25	4.19	37.0	2.76	0.55
7	3.08	3.41	28.0	2.89	0.37
8	1.23	2.89	24.0	1.79	1.95
9	0.18	1.55	2.0	7.32	0.37
10	0.80	1.11	7.5	4.44	0.32
11	1.74	2.41	22.5	3.00	0.67
12	0.33	2.77	4.5	4.41	0.85
13	1.23	2.73	13.0	4.10	0.53
14	1.66	3.10	12.5	5.41	0.27
15	2.20	2.98	32.5	2.17	0.97
16	1.51	2.30	13.5	4.73	0.24
17	2.53	3.17	33.5	2.29	0.89
18	0.95	3.47	11.5	1.53	0.46
19	3.82	2.45	30.0	2.72	0.26
20	1.87	5.59	34.0	2.35	1.36

Sodium Adsorption Ratio (SAR), which is the rate at which sodium is being adsorbed from water by the soil, depends on the concentration as well as the composition of soluble salts in water. This could have a negative effect on some physical characteristics or properties of the soil such as infiltration rate and permeability. Its value for the area ranges between 0.18 and 5.5, Table 5. According to Mandel and Shiftan (1981) groundwater with such values are suitable for irrigation.

Residual sodium carbonate (RSC) is the difference between the sum of carbonate and bicarbonate in the groundwater and that of the calcium and magnesium ions. The RSC ranges between 1.11 and 6.22., Table 5. Water with high RSC value gives rise to soil that is infertile which will contain high carbonate and bicarbonate deposit (Dhirendra et al., 2009). However water with RSC value of less than 2.5 meq is safe for irrigation. In the area of study seven samples are suitable, Table 6. This number constitutes only 30% of the total water samples.

Table 6: groundwater quality classification based on RSC (Ragunath 1987)

RSC	Remark
<1.25	Good

1.25-2.5   Doubtful

>2.5   Unsuitable

Percentage Sodium (Na %) is the ratio of all the alkali to alkali and alkali earth metals present in the sample expressed as a per cent. This index reveals the extent to which sodium hazard may affect the quality of water for irrigation. Higher percentage of Na^+ in groundwater can lead to stunted growth in plants and at the same time reduce soil permeability.

The percentage sodium in the water from the study area ranges between 2.0% and 37.0%,

Table 7. The high values may be due to the process of ion exchange taking place between the alkali metal ion (Na^+) and the alkali earth metals ions (Ca^{2+} and Mg^{2+}) present in the water samples and clay (finer grains) in the soil respectively. Todd (1980) shows that ion exchange process leads to changes in the physical properties of the soil leading to deflocculation, which causes reduction in the soil permeability and drainability. For the study area one sample falls within in the excellent class, two are within the good class range, five fall into the permissible class, eight are in the doubtful class and four fall within the unsuitable class, Table 6.

Table 7: Suitability of groundwater for Irrigation based on percentage sodium after Wilcox (1955)

%Na water clear

< 20   Excellent

20 – 40   Good

40 – 60   Permissible

60 – 80   Doubtful

> 80   Unsuitable

Permeability index indicates the suitability of the groundwater for irrigation purpose. It is influenced by such factors like the TDS, concentration of $NaHCO_3$ and CO_3 in groundwater to be use for irrigation and the initial soil properties of the soil. Doneen (1966) proposed a concept called "permeability index" **(PI)** to assess probable influence of water quality on physical properties of soils. Based on Doneen permeability index classification of irrigation water are grouped as Class I, Class II and Class III. The Class I and Class II has maximum permeability of 75% or more and are termed as good waters for irrigation while the Class III water is unsuitable for irrigation with 25% maximum permeability. For the area of study the **PI** values ranges between 2 and 8, these fall in the Class II Category of 65% maximum **PI** of the good water.

Total Hardness, the sum total of the alkali earth metals present in the sample water varies from 0.11 to 2.83. Based on the classification of total hardness by Hem (1970) Table 8, the water in the area is soft.

Table 8: Classification of Hardness after Hem (1970)

Hardness $Ca^{++} + Mg^{++}$ carbonate	Water classification
0-60	Soft water
61-120	Moderately hard
121-180	Hard
> 180	Very hard

By plotting the concentrations of the major cations and anions in the Piper (1944) Trilinear diagram, Fig. 4 the groundwater species were determined. The analysis of the plot shows that two water types are present in the area. These are $Ca-Mg-HCO_3$ and $Na-K-CO_3$. A comparison of the results obtained for the area with the World Health Organization (WHO), WHO (2004) Drinking Water Standards Table 9 reveals that the groundwater is potable.
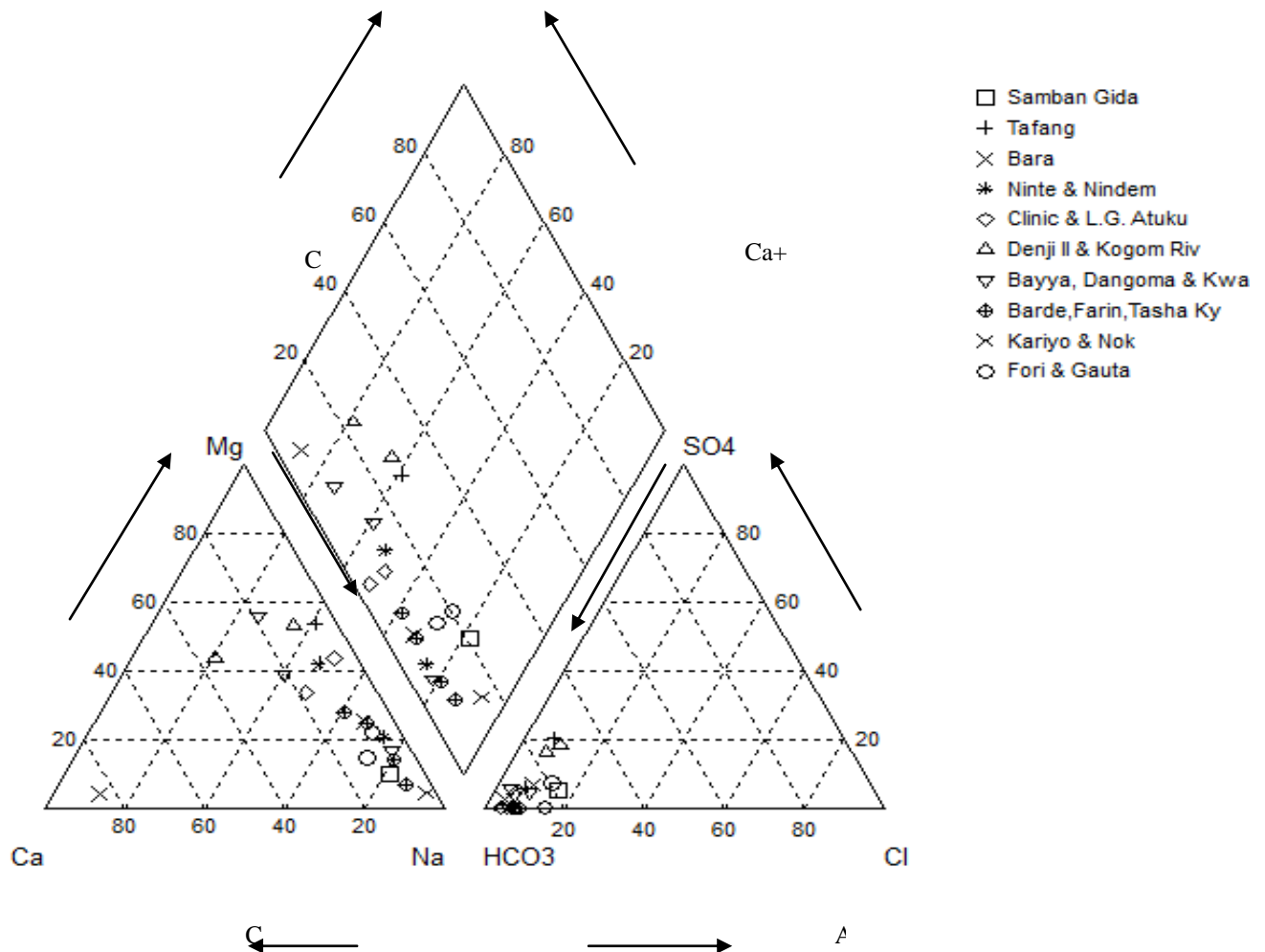
Figure 4: Trilinear Piper Diagram showing the domain of the different water types

The analysis of the plot shows that two water types are present in the area. These are $Ca-Mg-HCO_3$ and $Na-K-CO_3$. A comparison of the results obtained for the area with the World Health Organization (WHO), WHO (2004) Drinking Water Standards Table 9 reveals that the groundwater is potable.

Table 9: WHO (2004) Drinking Water Standards

Parameters	WHO (2004)		Results for the study area	
	Highest Desirable	Minimum Permissible	Range	Mean
pH	7-8.5	Min 6.5 Max 9.2	5.3-6.66	5.48
TDS	1000		30-280	126
K^+	1.0-12	>12	0.32-4.5	2.21
Na^+	200	>200	0.63-14.40	7.29
Mg^{2+}	50	150	0.27-5.52	1.46
Ca^{2+}	75	200	0.24-21	1.87
HCO_3^-	Variable	500	50.5-373.7	122.20
Cl^-	200	600	2.49-13.49	6.17
SO_4^{2-}	20	400	5-20	4.0
NO_3^-	45	50	0.3-10.3	3.69
Fe+	0.1	1	0.002-0.006	0.00024

Pano *et al* in Bala (2001) confirms that the low concentration of Cl^- and SO_4^{2-} indicates rapid recharge from rainfall. The study area is in deed recharged directly by rainfall leading to

Leaching of the minerals during which the Ca^{2+} and Mg^{2+} are displaced by the Na^+ and K^+, Alagbe (2002) by cation exchange process.

Conclusion

Groundwater quality based on its chemical composition has been investigated for Sabon Gari town and environs. By using appropriate indices for evaluation of suitability for different uses, it can be concluded that the groundwater in the area is suitable for domestic, agricultural and industrial uses.

Acknowledgement

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Data Treatment in Urban Studies: The Ignored Value and Implications for Decision-Making

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Abstract

Understanding the dynamics and influencing the growth and development of the built environment, and urban areas in particular, often require empirical studies of relevant phenomena, in which data is always a central issue. However, when such studies are carried out and reported, most aspects of data treatment, including choice and measurement of variables, definition and operationalization of variables, management of missing data, validity and reliability of data, choice and use of analytical techniques, etc, are ignored or assumed to be appropriate when they are not. This has been the reason for spurious results, which though are less noticeable to the users of research products, including policy makers and even the later researchers, leads to ineffective decision making. It is against this background that this paper attempts to unravel the issues surrounding data treatment itemized above. It starts by exploring issues in urban areas and the need for their empirical analyses. The paper proceeds by identifying different types of and/or approaches to urban research/studies, and later places emphasis on quantitative studies. It attempts to theorize 'data' and unveils various issues affecting data treatment in urban studies to make their findings reliable and less misleading in urban-related decision-making process.

Keywords: Quantitative Data Model, Operationalization of Variables, Data Measurement

1.0 Introduction

Data is central to every decision-making process, as the quality of the outcome of a decision-making also depends on the quality of the data inputs and the process of handling the data. Most-decision making process about the management of growth and development of urban areas are, or supposed to be, informed by data-based empirical studies of urban phenomena, including urban land use, traffic management, waste disposal, housing, slums and informality, water and sanitation, crimes, etc. All these are urban issues, which may not be well understood without access to and proper handling of data. It is saddening, however, to observe that reports of most of these studies trivialize the aspect of data treatment, and no one seems to be bothered about the implications that may have on the reliability and reputation of such studies or reports, not until recently. For example, Peng, et al, (2006) and Saunders, et al (2006) observe that in spite of the importance of adequate handling and reporting of missing data, the issue is often omitted from reports of research. The same holds for other aspects of data treatment, including use or rather, misuse of certain techniques. In a similar development, Schlomer, et al, (2010), in his study on 'missing data' observes that out of 37 sampled journal articles only 14 reported the percentage of missing data. It is important to mention that, while the focus of this paper is more than the issue of missing data, it is a pointer to the fact that data treatment is taken with levity, and that the approach to addressing the problem of data treatment by scholars in recent time (Bennett, 2001; Acock, 2005; Allison, 2001; Graham, et al, 2003; and Graham, 2003; Schmitt, 1996; among others) are observed to be less encompassing.

In this paper, an holistic approach is taken to address the issue of data treatment. By data treatment, the paper refers to such issues as: (1) identification and use of, forms and types of data, (2) choice, definition and operationalization of variables: (3) data measurement and or scaling, (4) validity and reliability of data, and (5) missing data handling. The main objective of the paper, therefore, is to unravel all these aspects of data treatment, and the implications of their handling or rather mishandling for decision-making by the end users of research product – policy makers and potential researchers. It shall proceed, however, with the illustration of the centrality and importance of data to urban research or study via a theorizing approach.

2.0 Conceptualizing and Theorizing Data

The word data is a common phenomenon, used not only in research or technical reports, but also in day-to-day activities. It is used both as a singular and plural word. For example, it may be used as a plural noun in: "these data do not support the conclusions", and as a singular word in: "the only aspect for which data is available is..." (Burchfield, 1996). What is important is the fact that data are values of qualitative or quantitative variables; and any measurement or result is a datum or data point (Dye, 2001), or better still, a score or observation. Data refers to numbers, words, images, (maps or pictures), etc, which are in the raw state or semi-processed, and meant for processing (or further processing), analysis and in most cases, drawing of inferences.

Theorizing data may take two approaches or models. These are observed here to include: (1) situating data within the general knowledge system and study cycle, and (2) operationalizing data (data model). The former is a macro analysis of the centrality of data to the knowledge system, while the latter explains in detail the structure of data, which determines its measurement, analysis and explanation.

2.1 Situating Data within the General Knowledge System and Study Cycle

Data is demanded not for its sake, but to learn about the real world. In other words, it has a 'derived demand', in that it is meant to be processed to obtain 'information' about the real

world. This is why Leedy and Ormrod (2011) define data as manifestations of reality. Still from this perspective (of derived demand) and as an abstract concept, data can be viewed as the lowest level of abstraction from which information (the second level), and then knowledge (the third and highest level) are derived (Wikipedia)

For example, if an urban researcher is interested in studying the problem of housing quality in an urban neighbourhood, he might be willing to collect data on 'age of building' and other housing and socio-economic variables of the people of the area. The value obtained from an <u>observation</u> of a particular building or data point is a <u>score</u>, while all the data scores for variable 'age of building' and/or those of other variables are data. If after some processing of the data, he observes that "25% of the housing units or buildings in the area are aged" (based on a given age benchmark), at that point information is supplied. If after further processing, he comes to a conclusion that "housing quality is a function of socio-economic characteristics of the people living there", knowledge is generated (either by confirming or debunking an existing theory or hypothesis, or by generating a new one).

It is important to mention that the concept of data and information are interwoven. For example, while the values, observations or scores obtained for different data points, in a way, provide some sort of information at that level, the pieces of information obtained about the percentage of the housing units or buildings that are aged (illustrated above), and similar ones, could also constitute data when they are to be subjected to further analyses. Therefore, data refers to those pieces or observations, which contain some 'substance' or meaning understood by the user or potential user of such 'substance'.

Knowledge on the other hand, is the understanding had of a well-articulated and coherently arranged set or pieces of information, which in scientific study, may be described as postulates or hypotheses. This is not at variance with the Oxford Dictionary's (2013 online version) definition, which puts it as "theoretical or practical understanding of a subject".

The relationship between data and other elements of the knowledge system and study cycle is illustrated below:
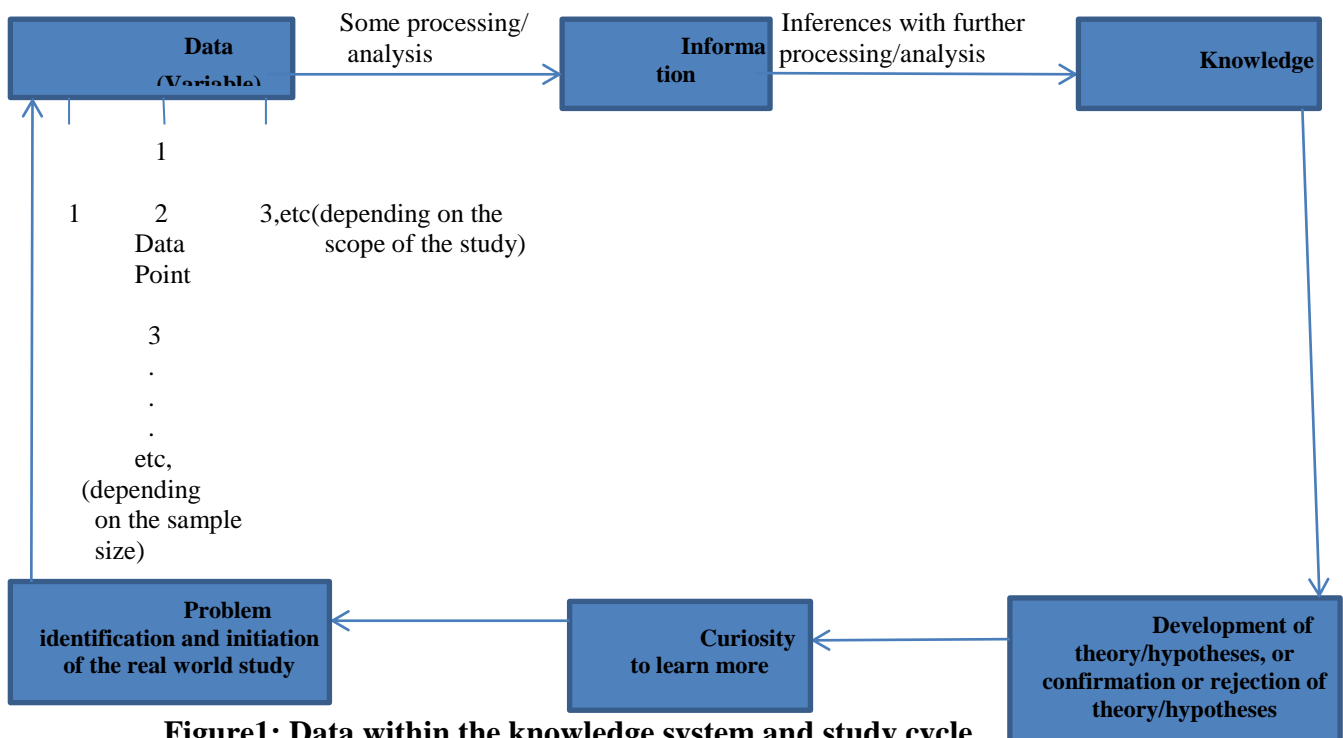

Figure1: Data within the knowledge system and study cycle

Source: Author's Model, 2013.

This is a cyclical model that begins with the problem identification and then study of the real world, on which data is collected (in form of variables) over a number of data points (depending on the sample size) for each variable and over a number of variables, depending on the scope of the study. With some form of processing or analysis information is obtained, and from series of information, with further analysis and inferences or generalizations, knowledge is generated. Such generalizations, when well coherently arranged, and properly articulated, lead to development of theory and/or hypothesis (in the case of <u>inductive research</u>), or confirmation and rejection of existing theory and/or hypothesis (in a <u>deductive research</u>).

2.2   Data Model

The concept of data model is rooted in programming and information science, but could be and of course has been borrowed into all other fields that make use of data to explain the real world, and influence decision-making. A data model is a data structure in any information system. It is used to support the development of information system by providing the definition and format of data (Michael, 1999). As such, data models for different systems are arbitrarily different (West and Fowler, 1999). For example, there are: (1) GIS data model, which is a mathematical construct for representing geographic objects or surfaces as data; (2) semantic data model, which is a technique in software engineering, used to define the meaning of data within the context of its interrelationships with other data (FIPS, 1993); (3) an information model, which is a general representation of concepts, relationships, constraints, rules and operations, aimed at specifying data semantics for a chosen domain of discourse (Lee, 1999), and (4) what is described here as 'quantitative data model' (QDM), which is aimed at operationalizing data and other aspects of data treatment, treated further in different sections of this paper.

The construct of quantitative data model (QDM) should not be confused with statistical models of explaining relationships between variables, making forecasts and projections, etc. It is rather a well-established system of defining, explaining, operationalizing and even measuring data, which are meant for quantitative analysis, explanation of results and drawing of inferences on a phenomenon. It essentially possesses the characteristic of a data model, observed by Michael (1999) in that it "explicitly determines the structure of data" to be subjected to analysis, and facilitates the explanation of results therefrom. A QDM is therefore a prerequisite to an applied statistical operation or model. It includes such issues as data classification, measurement, missing data handling, variable definition and operationalization, among others treated separately below. It is conceptualized here as a system of explaining the processes of data treatment.

3.0   Data Classification

Data may be classified based on: (1) type of or approach to study, and (2) source of data. Other forms of classification could be by scale of measurement treated later in this paper.

By approach to study, data may be classified into qualitative and quantitative data, which are used in qualitative and quantitative research respectively. Qualitative research is defined as "the examination, analysis and interpretation of observation for the purpose of discovering underlying meanings and patterns of relationships, including classification of types of phenomena and entities, in a manner that does not involve mathematical models" (MIT, 2010). As such, qualitative data refers to observations, which are measured or expressed not in numerical values, including texts such as documents, reports, video or audio clips, pictures, as well as observations from oral interview, key informant interview (KII), and focus group

discussion. They are, thus, not amenable to statistical analysis, other than categorization of similar responses or items to give a structure or pattern.

Quantitative research, on the other hand, refers to the systematic empirical investigation of social phenomena via statistical, mathematical or computational techniques (Given, 2008). It involves looking at amounts, or quantities, of one or more variables of interest (Leedy and Ormrod, 2011). Quantitative data, therefore, refers to data, which are obtained or measured numerically in form of figures, which may be subjected to statistical analysis and or models for necessary inferences or generalizations. This data type could also be of two forms including: (1) discrete data existing as integers (whole numbers), and continuous data, which are data that are measured to take decimals, eg, heights and weights of any phenomena.

The main differences between the quantitative and qualitative research are summarized in the table below:

Table 1: Quantitative and Qualitative Research Compared

Quantitative Research	Qualitative Research
Use of Numerical data	Use of textual data
Testing of hypotheses	Exploration of phenomena
Use of questionnaires and other calibrated measuring instruments	Use of in-depth interviews, focus group discussion, and participant observation
Quantification, explanation and prediction of population characteristics and their relationships.	Description and explanation of relationship of individual experiences and group norms
Responses of the sampled respondents do not determine what questions to ask next	Responses of the respondents do
Research design is predetermined and influenced by the envisaged statistical assumptions	Research design is adjusted constantly to accommodate issues as they unfold
The report is technical and scientific	The report is literary and narrative in nature

Source: Author's summary, 2013.

By data source, data can be classified into: (1) primary data, secondary data, and derived data.

Primary data refers to the data, which are first-hand information obtained directly from field work by the researcher. Such data are obtained through the use of research instruments such as:

1   direct observation and recording
2   direct measurement and recording
3   use of questionnaire
4   focus group discussion

Secondary data refers to data that are already in existence. Such data are kept as records on different subjects, by different organizations, government departments, parastatals, public agencies, schools, and other corporate bodies. Examples of secondary data include population figures, enrolments of schools, list of staff and their qualifications, climatic data at meteorological stations, election results, records of applications for development permit and records of approvals for development proposals kept by planning authorities, etc. The list is endless. The important thing is that the study at hand determines what secondary data are

required and where to obtain such. It is equally important to mention, however, that date is very important when making use of secondary data, as they tend to vary over time.

Derived data, on the other hand, is not as popular as the first two. It could be described as pseudo-type of data, as it does not exist in isolation of other data types. It refers to the results from certain statistical operations or manipulations of other data types, which become inputs in another analysis of either the same study or a different one. For example, percentages, standard scores (z-scores) or other descriptive data summaries obtained from a particular statistical operation, may be subjected to another analyses like correlation, ANOVA, etc in that same study or in a different one. More so, when a factor analysis or other types of data reduction technique is used to collapse a large number of variables to fewer ones, the factor scores (part of the results) may be saved as variables, which are data for and amenable to further analysis in the same or other study. This implies that derived data can also be kept as secondary data. This is why it is not so regarded as a category of data in its own in some quarters.

4.0 Choice, Definition and Operationalization of Variables

The choice of data in any study usually begins with the research design, at which stage a decision is taken as to the approach of the study (whether quantitative, qualitative or both; and whether deductive or inductive). In quantitative urban studies, data are chosen by taking cognizance of how it shall be measured. They are chosen as quantifiable concepts or constructs (variables) whose measurements are informed by the operational definitions already advanced for them. The main issue here is to: (1) acknowledge the difference between a literary or conceptual definition and an operational one, and more importantly (2) be able to derive the latter from the former using some quantitative knowledge.

For example, crime may be defined as any action or inaction prohibited by law. This (or a similar one) is just a conceptual definition. An operational definition will put it as: "number of reported cases of crime per day". This is broad and general. It may be necessary to operationalize the variable 'incidence of crime' in an urban neighbourhood, for example, as a composite of incidences of different types of crime. This shall be an aggregate of all incidences of crime types, which may and may not be defined as a direct sum of all incidences of crime types. For example, each crime type may be considered as having a different weight or impact on the society. For example, murder, rape, theft, driving without license, and child abuse may be assigned 5, 4, 3, 2, and 1, and the corresponding value or weight is used to multiply the number of reported cases in each case. In this case, the overall incidence of crime for a particular urban neighbourhood will then be represented by a 'surrogate', which is defined/obtained as shown below:

$ICUN = (5xn_1)(4xn_2)(3xn_3)(2xn_4)(1xn_5)$, where:

$ICUN$ = incidence of crime in the urban neighbourhood (surrogate)

n_1 = number of reported cases of murder

n_2 = number of reported cases of rape

n_3 = number of reported cases of theft

n_4 = number of reported cases of driving without license

n_5 = number of reported cases of child abuse

More so, 'housing affordability' may be defined as "the extent to which the people are able to access decent housing, given their income level". This is also a conceptual definition which does not reflect much about how it shall be measured. For measurement purpose,

therefore, housing affordability may be defined and operationalized as "the percentage of the income of the household head (to be) spent on decent housing" (this will also necessitate a definition of a decent housing), say x – the less the x, the more affordable the housing is to the household. Or more precisely, it may be expressed as the percentage of the income of the household head remaining after paying for a decent housing, say x_1 – the higher the x_1, the more affordable the housing is to the household.

The list of examples could not be exhaustive. It therefore becomes imperative for an urban researcher to know the correct way of operationalizing variables before data collection is done.   This must have been put in place before identifying and designing the research instrument(s) to be used in data collection. In most socio-economic surveys of quantitative studies, however, the use of questionnaire is very popular; urban researcher should therefore learn about how questionnaire is designed to reflect the definition and operationalization of variables. Other instruments include direct measurements and recording, observations and other instruments mentioned for qualitative studies (FGD, KII, etc) which may be used to obtained information necessary to buttressed points or generalizations from quantitative results. In other words, quantitative studies are in most cases, not completely devoid of qualitative discussion.

5.0   Data Measurement or Scaling

In order for data to be amenable to statistical analysis, they must be measured in specific procedural ways (Okoko, 2000). If otherwise, the results will be misleading. There are four basic scales of measurement, including nominal, ordinal, interval and ratio. Other supplementary ones are interval-like ordinal and dummy- variable.

5.1   Nominal or Classificatory Scale

Nominal measurement is logically the lowest form of measurement. It involves categorizing data or objects and numbering them accordingly. For example, individuals could be classified into male and female, and assigned 1 and 2 respectively. We could as well have religion, as a variable, classified into Islam, Christianity, Judaism, Hinduism etc, and given each category 1, 2, or 3 and so on. Since these categories do not give information on the order of magnitude, no serious mathematical or statistical operation could be performed on them. Data collected at this level of measurement could be subjected to frequency count (tabulation), mode (as a measure of central tendency), different forms and types of graphs or charts, as well as such non-parametric tests as chi-square, among others.

5.2   Ordinal or Ranking Scale

This scale of measurement is also a lower scale, but higher than the nominal scale. At this level, the order of magnitude of categories is known. The ranking or ordering of categories is done to reflect the increasing or decreasing levels of categories. For example, the variable 'educational attainment' could take any of the values 1, 2, 3, and 4 for no formal education, primary education, secondary education and tertiary education respectively. One observes, however, that while the question 'which one is higher' is answered, that of 'by how much' is not. In other words, the intervals between the categories are unknown, and so it is not possible to perform standard arithmetic operations on such data. Such analyses as median, mode, percentile, frequency distribution, chi-square and rank-correlation could, however, be performed on the data.

5.3   Interval Scale

The interval scale is higher and superior to nominal and ordinal scales. It measures both the order and interval of the magnitude. That is, one can say that a particular observation is

greater or lower than the other and as well go further to specify 'by how much'. This attribute of the scale allows for standard arithmetic operations and statistical analyses. Data measured at this level usually have specific units of measurement such as naira, centigrade, etc. Such variables as temperature, income, intelligent quotient (IQ), etc are measured at this level and could be made to perform such statistics as mean, standard deviation, product moment correlation, and analysis of variance (ANOVA), among other parametric and non-parametric tests.

5.4   Ratio Scale

The major difference between ratio and interval scales is that, the ratio scale has true zero points as their natural origins. The zero indicates that exactly none of the property is represented by the scale. All the measurements obtained by counting objects are ratio-scale measurements. This is because there is a state of 'no-object' (genuine zero), and some number of objects where they are present. Such variables as weight, length, counts of objects, traffic count, age etc, which have natural zero points are amenable to measurement at the ratio scale level and both non-parametric and parametric tests.

It is important to mention that while the statistics performed with data obtained at the first two lower scales of measurement (nominal, and ordinal) are usually described as descriptive and non-parametric tests, the two higher scales of measurement (interval and ratio) may be subjected to both parametric and non-parametric tests as well as descriptive analysis. A parametric test, apart from having its data obtained at interval or ratio scale, has characteristics of the normal distribution.

5.5   Interval-like Ordinal Scale of Measurement

Recall that ordinal scale is all about ranking following a particular order, while interval scale gives the actual observation as measurement. The interval-like ordinal scale measures observations as ordinal scale, but with quite a number of options, which are values ranging between 1 and at least 7 (Dunteman, 1984). In other words when the ranking is done for seven or more options in a simple arithmetic progression with common difference 1, the data can be likened to interval scale data and used as such.

5.6   Dummy Variables

The concept of dummy variable is all about assignment of numerals to a yes-or-no question, such that each of the possible options of 'yes' and 'no' takes a value not only with regards to order (as in ordinal scale), but also and more importantly to indicate the fact that 'something is existing' or 'something is not'. The options usually take the values of '1' and '0' for existent and non-existent conditions respectively. When this is done for a sample size on a variable, the result would be arithmetically logical to be amenable to statistical processes just like ratio data.

6.0   Validity and Reliability

These are two concepts that are often encountered in research methodology; they are used in connection with measurement. The validity and reliability of a measurement instrument influence the extent to which one can learn about the phenomenon being studied, and the extent to which meaningful conclusions can be drawn from the data (Leedy and Ormrod, 2011).

The validity of a measurement instrument is the extent to which the instrument measures what is intended to measure. In most urban studies, variables that are measured, particularly by surrogates, may not be said to be totally validly measured. For example, while it is not controversial to measure temperature with thermometer, it is not easy to measure such

variables as level of satisfaction (with any phenomenon), incidence of informality, incidence of crime, etc in an urban neighbourhood. For example, if level of satisfaction is measured with a scale using: 'very satisfied', 'satisfied', 'sit on the fence', 'not satisfied', 'not at all satisfied', what does 'very satisfied' mean? Is it 100%? Does it mean that every aspect of that phenomenon is satisfied with, with the option 'very satisfied'? In other words, the scale may be measuring something else, if the respondent only has a strong interest in a particular aspect of the phenomenon, while they are dissatisfied with many others.

Reliability, on the other hand, measures the extent of consistency in measurements. The reliability of a measure concerns the extent to which it yields the same result on repeated trials (Sullivan and Feldman, 1994). It is therefore a necessity to attain 'validity' (but not sufficient for the latter). It is usually measured using Cronbach's alpha (Cronbach, 1951). Although, there are some arguments against using a Cronbach's alpha or a particular benchmark of its value as a measure of 'reliability' (Schmitt, 1996), the available evidence in the existing literature suggests that Cronbach's alpha is still the most popular means of testing the reliability of measurement, particularly, when the condition of unidimensionality exists (i.e. when a scale measures only a single underling phenomenon).

Theoretically, alpha varies between 0 and 1, corresponding to a complete unreliable measure and a perfectly reliable measure respectively (Oduro-Kwarteng, 2011). As a general rule, an alpha value of not less than 0.80 suggests a reliability condition (Carmines and Zeller, 1994).

7.0 Missing Data

This is one of the most serious aspects of data treatment, which unfortunately is being treated with levity. Missing data occur in most social science studies, yet they are less reported (Allison, 2001; and Streiner, 2002). Two things are important in handling missing data. These include: (1) the extent and nature of missing data, and (2) the procedures used to manage the missing data (Schlomer, et al, 2010). While the extent of missing data may be made known in an empirical study in which it is expected to be properly reported, this paper identifies three types of missing data in the existing literature, including:

- Missing completely at random (MCAR), in which there exists no pattern in the missing data (Roth, 1994). In other words, the missing values are randomly distributed in the data sets. Though this is very rare in real life, it calls for little or no worry, as its effect on the performance of the data is negligible, provided that the extent is not much. But this must be ascertained and so reported.

- Missing at random (MAR), in which the probability of having a missing data is related to another variable in the data sets, but not related to the variable of interest (Allison, 2001). In this case, the researcher is advised to include the observed (other) variable in the analysis to avoid bias (Schlomer, 2010).

  At times, it is difficult to distinguish between MCAR and MAR, and this may be problematic for the study. To overcome this, it is possible to compute a dummy variable for the variable of interest ('missingness'); if the dummy variable is not related to other variables in the data set, then the situation is described as MCAR, not MAR and vise-versa.

- Not missing at random (NMAR), which occurs when the pattern of missing data is related to the scores on that same variable. This is a serious one, which has to be properly reported for the users of the information to be properly guided on the reliability and representativeness of the summary emanating from that variable.

Rather than leaving missing data missing, quite a number of techniques may be applied to replace them with values which are statistically considered to best approximate the missing values. Such techniques, whose details are beyond the scope of this paper, include mean substitution, regression substitution, pattern-matching imputation, stochastic imputation methods and full information maximum likelihood methods.

Another way of handling the missing data, particularly, when they are few in a data set, is by deletion methods, including list-wise deletion and pair-wise deletion.

Most of these methods of handling the missing data are available in such soft-wares as SPSS, SAS. Urban researchers in social sciences and the built environment are encouraged to get familiar with the use of at least one of these soft-wares.

8.0   Conclusion and Policy Implications

It should be reaffirmed that most urban problems being addressed in urban planning and management, and other decision making processes are complex issues, which are rarely understood without data-based empirical studies. Regardless of the approach used as urban planners or managers, the fact is that such studies would continue to be relevant to our decision-making process. The argument presented here, however is not only that decision-makers should borrow from the findings of such studies, but also probe into the authenticity of such findings, with particular reference to how data is treated, as data is considered the backbone of any empirical studies. By decision-makers, the paper refers not only to urban administrators (including relevant departments of municipal governments), but also and more importantly the authorities, which certify and approve such studies as meeting the minimum requirements of a standard study (including originality and contribution to knowledge). Such authorities as reputable journals, degree awarding institutions, and research institutes or organizations, are encouraged to base their judgment/assessment of research reports on not only the 'juicy' presentation of data and findings, but also the ability to articulate clearly how data are treated in such studies, particularly, in studies that require quantitative data. This would, to a large extent, guarantee the applicability of such studies to addressing real life urban problems. Otherwise, most studies' reports would remain at best a literature asset to only the academia, while the 'stubbornness' of the urban problems would continue to grow 'wings' and remain insurmountable. It is concluded here that that is not the essence of any study! The essence of any study or academic exercise generally is to benefit humankind!

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Hijacking the Roles of Women in Yorùbá Family Set Up: Olóbìnrin Ilé as a Case Study

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Abstract

In this paper, we examine the roles of women in the Yorùbá family set up in the time past. We realized that in the recent time, women have been pushed to the back stage in things that they were prominent in before. Civilization has taken up the roles of women in the family set up among the Yorùbá; particularly the issue of Olóbìnrin ilé (Wives in the household). In this paper, we found out that in the time past, women played prominent roles during ceremonies like burial, marriage, naming chieftaincy, town festivals among others. But of recent, women, that is house wives, are now replaced with commercial personalities. Those that are in vogue now are Alága Ìdúró / Ìjókòó (Master of ceremony) Alásè (Caterers) undertakers, bridal train etc. This paper points out the detrimental effects which civilization have had on the roles of women and its effects on the family and the society as a whole. The paper concluded by suggesting ways of bringing house wives back to play their normal roles in the family.

Key words: Family, house wives, civilization, roles, commercial personalities

Introduction

Household wives are the women married from one family into another family. The most senior in the household is always the leader; 'Ìyáálé'. (Mother of the House) other wives rally round her to see that there is peace and tranquility in the family. There women are the teachers, the sustainers and maintainers of the family (Adeoye 1979). They are the peace makers and the major molders of the character of their children. These housewives are the main custodian of social, cultural and rudimental values of the family they are married into.

They are the merry makers during ceremonies in the family. It is their daily duty to prepare food, sing the praises and chant the eulogies of their husbands' lineage. Whenever anyone of them has a baby, it is the duty of the other wives to take care of the baby and the mother until the naming day (see Adeoye 1979; Olajubu 1978; Daramola and Jeje1970.

These roles played by these women have become the things of the past. Scarcely can you find such co-operation among women married to the same family. This paper claims that these roles have been swept off by civilization. People prefer to hire commercial personalities to do things for them during ceremonies which will be discussed in the course of this paper.

Statement of The Problem

The roles of women in the society cannot be over emphasized. Everywhere in the world, women work both around the home and outside the home. The woman as a person is an agent of production of life itself. This placed her in the position of life blood of the entire humanity [Jekayinfa 1999]. According to Oyesakin (1982) in Jekayinfa (1999) women perform certain functions that make for development, they bear and take care of the children, they take care of the home and economically, they are helping hands for man. For example in Yorùbá land, women sell what the man produces and provide rescue when he is in financial difficulty. Denise (1971) describes the roles and duties of women in the family as wives, mothers and village politicians. He was of the opinion that women function in various capacities ranging from monarchs and warriors to founders of nation states.

From the submission above, it can be deduced that the roles women play in the family are of great value. Hence a bold step has to be taken to rescue these roles from extinction so as not to be overpowered by civilization, which this paper attempts to look into.

The Roles of House Hold Wives during Ceremonies in Yorùbá Family Set-Up

The women in the household (Olóbìnrin ilé) play prominent roles during ceremonies in the family that they are married to. During the burial of an old member in the family, there are functions that are performed by the household wives. They are the ones that will be frying beans cake. As they are doing this, some of them will be singing praises of the dead person and will be chanting his eulogy. On the day of burial, one of the household wives will dress like the old dead person and will be mimicking him or her. Members of the family will appreciate these women by giving them money. This act normally brings cordiality among the household wives and even their husbands and children.

More so, during marriage ceremony, the roles played by the household wives cannot be over emphasized. The major parts of the ceremony fall on them. They are the ones that will do the cooking; they will see to the cleaning of the compound and as well receive visitors. They will also take care of the bride by attending to her needs. During the engagement ceremony, the housewives in the bride's family are the ones that will lead the bride to the gathering and they will be chanting her eulogy. People in the gathering have to drop money for these wives before the bride's face can be opened.

When it is time for the bride to go to her husband's house, it is the wives that will escort her. They will help her to carry all her luggages and they will be chanting her lineage eulogy. From this eulogy, all the attributes of the bride will be made known as well as the taboos in her lineage. At the entrance of the groom's family house, it is the wives of the groom's household that will come out to receive the bride. As soon as she gets to her husband's house, she will be taken to the bathroom where all the dresses on her will be removed. She will enter the house naked while the household wives (the bride's seniors) will surround her to give her coverage. This will enable the senior wives to know that the bride has nothing to hide. It also encourages full co-operation and trust among the household wives (Ogunsina 1997).Furthermore, it is the youngest wife at the arrival of the bride that will receive the bride by washing the bride's feet. After which she will carry the bride on her shoulder to the most senior wife to pay homage (Adeoye 1979).

The roles of the household wives do not stop at this. As soon as the new wife gets pregnant, it is their duties to take care of the woman and the pregnancy. They will give her all necessary concoction that will make her and the fetus strong. On the day of delivery, it is the most senior that will take the delivery with the support of the other household wives. As soon as the baby is delivered, the care and the training of the baby fall on the mothers in the household. On the naming day, it is the most senior wife that will carry the baby and pray for him while the eldest man in the family will name the baby.There are cases when the mother of the baby will not be around that the senior wife will have to breastfeed the baby.

Household wives also play important roles during chieftaincy coronation ceremony among the Yorùbá. They always serve as the merry makers in such occasion. They will be in uniform and will be singing the praises of the chief. They will plait their hair the same way. They are called "Aya Olóyè" (Chief's Wives) these women are the ones that will be beating the drums by themselves and will be dancing also. People in the gathering will appreciate them by spraying them with money.

These roles played by the household wives in Yorùbá family setup create room for cordiality and intimacy among women that are married into the same family. The roles also encourage co-operation and strengthen the relationship in the family. All these will be transferred to the society and will contribute to the transformational process.

Replacement Of The Roles Of Household Wives In Yorùbá Family Set Up
All the roles earlier mentioned in this paper have been hijacked by civilization. Commercial personalities have replaced the household wives. During burial ceremonies among the Yorùbá what we now see at the lying-in-state is the role played by hired personalities who will do the decorations and the brigade bands will be beating the drums for people to dance. The household wives are no more recognized. It is the undertakers that will carry the coffin of the dead and will be dancing with it. All the parts that are to be played by the household wives have been side tracked.

Also in marriage ceremony household wives are no more in place, what is in vogue now is chairperson for the bride and the groom (Alága Ìdúró and Alága Ìjókòó). Those things that are supposed to be done by the household wives are now being done by the so called chairpersons that are representing the two families. Alága Ìdúró is for the groom's family while Alága Ìjókòó is for the bride's family.

The chairpersons act as the spokesmen for each family, they are the ones that will introduce the members of the two families to each other. In most cases, they always make mistakes because they are not members of the two families, there is no how they will know all

the members of the families to be introduced. Grudges can occur if there is any omission in their introduction.

Even Bridal Train does not allow the household wives to perform anymore. The bridal train consists of the bride's friends and her younger ones. They are the ones that will serve as assistants to the bride. These roles are supposed to be performed by the household wives.

In the case of pregnancy period and naming of the baby, the place of household wives has been overpowered. Starting from the anti-natal to post-natal stages, it gives the senior wives the opportunity to teach the new wife about the history of their husband's lineage, their taboos, and their achievements.What to do during pregnancy and after delivery would be well stated. Civilization has eroded all these, what we have now is anti-natal, delivery and post-natal all in the hospitals. Religion is not helping matters also. All the herbs and family eulogies that the senior wives used to teach the junior wives are now seen as idolatry. Instead of junior wives to take lessons from their senior wives, they prefer to go to their pastors or women leaders in their churches; meanwhile, this people do not knows anything about their lineage or their husbands' lineage. This has contributed to the lack of cordiality and closeness among the extended family members of the Yorùbá.

Furthermore, the emergence of commercial caterers (Alásè) has replaced the roles that household wives play during occasions or ceremonies in the family. Initially, it is the duty of the household wives to cook and serve the food during functions in the family. But nowadays, the commercial caterers have taken over. They are the ones that will do the cooking and at the same time serve the food. This does not encourage co-operation and commitment among the household wives.

Effects of The Replacement Of Household Wives

The replacement that has taken over the roles of the household wives in Yorùbá family set up has a lot of effects on the family and its members.

Firstly, it brings about loss of transfer of knowledge between the new/younger wives and the senior wives. It is the duty of the senior wives to teach the younger ones about the history, the dos and don'ts of the family. They familiarize the new wives with the events in the family. But since they seldom come together, therefore, their level of interaction is limited. The impartation of knowledge by the senior to the junior wives is impossible.

Also, the level of intimacy between the senior and junior wives become very low. For instance, in the time past, it is the senior wives that will receive the new bride into the family and will be handed over to the most senior one but in the recent time, such thing is difficult to come by. Most brides now just move straight into their husbands' houses after marriage ceremony. The care that the younger wives enjoy during pregnancy and after delivery is no more there. Children from the same lineage do not know each other since they don't know their family background.

This replacement has led to the exposure of Yorùbá culture to danger. The cultural heritage that needs to be passed from one generation to another in a family can go to extinction if care is not taken.

Recommendation And Conclusion.

In this paper, we have been able to identify the roles played by household wives in the time past, the changes that had taken place and the effects of the changes on the family. The

paper stated that the hijack of roles of household wives by commercial personalities in Yoruba family set up has brought about lack of cordiality and relegation to the household wives.

One major way out to the relegation of household wives in Yorùbá family set up is to revive the culture of allowing the women to perform their ceremonial roles in the family. Household wives should be given the opportunity to occupy their place in the family. They need to be heard and seen. This has to be done in order to make them have a sense of belonging in the family they are married to and to reinstate intimacy among them. If this is put in place, it will bring about a strong relationship between the family members which include the husbands and the children of these household wives. Since the family is an offshoot of the society, if there is cooperationn in the family, it will surely extend to the society.

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